**Commercial Environmental Cleanup—
The Products and Services
DIRECTORY**

**Treatment, Characterization and
Extraction/Delivery/Materials Handling
Technologies**

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**Prepared by
Rust Geotech
U.S. Department of Energy
Albuquerque Operations Office
Grand Junction Projects Office**

MASTER

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About this

Commercial Environmental Cleanup—The Products and Services Directory

The *Commercial Environmental Cleanup—The Products and Services Directory* (Directory) is patterned after the telephone Yellow Pages and is designed as a reference tool to those who may seek commercial remedies for their environmental cleanup problems. It offers the user the opportunity to survey 325 environmental cleanup businesses that currently market their products and services through 1,134 applications of commercially available technologies. Like the Yellow Pages, the Directory furnishes the user with points-of-contact to investigate the capabilities of the listed companies to perform within acceptable standards, practices, and costs and to meet a user's specific needs.

The Directory is an outgrowth of the U.S. Department of Energy's (DOE's) "Crosswalk" activities of the Office of Program Integration (EM-43) within DOE's Office of Environmental Restoration. It supports the recommendations of the DOE Environmental Management Board to "buy first, then make" (*Weapons Complex Monitor*, September 26, 1995).

Information in the Directory was obtained from three sources¹ and by direct contact with each of the listed companies. The three major sections of the Directory are organized under the broad headings of Treatment, Characterization, and Extraction/Delivery/Materials Handling. Within each section, information is grouped according to the applicable contaminant medium and companies are listed alphabetically under each medium heading.

Not all vendors in the environmental cleanup business are included in this first edition of the Directory. Future editions will more completely reflect the status of the industry.

The database of the commercial cleanup products and services Directory will be offered on the Internet in the future and will be available on the Homepage www.doe.gjpo.com.

¹U.S. Environmental Protection Agency's VISITT (Vendor Information System for Innovative Treatment Technologies) database, DOE's domestic Technology Connection (TechCon) program, and DOE's international TechCon program.

 

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TRANSDUCER RESEARCH, INC. C46, C109, C156, C199, C236, C271, C344

Triton Enviromental Consultants T236, T323, T352, T440

Triumpf C60, C119, C165, C207, C243, C279, C295, C311, C351

Troxler Electronic Laboratories C81, C369, C373, C385

TVIES, Inc. T107, T383, T476

Ultrox (Division of Zimpro Environmental, Inc.) T312

Umweltschutz Nord GmbH T48, T166, T298, T452, T618

Uranium Resources Inc. C82, C172

URT Umwelttechnik GmbH T221, T308, T344

Va-Tran Systems, Inc. T591

Vert LTD. T147, T419

Viking Industries T183

Viking Instruments C47-C48, C110-C111, C157-C158, C200, C237, C272, C345-C346

VKI Water Quality Institute T27, T255, T299

W.E.S. Environmental Division T168, T209, T293, T300, T424, T638

W.S. Atkins Consultants Ltd. E70, E86, E109

Wall-Rite E15, E45

Walsh & Associates T149, T269

Walsh Environmental E52

Waste Minimization and Containment Corp. T550, T592

WASTECHEM Ltd T524, T569, C49

Wastewater Technology Centre T17, T75-T76, T371-T372, T448, T463-T464

Wastewater Technology Centre/Rockcliffe Research Management T118, T395, T486

West PAC Environmental, Inc. T108, T384, T477

Westbay Instruments C123

Western Research Institute T286

Westinghouse Communcations T143, T413, T499

Westinghouse Remediation Services, Inc. T109, T385, T478

Wheelabrator Technologies, Inc. T396

Wismut GmbH C50, C66, C80, C170

Yellowstone Environmental Science, Inc. T77-T78, T195-T196, T250, T373

Zapit Technology, Inc. T623

Treatment

Treatment

Soil

Treatment

Soil

Treatment

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : Biological Soil Remediation

Application : In-situ (vadose zone)

Brief Description : This technology cleanses soil polluted by hydrocarbon components (Diesel/Light fuel), PAHs and chlorinated solvents through the use of biodegradation. Additionally, the technology extracts heavy metals from soil by electrokinesis.

Company Name/POC: A.S. Biotechnisk Jordrens/Soren Schiotz

Address : 10. Maglehojvej/DK 4400 Kalundborg, Denmark

Phone Number : 45 5350 4668

Fax Number : 45 5350 4490

Technology Maturity : Commercial use experience

Performance History : Contact company for performance history.

Comments : The general attitude in Denmark is that polluted soils should be cleansed if possible. This company is well known in the public mind. Since its foundation in 1986 as the first company of its kind on the industrial scale, the company has had a major share of the Danish market. The management is on an advisory board to the Danish Minister for the Environment.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Biodegradation (In Situ)***Technology Name :** Biogard method

Application : In-situ (vadose zone)
 In-situ (saturated zone)

Brief Description : The Biogard Method combines absorption and encapsulation of free hydrocarbons with a catalyzing effect of naturally occurring oil degrading bacteria.

Biogard is a powder product that is mixed into polluted soil or spread over surface water with the above-mentioned effect.

The degradation time will, due to the catalyzing effect, be decreased substantially.

Company Name/POC: AEC/Jan Hyttel, Managing Director**Address :** GI Kongevej 131/DK-1850 Frederiksberg C/Denmark**Phone Number :** 45 31247122**Fax Number :** 45 3124722**Technology Maturity :** Commercial use experience

Performance History : Invented by a German scientist in the late seventies. Patented in the US (and almost world wide) in 1980/1981.

Hundreds of references in Denmark, Europe, and the Middle East.

Comments :

Biogard is able to treat all sorts of oil pollution on sea and on land.

Easy and flexible to use. No need for special equipment or infrastructure.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : Bioaugmentation

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : BioGEE's HC is composed of specifically selected and adopted bacteria, and is formulated to effectively digest a wide variety of long and short chain hydrocarbons. The key treatment steps include: implement an aeration system or oxygen supplements, apply nutrients and BioGEE HC, and control the temperature and moisture level. BioGEE HC is a liquid concentrate as opposed to other bioremediation products which come freeze dried or in powder form. The advantages of this are in its ease in transporting, its ease in on-site mixing (1 pt HC per 55 gallons of water). Competing powder formulations need to be rehydrated before application.

Company Name/POC: BIOGEE International, Inc./Trey Barber

Address : 16300 Katy Freeway/Suite 100/Houston, Texas 77094-1609

Phone Number : 713 578-3111

Fax Number : 713 578-1114

Technology Maturity : Commercial use experience

Performance History : The accomplishments in Alaska with the EPA using bioremediation on part of the Exxon Valdez spill provided new insights and knowledge on bioremediation. Since that time, countless laboratory tests and field applications have shown conclusively that bioremediation is effective, safe, and poses no adverse environmental consequences.

Comments : The key conditions that can limit rapid microbial growth, and thus limit bioremediation, are: lack of nutrients and oxygen supply, the presence of substances toxic to microbes, pH levels greater than 12 and less than 5, and insufficient moisture. Soil temperatures below 50 degrees Fahrenheit will cause a drastic reduction in microbial activity.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE: *Biodegradation (In Situ)*

Technology Name : Bionergies, Biosmose, Biosurf

Application :	In-situ (vadose zone)	Off-site	Ex-situ
	In-situ (saturated zone)		

Brief Description : Bioremediation of organic pollutions (in soils, water, effluents) by using: 1. exogenous specific bacterial consortium (non toxic, environment safe, European Federation of Biotechnology class I in order to control a full, complete and non selective biodegradation; 2. Biofixations (mineral natural support); 3. Biosurfactants (produced by selected bacteria) provide an effective, fast and secure alternative to common place bioremediation because Bionergies controls the biodegradation of the pollutant (and metabolites) by using specialized bacteria and feasibility tests (in labs, on the field).

Company Name/POC: Bionergies Laboratories, Biosurf/M. Jacques FAUDIN

Address : 59/100, rue des 4 termes/B.P. 1009/Z.I. des Paluds/13781 AUBAGNE Cedex, France.

Phone Number : 33 42 84 30 07

Fax Number : 33 42 84 23 3

Technology Maturity : Commercial use experience

Performance History : Contact company for performance data.

Comments : Each case is analyzed in order to optimize the treatment and the on site materials and personnel. Bioenergies controls the bacterial action by using exogenous specific bacterial strains; biofixations and biosurfactants. None of the bacteria is genetically engineered. They are classified into class I (one) of the European Federation of Biotechnology, and produced under French and European Community regulations. The company is looking for join-ventures in U.S. in order to cover the environmental and industrial field.

Source of Information :International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : Bioremediation

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : ChemPete, Inc. has developed and proven an effective, continuous, and timely clean-up method for transforming gasoline, diesel fuel, fuel oil, kerosene, and chlorinated solvents to nonhazardous organic matter, carbon dioxide, and water. ChemPete currently uses bacteria, nutrients, and a catalyst developed by Alpha Environmental Biosystems Inc., which has a worldwide reputation for success.

Company Name/POC: ChemPete, Inc./John Peterson

Address : 405 E. Pierce Street/Elburn, Illinois 60119

Phone Number : 708 365-2007

Fax Number : 708 365-9099

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

By combining Alpha Inc., material with ChemPete's 15-year experience in chemical process design and fermentation, ChemPete Inc., was the first company to close both gasoline and fuel oil sites in situ in accordance with Illinois' rigorous closure guidelines (5 ppb benzene). ChemPete has reduced 140 ppm benzene to nondetectable levels in aboveground sandy piles in as short a time as 40 days. ChemPete has reduced 85 ppm fuel oil (TPH) to 4 ppb in 75 days at a depth of 27 feet.

Comments : ChemPete Inc. has the capability of doing ex situ work and treating groundwater, utilizing bioreactors. ChemPete uses trenches, vertical wells, biobarriers and other techniques, depending on the soils' hydraulic conductivities, to set up an effective bioremediation system to conclude the process in a timely manner. The major limitations to the ChemPete system are refractory materials that would not allow the bacteria to exist. Examples of materials that are refractory are strong acids, strong bases, biocides or soils heavily contaminated with solvents.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Biodegradation (In Situ)**Technology Name :** Biocatalytic Contaminant Degradation (BCD)

Application : In-situ (vadose zone) Ex-situ
 In-situ (saturated zone)

Brief Description : ECO-TEC, Inc. (ETI), utilizes "Enviromech Gold", (EMG), a proprietary biocatalyst to dramatically accelerate the biodegradation of petroleum hydrocarbons and other biodegradable contaminants. The biocatalytic contaminant degradation (BCD) process can be applied to soil or groundwater, ex situ or in situ. A pH-balanced microbial inoculum (BMI) consisting of water, EMG, indigenous microbes, contaminant specific microbes (if needed) and all trace minerals and nutrients required for microbial proliferation is created.

Company Name/POC: ECO-TEC, Inc./Ecology Technology, Inc./Herbert R. Pearse**Address :** P.O. Box 1113/Issaquah, Washington 98027-1113**Phone Number :** 206 392-0304**Fax Number :** 206 392-057**Technology Maturity :** Commercial use experience

Performance History : The Biocatalytic contaminant degradation, (BCD), technology has been successfully demonstrated many times on full-scale remediation projects in Washington State.

Comments : Generally, BCD technology can be applied to various sites and media, and can be implemented utilizing equipment that is readily available. Since many variable parameters exist between sites, no one BMI or application technology is best suited to all situations. The BCD process will be modified to meet site-specific criteria. The Biocatalytic contaminant degradation, (BCD), process is not the one cure for all remediation problems, although it can be utilized in conjunction with other remediation technologies. The BCD process is limited by the availability of oxygen, range of temperature and the availability of moisture. All of these limiting factors can be controlled in modern site remediation operations.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : FyreZyme

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : FyreZyme is a multifactoral liquid (aqueous) agent, combining a rich source of bacterial growth-enhancing agents, extracellular enzymes, and bioemulsifiers. For in situ treatment, a "front" of FyreZyme-containing aerated water is moved through the soil by a combination of infiltration galleries or injection wells upgradient and extraction well(s) downgradient. It is necessary to maintain aerobic conditions through use of peroxide, injection wells, bioventing, sparging, etc. for maximal rates of bioremediation. This technology can be added to and increase the effectiveness of other technologies such as bioventing, air sparging, soil vacuum extraction, etc.

Company Name/POC: Ecology Technologies International, Inc./Mr. Pete Condy

Address : 1225 So. 48th Street/Suite 2/Tempe, Arizona 85281

Phone Number : 602 985-5524

Fax Number : 602 985-2988

Technology Maturity : Commercial use experience

Performance History : An in-situ field program is in progress in California and Nevada, using a combination of upgradient vertical and horizontal injection wells and a downgradient extraction well. A similar program is being engineered at a Waco, Texas, site with Technologies International, Inc.

Comments : The main limitations are those that limit bacterial growth, such as temperature extremes, pH below 3 or above 10, and bactericidal contaminants in high concentrations. Enzyme poisons must be flooded with FyreZyme before bioremediation will ensue. Aerobic conditions must be attained, at least periodically, to ensure complete metabolism of contaminants to non-toxic end products.

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : Electro-Klean

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : The electrokinetic bioremediation (or bio-electrokinetic remediation) technology for continuous treatment of in situ groundwater or soil utilizes either electro-osmosis or electrochemical migration (ion migration) to initiate or enhance in-situ bioremediation.

Company Name/POC: Electrokinetics, Inc./Robert Marks/Yalcin Acar/Robert Gale

Address : LA Business and Technology Center/Suite 155/South Stadium Drive/Baton Rouge, Louisiana
70803-6100

Phone Number : 504 388-3992

Fax Number : 504 388-397

Technology Maturity :

Bench scale testing, only

Performance History : Electrokinetics, Inc. has developed a strong research and development plan. One of their first pilot tests for the electrokinetic bioremediation program will be to compare removal of jet fuel from contaminated sites with other conventional remediation processes.

Comments : None.

Source of Information : VISITT 3.0

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : Anaerobic Biotransformation

Application : In-situ (saturated zone)

Brief Description : ENSR has designed and implemented a full-scale system combining several remediation technologies to treat soil and groundwater contaminated with chlorinated solvents. The system combines bioremediation, steam injection, soil vapor extraction, groundwater extraction, and air-stripping. The remediation approach for this technology combines the use of steam injection for the removal of dense nonaqueous phase liquids (DNAPL), coupled with the application of nutrients to groundwater to promote biotransformation of TCE and 1,1,1-TCA to compounds which are more easily removed from the subsurface. DNAPLs which are volatilized by close contact with injected steam are removed in the vapor phase by a network of vapor extraction wells.

Company Name/POC: ENSR Consulting and Engineering/D. J. Poehls

Address : 1220 Avenida Acaso/Camarillo, California 93012

Phone Number : 805 388-3775

Fax Number : 805 388-3577

Technology Maturity : Commercial use experience

Performance History : ENSR has been operating a full scale remediation system based on biotransformation combined with steam injection for approximately two years. A design for remediation of a second site impacted by chlorinated solvents present as DNAPLs using a similar approach was completed in mid-1993. System installation and start-up is scheduled for 1994. Both sites where this technology is being applied are being remediated under privately funded voluntary cleanups.

Comments : This type of in-situ remediation process is limited to the treatment of chlorinated solvents. Implementation of this technology requires bench- or pilot-scale testing to aid in design of a full-scale system. Injection of substrate and nutrients into groundwater will likely require a permit in most states.

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : In Situ Bioremediation

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Process for degradation of TCE and its sister compounds, vinyl chloride and dichloroethylene, from aquifer solids using TCE-degrading bacteria capable of penetrating soil, maintaining activity and reaching the TCE contamination. Replaces pump-and-treat and soil vapor extraction combined with carbon adsorption or incineration. Envirogen's in-situ system will save 90 percent of the cost and shorten cleanup time by many years.

Company Name/POC: Envirogen, Inc./William J. Guarini

Address : 4100 Quakerbridge Rd./Lawrenceville, New Jersey 08648

Phone Number : 609 936-9300

Fax Number : 609 936-922

Technology Maturity* :

Bench scale testing, only

Performance History : Bench-scale results demonstrate technology feasibility.

Comments : System requires either horizontal or vertical well installation, pumping of microorganisms into soil, and sampling and analysis of soil. System will provide cleanup of contamination at the source. Little operator-attention is required.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : Anaerobic Metal Removal Technology (AMR)

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : The AMR process was developed to release, separate and remove toxic metal contaminants in solids (soils, sediments, sludges) and can simultaneously bioremediate organic pollutants. The AMR technology involves the use of indigenous anaerobic heterotrophic denitrifying microbial populations which are resistant to and will aid in the solubilization of metal sulfides in the presence of other organic pollutants. AMR technology operates in the absence of oxygen, thereby eliminating the need for aeration. The process produces no acid which eliminates the secondary pollution problems. The addition of a low-cost and readily available soluble alternate electron acceptor source (nitrate) allows the system to be operated at low cost.

Company Name/POC: Geo-Microbial Technologies, Inc./D.O. Hitzman

Address : P.O. Box 132, East Main Street/Ochelata, Oklahoma 74051

Phone Number : 918 535-2281

Fax Number : 918 535-2564

Technology Maturity : Bench scale testing, only

Performance History : Development for removal of metals from spent coal liquification catalysts (DOE contracts).

Comments : The elimination of oxygen requirements allows broad usage. Microbial ecology would be easily manipulated by minimum alternate electron acceptor amendments. The system has broad potential applications with minimum requirements for implementation. The ease and flexibility of amendment addition and use of indigenous microflora expand the range of applications.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : Daramond

Application : In-situ (vadose zone)

Brief Description : The Daramond process consists of three components: Addition of solid phase organic soil amendments of specific particle size distribution and nutrient content; distribution of the soil amendments through the target matrix; and the homogenization and aeration of the target matrix using specialized tilling equipment. A specialized soil moisture control system is designed to maintain moisture content within a specified range to facilitate rapid growth of an active microbial population and prevent the generation of leachate.

Company Name/POC: Grace Dearborn, Inc./J. Marvan

Address : 3451 Erindale Station Road/P.O. Box 3060/Station A/Mississauga, Ontario L5A 3T5

Phone Number : 905 279-2222

Fax Number : 905 279-002

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

In pilot- and full-scale field demonstrations, Daramond has been used to remediate soils contaminated with up to 2000 mg/kg of PCP and 18,000 mg/kg of PAHs. The Daramond process is at full-scale demonstration, with full-scale jobs being initiated. US EPA is conducting an audit of the full-scale demonstration under the SITE demonstration program.

Comments : The Daramond process cannot be used to remediate soils containing metals and/or PCBs.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : Bioinjection

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Bioinjection is a proprietary, in situ treatment process developed by Hayward Baker in which combinations of nutrients, oxygen sources, enzymes and other appropriate materials are injected directly into contaminated soil to enhance the degradation of organic compounds by indigenous or applied microorganisms. Injection machines are equipped with three to four injectors mounted in line and are capable of penetrating to depths of up to 40 feet below the ground surface. The injectors are pushed into the soil without requiring pre-drilling. This very efficient production equipment allows multiple injection passes to be made on close, overlapping grid spacings to assure permeation of the contaminated zones with bioslurry mixtures. Treatment of up to 2,500 cy of soil per day per unit is not uncommon.

Company Name/POC: Hayward Baker Environmental, Inc./George K. Burke, P.E.

Address : 1130 Annapolis Road/Odenton, Maryland 21113

Phone Number : 410 551-1995

Fax Number : 410 551-1900

Technology Maturity : Commercial use, experience

Performance History : Chemical and Lime Injection Technologies are field proven techniques which economically saturate and stabilize the desired subsoils for in situ ground improvement applications. Numerous geotechnical projects have been successfully completed with this technology. The same basic technology concept has been developed and applied to the environmental remediation field. Pilot tests have been performed with the equipment and a full-scale Hexane remediation project recently has been completed. Preliminary results from the full-scale project have indicated concentration reductions below the required clean-up guidelines.

Comments : The key feature of the in situ Bioinjection technology is the ability of the equipment to cost effectively inject biomaterials throughout the entire contaminated soil zone. The system is effective for a wide range of contaminants that are biodegradable and is not dependent on the mass transport phenomena of the soil as with traditional withdrawal/injection systems. Associated costs for the technology range from \$7 to \$25 per cubic yard for the injection services with the biomaterials ranging from \$8 to \$23 per cubic yard. Combining the system with the BioSparge technology will significantly reduce the cost for biomaterials on larger projects. Injection technology has been well proven by completing over 75 projects annually.

Source of Information : VISITT 3.0

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Biodegradation (In Situ)*

Technology Name: In Situ Bioremediation

Application: In-situ (vadose zone)
In-situ (saturated zone)

Brief Description: NGI provide: Site characterization, treatability studies, pilot scale tests, full scale remediation (including: design, implementation and monitoring for in-situ bioremediation).

Company Name/POC: Norwegian Geotechnical Institute/Tor Loken

Address: PO Box 3930, Ullevaal Hageby/N 0806 Oslo, Norway

Phone Number: 47 22023000

Fax Number: 47 2223044

Technology Maturity: Commercial use experience

Performance History: Used on 20m3 spill of fuel oil contaminating 2000m3 of sandy and gravelly soil above ground water (in Norway). 70% reduction of contaminate was achieved with no ground water contamination occurring. Pilot tests on PAH contaminated soil from creosote and gas work plants have been performed.

Comments: None

Source of Information: International.TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Biodegradation (In Situ)***Technology Name :** Phytostabilized Bioremediation

Application :
 In-situ (vadose zone)
 In-situ (saturated zone)

Brief Description : Uses enhanced biotechnology to degrade organics - e.g., phenol, PCB, dioxin and inorganics - nitrate, ammonia etc. The technology can be used in a soil matrix to treat flowing groundwater/effluent or by direct planting into soil. Non-stabilized bioremediated and many types of conventional water treatment. Microorganisms (fungi and bacteria) which develop in the planted soil are responsible for most of the treatment. The root and rhizone systems of the reeds bring air into the soil surrounding them while further away the environment is anaerobic creating a unique mosaic of treatment spheres which facilitates the impressive ability of reed beds to remove complex and previously intractable pollutants. The majority of treatment is by soil microbes but certain contaminants (such as heavy metals, sulphur and phosphorous) are removed via soil processes.

Company Name/POC: OEEL Ltd/ESU Ltd/ Lucian S. Gill**Address :** 4 Cumberland House/Greenide Land/Lidget Green/Bradford W. Yorkshire BD89TF England**Phone Number :** 1274 480033**Fax Number :** 1274 483003**Technology Maturity :** Commercial use experience

Performance History : Over 500 applications worldwide including PCB, Pesticide, Dioxins, Organics - including solvents, phenolics, PAH's, ammonia, nitrates, cyanide etc., sewage, farm slurries, metal entrapment/extraction.

Comments : Requires adaptation and monitoring over the first 3 years to maturity but then continues in some cases with little or no attention. Requires larger land areas than conventional "packaged" systems. Requires three years adaption period. Once adapted is extremely flexible and will readapt to changes in input. The technique involves genetics selection of plant types to withstand toxic material. The plant/soil/bacterial matrix is then adapted to the site conditions and once stabilized - continues to treat the toxic material indefinitely. Effluent/groundwater is fed into a basin containing the PL/SO/BAC matrix. Plants are allowed to develop and penetrate their rhizomes into the toxic soil. Because each site has a unique problem, no hard rule for system costs can be given. Smallest system - 10 sq. meters, largest 20 hectares; volume 1 m(cubed) per day to 5000 m(cubed) per day.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : Bioremediation

Application : In-situ (vadose zone)
 In-situ (saturated zone)

Brief Description : SBP Technologies, Inc. (SBP) has compiled a unique collection of patented microorganisms for use in bioremediation applications. The integrated use of these microorganisms together with in situ bioreactor technologies promise to yield an effective and cost-efficient remedial solution for soil, sediment and groundwater contaminated by a great number of organic compounds. The in situ bioreactor is an encapsulated cell designed to be inserted into a well. The bioreactor can be inserted to treat the vadose zone or groundwater.

Company Name/POC: SBP Technologies, Inc./Dr. James Mueller, Ph.D.

Address : One Sabine Island Drive/Gulf Breeze, Florida 32561-3999

Phone Number : 904 934-9282

Fax Number : 904 934-920

Technology Maturity : Pilot plant testing

Performance History : Specially selected microorganisms have been patented for the treatment of soil (and water) containing organic wood preservatives, namely creosote and PCP, and chlorinated solvents, especially TCE. Application strategies using in situ bioreactors and encapsulated cells are designed on a site-specific basis.

Comments : Time constraints often limit in situ applications. All conventional limitations to biological processes apply (e.g., high metal concentrations, temperature, pH, nutrient status, oxygen potential, bioavailability, etc.). Physical/hydrogeological constraints are also relevant.

Source of Information : VISITT 3.0

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Biodegradation (In Situ)***Technology Name :** Enhanced Bioremediation**Application :** In-situ (vadose zone)

Brief Description : Enhanced biological degradation/destruction of contaminants in soils/sediments: improved microbial growth for contaminant mineralization to innocuous end-products, excellent destruction for organic contaminants.

Company Name/POC: Wastewater Technology Centre/Kevin Hosler**Address :** 867 Lakeshore Road/P.O. Box 5068/Burlington, Ontario, Canada L7R 4L7**Phone Number :** 905 336-6021**Fax Number :** 905 336-4765**Technology Maturity :** Field demo complete**Performance History :** Technology is presently licensed to S. R. Grace Ltd.

Comments : Best success achieved for medium-to-coarse-textured soils. Easy to use; irrigation/moisture control system required.

Source of Information : International TechCon

CONTAMINANTS :☒ Pesticides/Herbicides☒ Heavy Metals☒ PCB☒ Explosives/Propellants☒ Petroleum Hydrocarbons☒ Radionuclides☒ SVOC☒ Other Contaminant☒ Nonhalogenated VOC☒ Halogenated VOC☒ N/A**TECHNOLOGY TYPE :** *Bioventing***Technology Name :** Bioventing**Application :** In-situ (vadose zone)

Brief Description : Biodegradation of contaminated soil is enhanced through the induction or injection of ambient air into the subsurface via venting wells screened in the contaminated soil zone. In some cases, groundwater depression may be incorporated in the treatment system design to expose contaminants trapped in the smear zone. In most cases, the viability of bioremediation of bioventing at a particular site is preceded by field tests to determine the soil's permeability, and vertical or horizontal vent radius of influence. In situ respirometry is also conducted to determine potential oxygen utilization rates and related stoichiometric based contaminant degradation rates.

Company Name/POC: ENSR Consulting and Engineering/Ellen Moyer, Ph.D. P.E.**Address :** 35 Nagog Park/Acton, Massachusetts 01720**Phone Number :** 508 635-9500**Fax Number :** 508 635-918**Technology Maturity :** Commercial use experience

Performance History : ENSR, along with many other environmental engineering contractors, has employed various in-situ treatments using aeration of groundwater or vadose zone soils. ENSR has experience in the sequential anaerobic/aerobic dechlorination of TCE at a manufacturing site contaminated with cutting oil. This in-situ treatment exempted the treatment from RCRA standards. Other experience includes pilot testing, design, and installation of a bioventing treatment system using a radial well pattern with central air induction vents to treat silt contaminated with gasoline. ENSR has performed bioventing ex-situ through the use of biopiles.

Comments : Conditions that limit the technical viability of bioremediation or bioventing of vadose zone soils include low soil permeability, low nutrients levels or inability to distribute nutrients, excessive contaminant levels affecting the soil toxicity or soil wetting characteristics, low temperature restriction of degradation rates, aerobic or sequential aerobic/anaerobic biodegradability of contaminants of concern, presence of more easily degradable or preferred alternative carbon sources, and soil pH levels.

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Bioventing*

Technology Name : Bioventing by Global Environmental Inc.

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Anoxic air is injected through well points into the vadose zone. The resulting air flow through the contaminated soils accelerates the volatilization of high vapor pressure halocarbons. The vaporized halocarbons migrate toward the ground surface. As the vapors move upward, they are biodegraded through a co-metabolic process using a supplemental substrate and nutrients to enhance bioactivity. Aliphatic hydrocarbons or acetate are the usual substrates.

Company Name/POC: Global Environmental Engineering/Robert H. Douglas

Address : 2640 Aero Park Dr./Traverse City, MI 49686

Phone Number : 616 947-1000

Fax Number : 619 947-1044

Technology Maturity : Field demo complete

Performance History : Bioventing has been used successfully for remediating hydrocarbon-contaminated vadose and capillary fringe soils at the USCG Air Station in Traverse City, MI. Contaminant concentrations were reduced to below regulatory cleanup standards. Halocarbon treatment by use of an introduced co-metabolic substrate has been successfully used for groundwater remediation at Moffit Naval Air Station in California and at a site in St. Joseph, MI.

Comments : Bioventing can be applied to a wide variety of physical locations, but generally requires an open area with at least 6-12" of loamy top soil and minimal infrastructure which may inhibit or redirect air flow from below and infiltration from the surface. General labor can be used for most construction activities such as trenching and piping with on-site technical supervision. Electrical hook-up requires skilled labor. Construction requires 2-4 weeks. A bioventing project will consist of a field technician to monitor, maintain, and sample the system, a project engineer to evaluate system performance, and a project manager to assure compliance and coordinate all associated activities such as contractors, regulatory reporting, health and safety measures, etc. Global provides a whole range of soil and groundwater environmental services.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Bioventing*

Technology Name : Bioaugmented Soil Vapor Extraction (BSVE)

Application : In-situ (vadose zone) Ex-situ

Brief Description : Bioaugmented soil vapor extraction (BSVE) is the removal of volatile organic compounds from unsaturated soils by aeration forces and nutrient augmentation. The technology results in the physical removal of VOCs through enhanced volatilization and in the biodegradation of organic compounds through the acceleration of indigenous microbial processes. The key to the process is the effective contact of contaminated soil with an induced air stream. The partitioning of the process between physical removal and biodegradation is a function of the rate of aeration and the relative biodegradability of the material being used. Combining physical removal with biodegradation accelerates remediation and allows for the achievement of lower closure levels. The system can be applied both in situ and ex situ. Bioaugmented soil vapor extraction extends the range of contaminants that can be effectively treated through vapor extraction. It has been demonstrated effective in treating chlorinated hydrocarbons. BSVE is effective in treating chlorinated organics and is faster than conventional technologies because it combines two remedial technologies: volatilization and biodegradation.

Company Name/POC: Groundwater Technology, Inc./Richard Brown

Address : 310 Horizon Center Dr./Trenton, NJ. 08691

Phone Number : 609 587-0300

Fax Number : 609 587-790

Technology Maturity : Commercial use experience

Performance History : BSVE has been successfully applied on a commercial scale to treat petroleum hydrocarbons, (e.g gasoline and diesel), organic chemicals (e.g., chlorobenzene) and numerous chlorinated solvents ex situ. BSVE has been used to treat sites ranging in size from <1 acre to >50 acres. Harry Mosley, Public Service of Colorado, Denver CO. 303 294-2815.

Comments : Ex-situ system consists of an aeration bed-gravel layer with aeration pipe that is placed in a soil pile. The pile is constructed around vacuum piping which is on 3-ft centers and connected to a vacuum pump. Nutrient infiltration is accomplished through an infiltration pipe. In-situ system consists of air nutrient injection wells and separate vapor extraction wells. The two limitations to the technology are the ability to aerate the soil/solid matrix and the properties of the contaminant. If the permeability is too low, or if the contaminant is both nondegradable and nonvolatile, BSVE will not be effective. Systems are relatively easy to design and implement. Bench-scale studies, which consist of loading columns with soil, adding nutrients and measuring rates of removal due to volatilization or biodegradation during aeration, are required. Air permeability must be measured in the field for in-situ systems; air permeability for ex-situ systems can be measured by pressure drop and flow-through columns.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Bioventing***Technology Name :** Bioventing**Application :** In-situ (vadose zone)

Brief Description : Bioventing utilizes the natural in situ biodegradation of hydrocarbon contaminants in the vadose zone. Biodegradation is a process in which indigenous bacteria break down the molecular bonds in toxic organic compounds, producing carbon dioxide and water. The biodegradation occurs aerobically, with oxygen consumed by the bacteria.

Company Name/POC: H2O Science, Inc./Mark P. Ausburn**Address :** 5500 Bolsa Avenue/Suite 105/Huntington Beach, California 92649**Phone Number :** 714 379-1157**Fax Number :** 714 379-1160**Technology Maturity :** Commercial use experience

Performance History : H2O Science is currently designing a bioventing system for a service station site in Southern California. H2O Science is periodically monitoring levels of volatile organic compounds, oxygen, and carbon dioxide at several soil vapor extraction (SVE) remediation sites in Southern California and Alberta Canada.

Comments : Off-gas treatment costs are eliminated or significantly reduced, and blower operation costs are reduced because of the lower extraction rates used for bioventing. There is an optimal range of soil moisture, which is soil specific, for effective bioventing. Too little soil moisture inhibits biodegradation because the bacteria utilize organic compounds in the dissolved phase. Too much soil moisture reduces soil air phase permeability. Bacteria are less active at lower soil temperatures. However, current bioventing pilot projects in northern climates are achieving significant rates of biodegradation.

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Bioventing*

Technology Name : Bioventing

Application : In-situ (vadose zone) On-site

Brief Description : Bioventing is the process of degrading a soil contaminant by providing soil bacteria with oxygen and amendments as necessary so that the bacteria can grow and consume the contaminant in the soil. Indigenous or transplanted bacteria are used if necessary. The contaminant must be readily degradable, such as, petroleum hydrocarbons in gasoline, fuel oil, lubricating oil, etc. Oxygen is provided by pumping air into the soil at a rate that maintains aerobic activity in the contaminated soil. Amendments such as nitrogen, phosphorous, pH buffers and others may be necessary to enhance the degradation process.

Company Name/POC: Hazcorp/Rick Mazur

Address : 360 So. Reynolds Rd./Toledo, OH 43615

Phone Number : 419 537-6000

Fax Number : 419 537-877

Technology Maturity : Commercial use experience

Performance History : Not available

Comments : The soil must be permeable and unsaturated so that sufficient oxygen can be provided to sustain aerobic activity. If the contaminant has reached the water table, other treatment methods must be used in addition to bioventing.

Source of Information : VISITT 3.0

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : Bioventing

Technology Name : Bioventing

Application : In-situ (vadose zone)

Brief Description : This technology is derived from soil vapor extraction technology. An air circulation system is established in the unsaturated zone of the given matrix (usually soil). Air movement throughout the contaminated area provides oxygen for the biodegradation process. A specially designed nutrient delivery system is attached to provide vapor-phase ammonia and phosphorus to the subsurface. Together, these substrates provide the essential requirements to stimulate indigenous bacteria to biodegrade contaminants in unsaturated matrices. This technology can be run continuously, or in batch form.

Company Name/POC: IT Corporation/Tom Geisler

Address : 312 Directors Drive/Knoxville, Tennessee 37923

Phone Number : 615 690-3211

Fax Number : 615 690-3626

Technology Maturity : Pilot plant testing

Performance History : Contact company for performance data.

Comments : A system can be optimized to operate with minimal contaminated air emissions, avoiding extensive carbon consumption or extensive air permitting. It can be effective on any contaminant that is readily biodegraded. Many of the transport limitations associated with aqueous delivery systems or saturated soils are avoided with this technology.

Source of Information : VISITT 3.0

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CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Bioventing*

Technology Name : Bioventing

Application : In-situ (vadose zone)

Brief Description : Bioventing is the use of air injection and/or extraction methods to increase soil oxygen levels and enhance the natural biodegradation of petroleum hydrocarbons.

Company Name/POC: Parsons Engineering-Science, Inc./Mr. Doug Downey

Address : 1700 Broadway/Suite 900/Denver, Colorado 80290

Phone Number : 303 831-8100

Fax Number : 303 831-820

Technology Maturity : Commercial use experience

Performance History : ES has applied bioventing techniques for in-situ soil remediation underneath concrete paved areas, railroad lines, buildings, and tanks. ES is currently performing bioventing pilot tests for government and commercial clients at over 120 sites nationwide. ES has obtained approval for bioventing and has systems operating in 25 states and in all 10 EPA regions.

Comments : Bioventing is limited to unsaturated zone remediation and is most effective in soils with moisture less than 75 percent of field moisture capacity. Bioventing may not be suitable for sites requiring rapid soil remediation. Two to three years of bioventing are generally required to achieve 100 mg/kg total petroleum hydrocarbon clean up levels.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Bioventing*

Technology Name : Bioventing

Application : In-situ (vadose zone) On-site

Brief Description : Quaternary Investigations, Inc. (QI) has developed an in-situ bioremediation treatment system for the degradation of chemical compounds in subsurface soils. Nutrients and microbes are induced into the subsurface soils utilizing a below ground aqueous infiltration unit. Microbe organisms are selected for their capabilities to degrade the specific site contaminants.

Company Name/POC: Quaternary Investigations, Inc. (QI)/Tony Morgan

Address : 300 W. Olive St./Suite A/Colton, CA 92324

Phone Number : 909 423-0740

Fax Number : 909 423-0743

Technology Maturity : Commercial use experience

Performance History : The system has been successfully demonstrated at a full-scale level at a site in Southern California. Agencies have approved the design and application of the unit for the treatment of fuel contaminated subsurface soils. No air permitting is required for the unit due to its in-situ technology and lack of emissions.

Comments : The system is limited to the types of compounds (e.g., not applicable to metals) that are biodegradable and the time period in which they are degradable. The system is more effective in sandy porous soils that allow for nutrient, microbe and oxygen movement.

Source of Information : VISITT 3.0

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Bioventing*

Technology Name: Biological Vapor Extraction

Application: In-situ (vadose zone)
In-situ (saturated zone)

Brief Description: Vapor extraction-enhanced bioremediation is an effective method for remediation of soils in the vadose and saturated zones which are contaminated with volatile or semi-volatile compounds. This technology supplements the capabilities of the vapor extraction process when compounds are present which have large non-volatile fractions. With this technology, the vapor extraction removes the volatile portions of the contaminant while the in-situ bioremediation degrades the non-volatile portion of the contaminant. Vapor extraction wells are installed into the area of contamination and well screens are installed such that the vadose zone and the saturated zone are subject to the vacuum influence. Experimentation is performed on the indigenous organisms at the site to determine what nutrients are required to maximize chemical breakdown of the non-volatile portions of the contaminant. In most cases, these aerobic bacteria are limited by a lack of oxygen, which will be provided in sufficient quantities by the vapor extraction process. In some instances, other nutrients, such as nitrogen or phosphorus, may be necessary to maximize bioremediation rates. During the remediation process, bioactivity is monitored by measuring the production of carbon dioxide in the exiting vapor stream and comparing it to a known baseline value. The vapor extraction wells are connected via a manifold of piping to a gas-liquid separator, a blower capable of inducing a vacuum in the system of vapor extraction wells and the surrounding soils, and finally to an airstream treatment device. Any water removed in the gas-liquid separator is treated separately from the air stream using a conventional treatment method.

Company Name/POC: Terra Vac/James Malot/Bruce Bosshard

Address: 356 Fortaleza St., P.O. Box 1591/San Juan, P.R. 00902-1591

Phone Number: 809 723-9171

Fax Number:

Technology Maturity: Commercial use experience

Performance History: Contact company representatives for performance summary and client list. Job size has ranged from small gas station projects to major superfund sites. Contaminants that have been recovered by this technology include: Benzene, toluene, xylenes, ethylbenzene, hexane, chloroform, methylene chloride, tetrachloroethylene, trichloroethylene, dichloroethylene, ethyl acetate, cyclohexane, methyl ethyl ketone, methyl isobutyl ketone, methanol, acetone, pyridine, tetrahydrofuran, dimethylfuran, carbon tetrachloride, trichloroethane, methyl methacrylate, decane, chlorobenzene, dichlorobenzene, trichloropropane, gasoline, jet fuel, Stoddard Solvent, diesel, kerosene, and heavy naphthas.

Comments: Conditions in the soil to be remediated must not create a toxic environment for microorganisms or bioremediation will not take place. The rate at which bioremediation takes place is much slower than the rate of volatile contaminant removal achieved by vapor extraction because the process of bioremediation is affected by many factors. Therefore, the system will have to be operated for a period of time after the volatile portion of the contaminant has been removed in order to assure degradation of the non-volatile portion of the contaminant. In some cases, naturally-occurring organisms do not exist to break down synthetically produced compounds. Genetically engineered organisms or accelerated evolution would have to be utilized to overcome this obstacle. After installation of the system, additional analysis will be required during system operation to maximize the rate of bioremediation. This may involve bacterial culture observation and additional chemical analysis. The most difficult part of this technology is the proper selection of well screening intervals and the correct maintenance of the microorganism's environment. The airflow path must be well known to ensure that the nutrients and oxygen are being supplied in sufficient quantities to the microorganisms. The presence of suitable nutrients must be verified during the site investigations process.

Source of Information: TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Bioventing***Technology Name :** In Situ Venting of Soil and Groundwater

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : The technology aims at providing the subsurface layers, including the groundwater aquifer, with air and/or oxygen either for stimulating the aerobic biodegradation of the organic compounds or by stripping volatile compounds from the soil layers. The air or oxygen is supplied through horizontal injection wells, ensures vertical aeration of the soil or the aquifer. The performance is dependent on the geology of the site, since very inhomogeneous soils and aquifers might interfere with proliferation of the air and thereby also the extent of contact between air and/or oxygen and the contaminants.

Company Name/POC: VKI Water Quality Institute/Bjorn Jensen**Address :** VKI/Agern Alle 11/DK - 2970 Hoersholm, Denmark**Phone Number :** 45 42 86 52 11**Fax Number :** 45 42 86 72 73**Technology Maturity :** Field demo complete

Performance History : Full-scale soil venting or bioventing using vertical injection and extraction wells have been applied in a number of cases in Denmark and abroad. Currently have an application of about \$2 million (US) submitted to the Danish Ministry of Business and Industry for development of venting techniques for further applications (clayish soils and aquifers).

Comments : If the compounds are stripped off the soil or groundwater, the gases must be trapped or treated on the ground. The technology cannot be used for non-volatile, persistent compounds like the heavy metals. It cannot be applied in cases with low permeability of the soil, and it is not clear at the moment whether it can be applied in fractured clay.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *White Rot Fungus*

Technology Name : White Rot Fungi For the Treatment of Recalcitrant Organics in Soil

Application : On-site Ex-situ

Brief Description : White rot fungi are able to degrade many recalcitrant organic pollutants. Biotol Ltd. have scaled the process up successfully for the treatment of chlorinated phenols. Current activities are laboratory and field work with PCB's and dioxins.

Company Name/POC: Biotol LTD./Dr. Philip Caunt

Address : 5 Chiltern Close/Cardiff Industrial Park, Cardiff Glanorgan South Wales/CF4 5DL, UK

Phone Number : 1222 766716

Fax Number : 1222 76694

Technology Maturity : Commercial use experience

Performance History : 10,000 metric tons of chlorophenol contaminated soil successfully treated in Finland. Levels reduced from 200 ppm to <10 ppm in 12 months. Further details available on request. Currently working at field scale on polyaromatic hydrocarbons following successful laboratory trials. Laboratory and small scale field programs for PCBs and dioxins.

Comments : Beds approx 2m deep. An area of one square meter is required for each two cubic meters of soil to be treated. Power is required for aeration fans : passive aeration under development beds formed using standard site machinery. (front end loader, drum screen tub grinder) No plant requirements during treatment period. Only suitable for organic contamination. Skills required for handling of fungus (Biotol will provide). For PCB's and dioxins, the question is how low can contamination be reduced and will it reach acceptable targets. High concentration may require some dilution to reach treatment target. PCB & dioxin program initiated in March 1994. Laboratory work scheduled to run March 94 - March 95. Field scale work scheduled for January 95 - September 95 work is supported by D.T.I. under SPUR (Support for Products Under Research Program).

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *White Rot Fungus*

Technology Name : Bioremediation

Application : In-situ (vadose zone)

Brief Description : A bench-scale bioremediation technology using *Phanerochaete chrysosporium* (white rot fungus) has been developed to degrade chlorinated compounds. The technology is tested using damp, corrugated cardboard boxes as the growth medium for the fungus. The corrugated cardboard provides the fungus with oxygen and nutrients. The experiments indicate that the cellulase provided by the fungus degrades the chlorinated compounds present in the media.

Company Name/POC: Clyde Engineering Services/Robert Clyde

Address : P.O. Box 740644/New Orleans, Louisiana 70174

Phone Number : 504 362-7929

Fax Number : N/A

Technology Maturity :

Bench scale testing, only

Performance History : Only bench-scale studies have been conducted but it is believed that the technology will also be an effective remediation tool at a large scale. Bench-scale studies have only used one type of soil; therefore, soil type could limit the effectiveness of this technology.

Comments : Some of the advantages are: (1) the treatment technology can be in situ; (2) by products are biodegradable; (3) since the corrugated cardboard provides the growth media, no additional material sources are needed; and (4) weekly tilling of contaminated soil is eliminated because the corrugation in the cardboard provides an aerobic environment necessary for the fungus.

Source of Information : VISITT 3.0

CONTAMINANTS:☒ Pesticides/Herbicides☐ Heavy Metals☐ PCB☐ Explosives/Propellants☐ Petroleum Hydrocarbons☐ Radionuclides☒ SVOC☐ Other Contaminant☐ Nonhalogenated VOC☒ Halogenated VOC☐ N/A**TECHNOLOGY TYPE:** *White Rot Fungus***Technology Name :** White Rot Fungi**Application :** In-situ (vadose zone)

Ex-situ

Brief Description : White rot fungi (WRF) are naturally-occurring organisms that cause the decay of fallen trees by degrading cellulose and lignin. This technology can be applied as a batch process in most ex-situ and some in-situ cases. To apply the technology, a fungus-inoculated substrate is mixed with the contaminated soil at a ratio which is dependent upon the contaminant and its concentration. The soil/substrate mixture is moistened during blending to provide an adequate environment for biological activity. The soil/substrate mixture is placed in a biocell or covered with a synthetic liner and aerated.

Company Name/POC: Earthfax Engineering, Inc./Larry DuShane**Address :** 7324 South Union Park Avenue/Suite 100/Midvale, Utah 84047**Phone Number :** 801 561-1555**Fax Number :** 801 561-186**Technology Maturity:** Pilot plant testing

Performance History : In December 1992, the Utah State University Foundation licensed the rights to the WRF technology to Intech One-Eighty Corporation. In February 1993, Intech sublicensed the environmental portions of the technology to Earthfax. Significant laboratory research has been performed on the technology for the past 10 years. Field implementation of the Intech technology began in 1993.

Comments : WRF are biological organisms which can exist in an environment where temperature, moisture, and oxygen content are maintained within certain parameters. They are, however, generally quite tolerant of pH variations. Although the fungi do not appear to be affected by the presence of metals, they also probably do not assist in metals recovery.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides ☐ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *White Rot Fungus***Technology Name :** Fungal Enzyme Degradation**Application :** In-situ (vadose zone) Off-site Ex-situ

Brief Description : The technology can be applied in situ for shallow contaminants in soil (up to 18 inches), or ex situ for deep contaminants by excavation, soil-substrate blending, and land farming type operations. Fungal enzymes are produced on a solid substrate which is introduced to the contaminated solid without separation. The fungi used by the technology are naturally occurring microorganisms which are non-soil fungi, and are selected by screening various isolated strains for optimum contaminant degrading capabilities.

Company Name/POC: Mycotech Corp./Robert Kearns**Address :** P.O. Box 4109/Butte, Montana 59702**Phone Number :** 406 782-2386**Fax Number :** 406 782-9912**Technology Maturity :** Commercial use experience

Performance History : The first full-scale prototype production system is completed and operational. This is a fixed plant facility and, fungal substrates must be shipped to site locations. Production for the first large-scale remediation of 6,000 cubic yards of soil began in early September 1991. Production capacity was increased during early 1992, and mobilized equipment was scheduled for completion by late 1994.

Comments : Fungi require 10-30 percent moisture for optimum growth. At temperatures below 40 degrees Fahrenheit and above 120 degrees Fahrenheit, fungi will go dormant or may die off. Soil pH is most favorable in lower ranges of 4 to 8. Tight clay soils restrict mobility and further inhibit mechanical blending to distribute fungal substrates uniformly in soils. Saturated soils and deep in situ conditions must be excavated and treated under aerobic conditions.

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *White Rot Fungus*

Technology Name : White Rot Fungus

Application : On-site Ex-situ

Brief Description : White rot fungi decompose aromatic hydrocarbons and a large number of other organic substances with their extracellular enzyme system. Straw injected with white rot fungi is mixed with the contaminated soil and then treated in regeneration table windrows with forced ventilation or in bioreactors. Air is drawn through the soil-straw-fungi mixture and the waste air is cleaned by activated carbon filters. Even soil with a PCB content is successfully cleaned using the white rot fungi process.

Company Name/POC: Noell Aball- u. Energietechnik GmbH/Mr. Rockkelein

Address : HuttenstraBe 3/D-38642/Goslar, Germany

Phone Number : 05321 3372 15

Fax Number : 05321 3372 5

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Has been used at pilot and full scale at over 20 sites since 1989.

Comments : None.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Soil Flushing*

Technology Name : Soil Flushing & Bioremediation

Application :
In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : EODT Services has several in-situ treatment methods. One of these methods is soil flushing and in-situ bioremediation of ground water, which involves the elutriation of organic and/or inorganic contaminants from soil for removal and treatment. First the site is flooded with appropriate washing solution/biodispersant, and then elutriate is collected in a series of shallow wellpoints or subsurface drains. The elutriate is then treated above ground within a liquid phase bioreactor and then released into the ground water table. Depending on the subsurface soil condition, bacteria is also recirculated into the subsurface soil to enhance the biodegradation.

Company Name/POC: EODT Services, Inc./Paul Greene, Monirul Haque

Address : 10511 Hardin Valley Road/Building C/Knoxville, Tennessee 37932

Phone Number : 423 690-6061

Fax Number : 423 690-6065

Technology Maturity : Pilot plant testing

Performance History : Not available.

Comments : The key component of this process is the biodispersant which basically desorbes the contaminant chemical and also serves as a high energy nutrient for the microorganisms.

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Soil Flushing*

Technology Name : In-Situ Surfactants Flushing (ISSF)

Application : In-situ (vadose zone)
 In-situ (saturated zone)

Brief Description : ISSF enables hydrocarbon recovery in the vadose zone and the capillary fringe. The soil is flushed with a surfactant solution which mobilizes the oil. The solution is then pumped out and treated to separate the oil and surfactants from the water. 70-80 percent of the organics can be removed this way.

Company Name/POC: GRS/G. Pottecher

Address : 13 Villa Croix Nivert/75015 Paris, France

Phone Number : 33 1 53 69 61 80

Fax Number : 33 4734 685

Technology Maturity : Pilot plant testing

Performance History : One pilot test on a controlled spill experiment. Numerous bench scale tests.

Comments : Permeability below $10E-4$ - $10E-5$ m/s is a limitation of the technology. Cost is highly variable according to site characteristics. The surfactants are of a kind produced by oil degrading to bacteria, and thus well accepted by the environment. A typical use of ISSF will be followed by in-situ bioremediation, which takes place in particularly good conditions due to the presence of surfactants and moderate hydrocarbons concentration.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Soil Vapor Extraction (In Situ)***Technology Name :** Horizontal Soil Vapor Extraction**Application :** In-situ (vadose zone)**Brief Description :** HSVE is used for the cleanup of soil contaminated with volatile organic compounds. HSVE creates a vacuum to induce air-flow through the soil matrix and vaporize volatile contaminants. Removal efficiencies of 99.99% in <1 year are possible.**Company Name/POC:** Four Seasons Environmental Inc./Bill Ballance**Address :** 3107 S. Elm-Eugene Street/Greensboro, North Carolina 27406**Phone Number :** 910 273-2718**Fax Number :** 910 274-5798**Technology Maturity :** Commercial use experience**Performance History :** Four Seasons has executed roughly 20 projects using HSVE technology.**Comments :** The horizontal design makes the system extremely effective for a wide variety of site conditions; high groundwater areas including areas beneath buildings and other structures. Applicable only to specific soil types and VOCs and semi-volatiles. May have long-term operations and maintenance expense. Affects a greater area of influence than traditional vertical extraction systems. Can be easily incorporated into a groundwater treatment system. The technology is effective in depths of 2-30 feet.**Source of Information :** TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Soil Vapor Extraction (In Situ)*

Technology Name : Soil Vapor Extraction

Application : In-situ (vadose zone)

Brief Description : Soil venting or soil vapor extraction is a technology that uses either active or passive equipment to remove air and gases from the subsurface. The soil vent systems use horizontal and/or vertical wells that are designed to remove soil vapor (soil gases) from the unsaturated zone, the capillary fringe, and the groundwater fluctuation zone. The soil venting helps to reduce the adsorbed, free-phase, and dissolved concentrations of the VOCs in the subsurface and, in many cases, reduce these concentrations to at or below regulatory cleanup levels.

Company Name/POC: IT Corporation/John G. Morse

Address : 312 Directors Drive/Knoxville, Tennessee 37923

Phone Number : 615 690 3211

Fax Number : 615 690-362

Technology Maturity : Commercial use experience

Performance History : IT has extensive experience in feasibility analysis, pilot testing, design, equipment fabrication, installation, and operation of soil venting systems.

Comments : In general, soil venting is most successful at sites with fairly homogenous soils, a good surface seal or confining layers, and permeabilities above 0.1 darcy. Soil venting is not directly applicable for the removal of nonvolatile constituents in the subsurface. The injection or extraction of air with or without gaseous nutrients can be used to enhance natural biodegradation of nonvolatile constituents. Low permeability soils, very shallow groundwater (less than five feet below the surface), and highly nonhomogenous soils may not be suitable for soil venting.

Source of Information : VISITT 3.0

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Soil Vapor Extraction (In Situ)*

Technology Name : VaporTech

Application : In-situ (vadose zone)

Brief Description : Soil vapor extraction and various enhancements performed by MWR/ETG recover VOCs and semi-VOCs from soils in-situ. Our process is capable of meeting health-based closure criteria. MWR developed and perfected the VAPORTECH system, a patented and proven technology for the removal or destruction of hazardous or petroleum VOCs and SVOCs from contaminated soils without excavation or disruption to site activities. The treatment injects clean air under pressure at the perimeter of the soil volume to be treated. As the clean air travels to withdrawal conduits at lower pressure located in the high contaminant concentration soils, it accumulates VOCs. The air is then brought above ground through use of a positive displacement blower. Process air and entrained VOC vapors are passed through contaminant control apparatus approved by regulators or clients. Cleansed or fresh atmospheric air is then injected into the treatment cell.

Company Name/POC: MWR, Inc., Division of ETG Environmental, Inc./Frederick C. Payne, PhD

Address : 7707 Rickle Road/Lansing, Michigan 48917

Phone Number : 517 322-9311

Fax Number : 517 322-2936

Technology Maturity : Commercial use experience

Performance History : Total projects - 58 (24 closed at health-based standards, 24 in progress)

Comments :

Largest closed to health-based closure = 425,000 yds(3)

Surface footprint is small (typically 1,000 square feet).

Power requirements vary; 40 HP for up to 40,000 cubic yards).

Contrasting pneumatic conductivities cause slow treatment rates. Heavy soils (e.g., clay) require more intensive efforts.

The technology is easy to implement, but requires experienced designers. Many engineering firms are submitting designs which are impractical. The majority of work tasks associated with the technology can be installed by local subcontractors directed by experienced project managers. This is a commercial technology which can be applied to many sites. However, contaminant characteristics and nature, as well as soil type and stratification, complicate the design and field implementation of SVE.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Soil Vapor Extraction (In Situ)*

Technology Name : Entrainment Vapor Extraction

Application : In-situ (vadose zone)
 In-situ (saturated zone)

Brief Description : Entrainment Extraction is a type of dual vacuum extraction and is an effective method for remediation of soils in the vadose and saturated zones having a low hydraulic conductivity where groundwater and soil are both contaminated with volatile or semi-volatile compounds. Vapor extraction wells are installed into the area of contamination and well screens are installed such that the vadose zone and the saturated zone are subject to the well's influence. A submersible tool lowered into the well is connected to the same manifold that the well casing is connected to. A vacuum is drawn within both the well casing and this submersible tool by the system blower. The low-pressure region created at the end of the submersible tool by air rushing into the tube causes the water in close proximity to the end of the tool to be entrained in the air rushing up the tool. In this way, the water table is lowered, thereby exposing more vadose zone to the vacuum being drawn on the well above the groundwater. This efficiency removes contaminants from the soil "smear zone" using only one well. The water from the combined stream created by the entrainment extraction well is removed in a gas-liquid separator and is treated separately from the air stream, using either activated carbon or another conventional treatment method.

Company Name/POC: Terra Vac/Bruce Bosshard

Address : 356 Fortaleza St./P.O. Box 1591/San Juan, P.R. 00902-1591

Phone Number : 809 723-9171

Fax Number :

Technology Maturity : Commercial use experience

Performance History : Performance Data are available.

Contact company representative for performance summary and client list. Job size has ranged from small gas station projects to major superfund sites. This technique has been successful in each location where it was applied. Contaminants that have been recovered by this technology include: Benzene, toluene, xylenes, ethylbenzene, hexane, chloroform, methylene chloride, tetrachloroethylene, trichloroethylene, dichloroethylene, ethyl acetate, cyclohexane, methyl ethyl ketone, methyl isobutyl ketone, methanol, acetone, pyridine, tetrahydrofuran, dimethylfuran, carbon tetrachloride, trichloroethane, methyl methacrylate, decane, chlorobenzene, dichlorobenzene, trichloropropane, gasoline, jet fuel, Stoddard Solvent, diesel, kerosene, and heavy naphthas.

Comments : Contaminant must be volatile or semi-volatile for this technology to perform correctly. Contaminants which complex with the soil matrix are not effectively remediated using this technology. The soil in which the well is installed should have a low hydraulic conductivity for this technology to be most effective. If the soil has high hydraulic conductivity, dual vacuum extraction should be utilized instead. After initial installation of the system (wells, manifold, and treatment system), system operation, monitoring and maintenance is routine. Some care needs to be taken in system optimization to ensure that the system is being used to its greatest potential. The most difficult part of this technology is the proper selection of well screening intervals. If the Entrainment Extraction (Trademark) well is not properly screened, then air will enter the well from regions of the soil which do not contain the contaminant or regions which do contain the contaminant will be completely bypassed by the air flow. The goal is to make the most use of the vapor extraction in the area which has been dewatered.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Soil Vapor Extraction (In Situ)*

Technology Name : Dual Vapor Extraction

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Dual Extraction is an effective method for remediation of soils in the vadose and saturated zones where groundwater and soil are both contaminated with volatile or semi-volatile compounds. Vapor extraction wells are installed into the area of contamination and well screens are installed such that the vadose zone and the saturated zone are subject to the well's influence. Various extraction techniques are utilized to lower the water table within the radius of influence, while a vacuum is drawn on the soil above the water table in the same well. In this way, the water table is lowered, thereby exposing more vadose zone to the vacuum being drawn on the well above the groundwater. This efficiently removes contaminants from the soil "smear zone" using only one boring. The vapor stream and the liquid stream from the Dual Extraction well is connected via separate piping to their respective treatment systems. The liquid stream is treated using the conventional treatment methods; while the vapor stream is typically treated using activated carbon or a catalytic oxidizer.

Company Name/POC: Terra Vac/James Malot/Bruce Bosshard

Address : 356 Fortaleza St., P.O. Box 1591/San Juan, P.R. 00902-1591

Phone Number : 809 723-9171

Fax Number :

Technology Maturity : Commercial use experience

Performance History : Contact company representative for performance summary and client list. Job size has ranged from small gas station projects to major superfund sites. Contaminants that have been recovered by this technology include: Benzene, toluene, xylenes, ethylbenzene, hexane, chloroform, methylene chloride, tetrachloroethylene, trichloroethylene, dichloroethylene, ethyl acetate, cyclohexane, methyl ethyl ketone, methyl isobutyl ketone, methanol, acetone, pyridine, tetrahydrofuran, dimethylfuran, carbon tetrachloride, trichloroethane, methyl methacrylate, decane, chlorobenzene, dichlorobenzene, trichloropropane, gasoline, jet fuel, Stoddard Solvent, diesel, kerosene, and heavy naphthas.

Comments : Contaminant must be volatile or semi-volatile for this technology to perform correctly. Contaminants which complex with the soil matrix are not effectively remediated using this technology. Highly permeable aquifers require a significant pumping rate to lower the water table sufficiently. After initial installation of the system (wells, manifold and treatment system), system operation, monitoring and maintenance is routine. Some care needs to be taken in system optimization to ensure that the system is being used to its greatest potential. The most difficult part of this technology is the proper selection of well screening intervals. If the Dual Extraction well is not properly screened, then air will enter the well from regions of the soil which do not contain the contaminant or regions which do contain the contaminant will be completely bypassed by the airflow. The goal is to make the most use of the vapor extraction in the area which has been dewatered.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Solidification/Stabilization (In Situ)*

Technology Name : Deep Soil Mixing (COLMIX)

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : This technology makes stabilized, in-situ, columns consisting of a binder and recompacted soil. The columns are made by means of sets of 2, 3 or 4 short augers, with opposite pitches, inserted in the soil by rotation with hollow drilling rods. Binder is injected through the rods and mixed in place by the augers. There is no removal of soil. It performs well in soils not too compact and not too cohesive.

Company Name/POC: Bachy Enterprise/M. Gandals

Address : Les Colonnades - 4 rue H. Sainte-Claire Deville/92563 Rueil Malmaison Cedex, France

Phone Number : 33 1 47 14 26 00

Fax Number : 33 1 47 14 26 2

Technology Maturity : Commercial use experience

Performance History : To date, 12 jobs performed. The smallest with 225 meters of column made, the largest with 40,000 meters of column. Average: 7,500 m/job. Jobs located in France and Italy mainly. One located in U.K. for stabilizing acid and wastes. Mainly 3 clients: National Railroad Administration, National Highway Administration and National Road and Bridges Administration. All jobs technically successful.

Comments : Main limitation is: stiffness of ground; presence of blocks and big cobbles. Method well applicable when: SPT<20 for granular soils; SPT<8 for cohesive soils. In normal operating conditions, there is no residual material.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Solidification/Stabilization (In Situ)***Technology Name :** Treatment Agents for In-Situ Infiltration

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : This technology uses modified natural clays (MNCs) to immobilize target contaminants such as heavy metals, radionuclides, and organics. The MNCs can be directly mixed into the material containing the contaminants or can be molded or injected to form in-situ barriers, preventing contaminant migration. MNCs drastically reduce contaminant migration by restricting hydraulic conductivity through a barrier constructed of MNCs and by providing reactive surfaces for contaminant adsorption and immobilization. MNCs, especially combined with binding agents, will impede the flow of contaminated-laden soil moisture and groundwater.

Company Name/POC: Fluid Tech, Inc./Dean Rowsell**Address :** 4335 West Tropicana Avenue/Suite 3/Las Vegas, NV 89103**Phone Number :** 702 871 1884**Fax Number :** 702 871-3629**Technology Maturity :** Bench scale testing, only**Performance History :** In-situ immobilization currently under R&D.

Comments : Treatability testing is required to formulate reagent for waste streams of peculiar characteristics (high salt concentrations, high level of chelating or complexing agents). Acidic, basic, reductive, and oxidative waste streams may require pretreatment. Slurried clay is easy to work with, requires less infrastructure than grout, and can be applied in many environments and remains stable (clays form in soils). The greatest challenge to this technology is bringing an awareness of the use of the technology to potential users. Matching MNC to the need in very complex environments requires bench testing. Finally, finding reliable data is difficult for comparison of critical factors such as volume expansion, thermodynamic stability in soils, susceptibility to freeze/thaw cycle stresses, stability to heat or radioactive decay, and energy usage, product cost, and final waste form disposal charges.

Source of Information : TechCon

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Solidification/Stabilization (In Situ)*

Technology Name: In-situ soil mixing using MecTool

Application: In-situ (vadose zone)
 In-situ (saturated zone)

Brief Description: MecTool provides unprecedented effectiveness in the delivery of in-situ remedial agents. The MecTool system's vigorous rotary mixing of the soil with the appropriate high-pressure injection of the remediation agent across the complete diameter of the soil column improves treatment effectiveness by creating a highly homogenous soil/treatment reagent mixture. An integral shroud can be used over the zone of influence to contain and capture volatilized contaminants for further treatment.

MecTool technology can replace ex-situ remediation strategies. MecTool's ability to reach depths >100 feet and diameters up to 18 feet make this technology better and faster, thus more cost efficient. MecTool's shroud's ability to handle off-gases from the drill site makes this technology safer.

Company Name/POC: Millgard Environmental Corporation/Roger Kapter

Address: 12822 Stark Road/Livonia MI 48151

Phone Number: 313 261-9760

Fax Number: 313-425 -062

Technology Maturity: Commercial use experience

Performance History: Contact Millgard Environmental Corporation for performance data.

Comments: Height limitations <110 feet. Minimum ground PSI of 25 PSI (with mats).

Grout cannot be pumped in temperatures consistently <40 degrees Fahrenheit due to freezing conditions.

Millgard Environmental Corporation was organized separately from The Millgard Corporation in 1989 as a remediation contractor using state-of-the-art techniques and equipment to provide complete remedial services to private industry and public works. The Millgard Corporation has more than 30 years experience in the most challenging excavation and subsurface drilling/foundation caisson projects from around the world.

Source of Information: TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Solidification/Stabilization (In Situ)***Technology Name :** In-Situ Fixation**Application :** In-situ (vadose zone)**Brief Description :** This technology uses a large boring rig, dozer or loader (with tiller for surface applications) to mix soil with fixing and/or stabilization agents in place.**Company Name/POC:** Radian Corporation/Joe Milanowski**Address :** 10150 West National Ave./Milwaukee, Wisconsin 53227**Phone Number :** 414 327-9955**Fax Number :** 414 327-2129**Technology Maturity :** Field demo complete**Performance History :** Contact Radian Corporation for performance data.**Comments :** Limitations include: subsurface obstructions; depths over 150 feet.**Source of Information :** TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Solidification/Stabilization (In Situ)*

Technology Name : Soil-Cement Mixing (SCM)

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : SCM is an in-situ solidification/stabilization system for contaminated soil by using multi-hollow-stem auger shafts. Reagent slurry is injected through auger bits. This high-shear mixing system creates a complete homogeneous soil-reagent mixture. The system can be applied to any type of soil (especially strong in clayey soil) and to any depth.

Company Name/POC: SCC Technology, Inc./Osamu Taki

Address : P.O. Box 1297/Belmont, CA 94002

Phone Number : 415 592-3435

Fax Number :

Technology Maturity : Pilot plant testing

Performance History : Contact company for performance history. Have just began marketing in the hazardous waste remediation business using U.S.-patented soil-cement mixing systems. Have ten years working experience in geotechnical construction projects. Pilot Plant testing started in February 1993.

Comments : Company has ten years experience with its original soil mixing system in Japan. For purposes of quality control, pilot testing is advisable at each site and each area. SCM does not have working experience in hazardous remediation, but SCM systems and experience in soil mixing is the only one that is accepted for a building foundation by the assured quality of the soil-cement mixture.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Solidification/Stabilization (In Situ)*

Technology Name : Stabilization/Solidification

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : STC Omega specializes in the development and application of technologies for the treatment of organic and inorganic contaminated soils, sludges and wastewaters. STC Omega's chemical fixation and solidification technologies have been utilized successfully to treat over 500,000 cubic yards of contaminated soils and sludges on >30 full-scale hazardous waste remediation projects across the U.S. and in Italy. STC Omega's technologies have been applied to industrial in-process treatment, hazardous waste site remediation projects, RCRA Landban treatment in a Part B permitted hazardous waste landfill facility, and organic and inorganic industrial wastewater treatment systems. Technology allows treatment to be performed in-situ. Full-scale treatment performance can be determined effectively on a laboratory- and pilot-scale basis before full scale.

Company Name/POC: STC Omega, Inc./Greg Maupin

Address : 7650 E. Redfield Road/Suite D5/Scottsdale, Arizona 85260

Phone Number : 602 948-7100

Fax Number : 602 991-3173

Technology Maturity : Commercial use experience

Performance History : Performance Data are Available.

Comments : This technology is quite versatile. It has been used inside buildings, in rural areas with minimal access to power, and normal construction sites. Soil matrix such as stiff clay can reduce the treatment rate production. STC Omega has been successful in treating all types of soil matrices. STC Omega treatment can be provided with standard rental construction equipment. Main attribute after treatment is significantly reducing the leachability and mobilization of contaminants. This reduction can be determined with such tests as the EPA TCLP and American Nuclear Society ANS 16-1.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *In Situ Vitrification***Technology Name :** In Situ Vitrification**Application :** In-situ (vadose zone)**Brief Description :**

In-situ vitrification involves electric melting of staged or in situ earthen materials (e.g., soil, sediment, mill tailings and sludges) to destroy organic contaminants and permanently immobilize heavy metals (including metallic radionuclides) in a glass and crystalline residual product. Organic destruction occurs due to thermal decomposition (pyrolysis) upon contaminant exposure to melt-temperatures, typically in the 1,600 degrees celsius to 2,000 degrees celsius range. Heavy/radioactive metal immobilization occurs due to strong chemical bonds in a high-silica glass and crystalline matrix of natural or designed chemistry. Significant volume reduction occurs (25 to 45 percent for typical soils). The ISV process possesses many advantages, compared to alternative technologies. ISV has been tested/demonstrated on a broad range of earthen materials contaminated with organic and heavy/radioactive metals. Organics of note include PCBs, dioxin, multiple pesticides, multiple explosives, PCP, and many other volatile, semivolatile and nonvolatile organics. All EPA priority pollutant heavy metals have been involved in testing. Numerous radionuclides have also been tested, including Pu, U, Am, Sr, Cs, Th, Ra, Rn and others.

Company Name/POC: Geosafe Corporation/James E. Hansen**Address :** 2950 George Washington Way/Richland, Washington 99352**Phone Number :** 509 375-0710**Fax Number :** 509 375-772**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.

The ISV process has been tested/demonstrated over 180 times at various scales. It is currently being applied at large-scale on a commercial basis. Numerous other large-scale remediation and demonstration projects are currently in Geosafe's backlog (client intention basis-not necessarily already contracted). The backlog includes projects in the U.S., Australia, and Japan. The backlog contains an estimated 40,000 tons of contaminated soil.

Comments :

Groundwater control may be necessary to limit recharge if processing below the water table. Contaminated matrix material must have adequate geochemistry to enable formation of a conductive melt and have sufficient glass formers to provide the desired residual vitrified product. Some modification through additives may be possible to make an unusual matrix amenable to ISV processing. ISV is not considered adequately evaluated for commercial application on ordnance, pressurized containers or sealed containers containing liquids. Existing equipment is limited to a total organic content of 10 wt percent in the matrix being treated; this limit can be increased through change of equipment. Metal debris content in the matrix is currently limited to 23 wt percent. The process cannot be used in areas where thermal effects may be damaging to underground items (e.g. pipes, cables, structures). The ISV technology is proprietary and available only from a sole source (Geosafe Corporation). ISV on-site remediation services, including full operating crew and related management, are available. For more information contact the vendor.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Composting***Technology Name :** Bioremediation**Application :** On-site Ex-situ

Brief Description : The initial steps of this technology consist of excavating contaminated soil/sediment or collection of contaminated waters for treatment. The contaminated material is then mixed with composting materials as a mixture formulated to yield the desired carbon to nitrogen ratio to result in optimal composting conditions. Air is circulated through the compost via perforated pipe in the compost bed. Temperature is controlled by the rate of air flow through the compost and pH is monitored regularly to ensure optimal composting conditions. Moisture is added as required to maintain a nominal 60% moisture in the compost and mixing is carried out on a weekly basis. Composting of energetic materials (explosives and propellants) is completed within a 4- to 6-week time period.

Company Name/POC: Arctech, Inc./Dr. Daman Walia**Address :** 14100 Park Meadow Drive/Chantilly, Virginia 22021**Phone Number :** 703 222-0280**Fax Number :** 703 222-0299**Technology Maturity :** Commercial use experience**Performance History :** Arctech has recently demonstrated its composting technology on radioactive energetics (explosives and propellants).

Comments : This technology is not applicable to volatile organics, solvents or inorganic metal contaminants due to the release of volatiles as a result of the heat generated during composting and/or due to the activity of the microorganisms in creating volatile organics, for example methyl mercury.

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Composting*

Technology Name : Terra Ferm

Application : On-site ☒ Ex-situ ☒
Off-site ☒

Brief Description : Biodegradation of contaminated soil hydrocarbons, PAH's, PCB's, chlorinated hydrocarbons. Composting technology with enhanced native organisms; product (clean soil) sold as potting soil in Germany.

Company Name/POC: Umweltschutz Nord GmbH/Dr. Kurt Lissner

Address : Industrie Park 6, 27767 Ganderkesee/ Germany

Phone Number : 49 4222 47 106 **Fax Number :** 49 4222 47 142

Technology Maturity : Commercial use experience

Performance History : Numerous sites remediated in Germany. Some problems with PCBS. Contact in US: Bioremediation Service; P O Box 2010 Lake Oswego, OR 97035; 800-775-9464 or 503-626-9464.

Comments : Company provides all equipment, analysis, and service. Can be used in U.S. through subsidiaries in Texas and Oregon or through J.A. Jones Construction. Company uses a high-tech composting approach with extensive pre- and post-treatment monitoring. Takes ownership of contaminated soil. On-site or remote treatment.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Solid Phase Biological Treatment*

Technology Name : Bioremediation

Application : Off-site Ex-situ

Brief Description : At the Alvarez facility, the soils are pulverized and run off a conveyor belt on to a 150,000 sq. ft. pad on top of an impermeable liner. The soil is inoculated with nutrients, aerobic bacteria, and a biocatalyst that is manufactured by the Alvarez Brothers to stimulate biodegradation of the contaminants. Water is also added to the soil to enhance degradation. The leachate is collected in a containment pit. The water is treated, recycled into mixing tanks, and reinoculated to be added back to the soil. Once the soils have been remediated to a TPH level of <10 ppm and BTEX level of <0.5 ppm, the soils are disposed of on-site.

Company Name/POC: Alvarez Brothers, Inc./Bob Alvarez

Address : 2004 S. Laurent/P.O. Box 2975/Victoria, Texas 77901

Phone Number : 512 576-0404

Fax Number : 512 576-2163

Technology Maturity : Commercial use experience

Performance History : As of October 1993, 47 projects have been undertaken. Of those, 46 projects have been successfully completed. High TPH levels of 44,000 ppm and high BTEX levels of 4,000 ppm have been successfully brought to non-detection limits. The Alvarez process now is averaging 21 days. The total volume of the completed projects constitute approximately 10,000 cubic yards.

Comments : The technology can only bioremediate TPH contaminated soils. Some metals are toxic to microbes and inhibit the bioremediation process. Analytical tests of the soils should be submitted for review. Soil types are not a problem. Current equipment and technology can handle muds and slurries. This technology is now mobile, and a consulting service is now available (\$1,000.00/day plus expenses).

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Solid Phase Biological Treatment*

Technology Name : Bioaugmentation - Solid Phase

Application : ☒ On-site ☐ Ex-situ

Brief Description : BioGEE's HC is composed of specifically selected and adopted bacteria, and is formulated to effectively digest a wide variety of long and short chain hydrocarbons. The key treatment steps include: implement an aeration system or oxygen supplements; apply nutrients and BioGEE HC, and control the temperature and moisture level. BioGEE HC is a liquid concentrate as opposed to other bioremediation products which come freeze dried or in powder form. The advantages of this are in its ease in transporting, its ease in on-site mixing (1 pt HC per 55 gallons of water). Competing powder formulations need to be rehydrated before application.

Company Name/POC: BIOGEE International, Inc./Trey Barber

Address : 16300 Katy Freeway/Suite 100/Houston, Texas 77094-1609

Phone Number : 713 578-3111

Fax Number : 713 578-111

Technology Maturity : Commercial use experience

Performance History : The accomplishments in Alaska with the EPA using bioremediation on part of the Exxon Valdez spill provided new insights and knowledge on bioremediation. Since that time, countless laboratory tests and field applications have shown conclusively that bioremediation is effective, safe, and poses no adverse environmental consequences.

Comments : The key conditions that can limit rapid microbial growth, and thus limit bioremediation, are: lack of nutrients and oxygen supply, the presence of substances toxic to microbes, pH levels greater than 12 and less than 5, and insufficient moisture. Soil temperatures below 50 degrees Fahrenheit will cause a drastic reduction in microbial activity.

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Solid Phase Biological Treatment*

Technology Name : Bioremediation Technology Services (BTS)

Application : On-site Ex-situ

Brief Description : Employs proven and patented technology in the application of the product (BTS) which reduces or destroys hydrocarbons and chlorinated compounds found in contaminated soils. When placed in contact with aliphatic or aromatic hydrocarbons the contained bacteria (in BTS) will use the hydrocarbon for food, and in a few weeks will have destroyed the contaminant converting it into CO₂ and water. The same process reduces chlorinated hydrocarbons to levels approved by the EPA.

Company Name/POC: Bioremediation Technology Services/Paul Richey

Address : P.O. Box 3246/Sonora, CA 95370

Phone Number : 209 984-4963

Fax Number : 209 984-3226

Technology Maturity : Commercial use experience

Performance History : Underground storage tanks - Agricultural Pesticide Operations - Railroad yards - Municipalities and Utility Companies - Airports and Military Bases - Steel Mills - Refinery tank farms

Comments : Product and process degrades hydrocarbons, chlorinated hydrocarbon, and some heavy metals. Process does not address radiation problems as yet. BTS product is NOT genetically engineered and is non-toxic to plants and animals. Physical area required must be sufficient to excavate contaminated soils and intermix with BTS product in windows 4 feet high. Additional mixing or aeration NOT required during remediation process. Air quality permitting NOT required. Small amounts of water may be required to maintain proper moisture content.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Solid Phase Biological Treatment**Technology Name :** Bioremediation**Application :**

On-site

Ex-situ

Brief Description :

Solid-phase treatment is a proven and cost effective means for the aerobic bioremediation of many petroleum hydrocarbon contaminated soils. The contaminated soil is excavated and placed in segregated treatment cells lined with impermeable pads. The soil is amended with nutrients and mechanically aerated by regular tilling to promote the growth of the indigenous microorganisms capable of degrading the target compounds. Alternatively, nutrients and oxygen can be delivered via perforated tubing introduced into the treatment cell. The leachate is collected and recirculated to accelerate the process. Additionally, composting techniques can be utilized for the remediation of highly contaminated soils.

Company Name/POC: COGNIS, Inc./Ron Wilson**Address :** 2331 Circadian Way/Santa Rosa, California 95407**Phone Number :** 707 575-7155**Fax Number :** 707 575-783**Technology Maturity :** Commercial use experience

Performance History : COGNIS has successfully demonstrated the aerobic and anaerobic bioremediation of a wide range of organic contaminants including: petroleum hydrocarbons; fats, oils, and grease; chlorinated aliphatics and aromatics; chlorinated pesticides.

Comments :

While bioremediation is frequently less expensive than other treatment technologies, it often takes a longer period of time to achieve final clean-up levels. If the indigenous microbial population is sensitive to high concentrations of organic contaminants, the remedial design may require either dilution of contaminated soils or augmentation with pre-adapted microbial cultures. Generally, the optimal ambient temperatures for effective bioremediation are between 20 - 37 degrees Celsius.

Source of Information : VISITT 3.0

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Solid Phase Biological Treatment*

Technology Name : Biocatalytic Contaminant Degradation (BCD)

Application : On-site Ex-situ

Brief Description : ECO-TEC, Inc. (ETI), utilizes "Enviromech Gold", (EMG), a proprietary biocatalyst to dramatically accelerate the biodegradation of petroleum hydrocarbons and other biodegradable contaminants. The biocatalytic contaminant degradation (BCD) process can be applied to soil or groundwater, ex situ or in situ. A pH-balanced microbial inoculum (BMI) consisting of water, EMG, indigenous microbes, contaminant specific microbes (if needed) and all trace minerals and nutrients required for microbial proliferation is created.

Company Name/POC: ECO-TEC, Inc./Ecology Technology, Inc./Herbert R. Pearse

Address : P.O. Box 1113/Issaquah, Washington 98027-1113

Phone Number : 206 392-0304

Fax Number : 206 392-0575

Technology Maturity : Commercial use experience

Performance History : The Biocatalytic contaminant degradation, (BCD), technology has been successfully demonstrated many times on full-scale remediation projects in Washington State.

Comments: Generally, BCD technology can be applied to various sites and media, and can be implemented utilizing equipment that is readily available. Since many variable parameters exist between sites, no one BMI or application technology is best suited to all situations. The BCD process will be modified to meet site-specific criteria. The Biocatalytic contaminant degradation, (BCD), process is not the one cure for all remediation problems, although it can be utilized in conjunction with other remediation technologies. The BCD process is limited by the availability of oxygen, range of temperature and the availability of moisture. All of these limiting factors can be controlled in modern site remediation operations.

Source of Information : VISITT 3.0

CONTAMINANTS :

- ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Solid Phase Biological Treatment***Technology Name :** FyreZyme**Application :**

On-site

Ex-situ

Brief Description :

FyreZyme is a liquid (aqueous) agent, combining a rich source of bacterial growth enhancing agents, extracellular enzymes, and bioemulsifiers. FyreZyme is used on site and is applied to 18-24 inch deep (for proper oxygenation) bermed soil weekly. Between applications the soil moisture level is maintained at 80 percent of field holding capacity or approximately 15-20 percent moisture, depending on soil type. Three to five weekly applications of FyreZyme diluted in water is average for total petroleum hydrocarbons (TPH) concentrations up to 60,000 ppm.

Company Name/POC: Ecology Technologies International, Inc./Mr. Pete Condy**Address :** 1225 So. 48th Street/Suite 2/Tempe, Arizona 85281**Phone Number :** 602 985-5524**Fax Number :** 602 985-298**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.

Used successfully in Florida lake water bench test to bring nitrates and phosphorous to limits of regulation in 48 hours (0.2 percent concentration of FyreZyme and lake water). FyreZyme has been used successfully in the field to clean soil contaminated with motor oil and diesel fuel (closed service station site). In a fuel-storage area, polynuclear aromatic hydrocarbons were brought to non-detectable concentrations and total petroleum hydrocarbons (TPH) levels were lowered from 60,000 ppm to 490 ppm with three FyreZyme applications. Application is continuing for final TPH reduction. Data are available for other applications on a total of over 190,000 cubic yards treated to closure at an average treatment time of 4 weeks.

Comments :

Main limitations are those which affect bacterial growth, such as temperature extremes, pH below 3 or above 10, and bacterial contaminants in high concentrations. If temperature is above 100 degrees Fahrenheit, the shelf life of FyreZyme may be shortened from 5 years to 2 years. Enzyme poison must be flooded with FyreZyme before bioremediation will ensue. Soil piles can be constructed to conserve space, with the largest to date 300 feet by 75 feet by 6 feet, with perforated PVC piping to distribute oxygen, water and FyreZyme to the pile.

Source of Information : VISITT 3.0

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Solid Phase Biological Treatment*

Technology Name : Bioremediation

Application : On-site Ex-situ

Brief Description : ENSR Consulting and Engineering has designed, permitted, operated and closed several ex-situ full-scale biotreatment facilities. The treatment system is constructed on a clay or a high density polyethylene (HDPE) liner, designed to prevent seepage of hydrocarbons or other contaminants present into the native soil, and is surrounded by a berm. In some cases, native topsoil can act as an impermeable barrier to contaminant migration. During construction of the treatment cell the soil is thoroughly mixed and nutrients or bulking agents are added as appropriate.

Company Name/POC: ENSR Consulting and Engineering/Ralph Baker, Ph.D. CPSS

Address : 35 Nagog Park/Acton, Massachusetts 01720

Phone Number : 508 635-9500

Fax Number : 508 635-9180

Technology Maturity : Commercial use experience

Performance History : For larger projects, it may be necessary to demonstrate the process at the site on a pilot-scale bases prior to final design and implementation. ENSR provides all services required for pilot demonstrations and full-scale design and operation.

Comments : Use of a vacuum source to draw the air through the treatment system facilitates control and treatment of volatile compounds in the off-gas if required. The leachate from the treatment system is recovered and recycled through an irrigation system, thus eliminating the need for disposal of the potentially contaminated water. This bioremediation treatment system can be used for treatment of heavier than diesel fuel type hydrocarbons. However, due to the limited solubility of these hydrocarbons in water, the treatment of these hydrocarbons may be extremely slow.

Source of Information : VISITT 3.0

CONTAMINANTS:

- ☒ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE: *Solid Phase Biological Treatment***Technology Name:** Murr System for Remediation of Contaminated Soils**Application:**

On-site Ex-situ
Off-site

Brief Description: This technology is a flexible mobile container reactor based system for cleaning up contaminated soil. The system can be adapted for use in a variety of modes dependent upon the nature of the contaminant and the environmental setting, this includes bioremediation, stripping for volatile compounds, acid washing for heavy metals.

Company Name/POC: Entec Europe/Dr. I. J. Fletcher**Address:** 160-162, Abbey Foregate/Shrewsbury/Shropshire, U.K. SY26AL**Phone Number:** 01743 236464**Fax Number:** 1743 23630**Technology Maturity:** Commercial use experience

Performance History: Over 100 references from the system with additional references being developed in Germany in the rest of Europe. The technology is primarily used for bioremediation but recently it has been extended to include air stripping and metals removal. Reference clients: Shell, Wackprchemie, Fina, Edelhof, Volkswagon, Municipalities

Comments: Clay soils need to be broken up. Recalcitrant organics which are not biodegradable are not appropriate for treatment with the system. Grease problematic.

Source of Information: International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Solid Phase Biological Treatment*

Technology Name : Bioremediation

Application :

On-site	Ex-situ
Off-site	

Brief Description : The bioremediation technology employed at the facility is best characterized as enhanced soil-pile bioremediation. The process employs microorganisms indigenous to the contaminated soils which are metabolically enhanced through optimization of environmental conditions and a supply of nutrients and oxygen. The hydrocarbon contaminants are used as a primary carbon substrate and are broken down to carbon dioxide and water products in a short amount of time. The key elements in the operations are pre-treatment of the contaminated soils using a shredding/additive application system followed by incubation of the contaminated soils in treatment cells.

Company Name/POC: Environmental Tech. of N. America, Inc./Michael J. Lamore, P.E.

Address : 311-J S. Westgate Drive/Greensboro, North Carolina 27407

Phone Number : 910 299-9998

Fax Number : 910 299-0655

Technology Maturity : Commercial use experience

Performance History : ETI's bioremediation process has been used to successfully treat over 12,000 cubic yards of petroleum contaminated soil since February of 1993. Projects have been completed for both governmental and commercial clients.

Comments : Biodegradation of hydrocarbon contaminants to acceptable levels is usually achieved within an eight-week incubation period. The rate of biodegradation varies depending on factors such as initial contaminant levels, air temperature, and type of hydrocarbon contaminant. The bioremediation facility operated by ETI is permitted to accept and treat only soils contaminated by virgin petroleum hydrocarbons generated from leaking underground storage tank sites. It is not permitted for used petroleum products containing metals, such as waste oils.

Source of Information : VISITT 3.0

CONTAMINANTS:

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Solid Phase Biological Treatment***Technology Name:** CNP-Plus Bioremediation**Application:**

On-site

Ex-situ

Brief Description:

The CNP-Plus is a speciality belended biological activator that stimulates indigenous microbial growth when applied to soils containing organic contaminants. The stimulating characteristics of CNP-Plus causes extensive proliferation in the indigenous microbial population to the point where the organic contaminants become their basic food source and biodegradation takes place.

Company Name/POC: Etus, Inc./Mark Wemhoff**Address:** 1511 Kastner Place/Sanford, Florida 32771**Phone Number:** 407 321-7910**Fax Number:** 407 321-309**Technology Maturity:** Commercial use experience

Performance History: Full-scale process installations have been used to reduce organic hydrocarbon contaminant loadings in soils to within the established parameters of the State and local regulatory agencies. Pilot-scale demonstrations have been performed at sites to treat soils and sludges contaminated with diesel fuels, TPHs, and PCBs.

Comments:

The treatment process may be applied both in situ or ex situ, while the ex situ process is greatly accelerated by the optimization of all the factors relevant to microbial proliferation. The main limiting factor of the process is sustained ambient air temperature below 50 degrees Fahrenheit but this can be overcome with the use of mechanical devices. The use of the enhanced bioremediation technology for organic hydrocarbon contaminants will achieve up to 90 percent reduction in concentration levels within 60 to 180 days.

Source of Information: VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Solid Phase Biological Treatment*

Technology Name : Daramond

Application : Ex-situ

Brief Description : The Daramond solid phase bioremediation consists of four components: Excavation of the soil or sediment; treatment of the excavated material on a lined treatment bed; addition of solid phase organic soil amendments of specific particle size distribution and nutrient content; and distribution of the soil amendments through the target matrix and the homogenization and aeration of the target matrix using specialized tilling equipment.

Company Name/POC: Grace Dearborn, Inc./I.J. Marvan

Address : 3451 Erindale Station Road/P.O. Box 3060/Station A/Mississauga, Ontario L5A 3T5

Phone Number : 905 279-2222

Fax Number : 905 279-0020

Technology Maturity : Commercial use experience

Performance History : In pilot- and full-scale demonstrations, Daramond has been used to remediate soils contaminated with up to 2,000 mg/kg of PCP and 18,000 mg/kg PAH. Competing bioremediation processes are often unable to reduce PCP and PAH concentrations to designated cleanup guidelines. Following treatment with Daramond, residual concentrations of PCP and even the most recalcitrant PAHs (e.g. fluoranthene, pyrene, benzo(a)pyrene and benzo(b)fluoranthene) can be degraded to below industrial remediation criteria.

Comments : The Daramond process cannot be used to remediate soils containing metals and/or PCBs.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Solid Phase Biological Treatment***Technology Name :** Bioaugmented Soil Vapor Extraction (BSVE)**Application :** In-situ (vadose zone) Ex-situ

Brief Description : Bioaugmented soil vapor extraction (BSVE) is the removal of volatile organic compounds from unsaturated soils by aeration forces and nutrient augmentation. The technology results in the physical removal of VOCs through enhanced volatilization and in the biodegradation of organic compounds through the acceleration of indigenous microbial processes. The key to the process is the effective contact of contaminated soil with an induced air stream. The partitioning of the process between physical removal and biodegradation is a function of the rate of aeration and the relative biodegradability of the material being used. Combining physical removal with biodegradation accelerates remediation and allows for the achievement of lower closure levels. The system can be applied both in situ and ex situ. Bioaugmented soil vapor extraction extends the range of contaminants that can be effectively treated through vapor extraction. It has been demonstrated effective in treating chlorinated hydrocarbons. BSVE is effective in treating chlorinated organics and is faster than conventional technologies because it combines two remedial technologies: volatilization and biodegradation.

Company Name/POC: Groundwater Technology, Inc./Richard Brown**Address :** 310 Horizon Center Dr./Trenton, NJ 08691**Phone Number :** 609 587-0300 **Fax Number :** 609 587-790**Technology Maturity :** Commercial use experience

Performance History : BSVE has been successfully applied on a commercial scale to treat petroleum hydrocarbons, (e.g. gasoline and diesel), organic chemicals (e.g., chlorobenzene) and numerous chlorinated solvents ex situ. BSVE has been used to treat sites ranging in size from <1 acre to >50 acres. Harry Mosley, Public Service of Colorado, Denver CO. 303 294-2815.

Comments : Ex-situ system consists of an aeration bed-gravel layer with aeration pipe that is placed in a soil pile. The pile is constructed around vacuum piping which is on 3-ft centers and connected to a vacuum pump. Nutrient infiltration is accomplished through an infiltration pipe. In-situ system consists of air nutrient injection wells and separate vapor extraction wells. The two limitations to the technology are the ability to aerate the soil/solid matrix and the properties of the contaminant. If the permeability is too low, or if the contaminant is both nondegradable and nonvolatile, BSVE will not be effective. Systems are relatively easy to design and implement. Bench-scale studies, which consist of loading columns with soil, adding nutrients and measuring rates of removal due to volatilization or biodegradation during aeration, are required. Air permeability must be measured in the field for in-situ systems; air permeability for ex-situ systems can be measured by pressure drop and flow-through columns.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Solid Phase Biological Treatment*

Technology Name : Biofast

Application : On-site Ex-situ

Brief Description : The most typical application is related to leaking underground storage tanks where excavated soil must be treated. The BIOFAST system is installed in the pit generated during tank removal; a liner is placed in the pit to prevent further contaminant migration. Excavated soil is treated with nutrients, lime and moisture as recommended by a simple bench-scale assessment. Layers of soil and air exchange conduits are placed in the lined pit until the pit is refilled. The pit is then typically covered with an asphalt cap.

Company Name/POC: IT Corporation/Duane Graves

Address : 312 Directors Drive/Knoxville, Tennessee 37923

Phone Number : 615 690-3211

Fax Number : 615 690-3626

Technology Maturity : Commercial use experience

Performance History : The BIOFAST system has been successfully deployed at full scale. Full-scale systems have been employed to treat gasoline and diesel impacted soil at service stations and at a trucking terminal.

Comments : The BIOFAST system provides an unobtrusive soil treatment alternative which is well suited for the treatment of contaminated soils associated with underground storage tanks and other remedial activities which involve the excavation of contaminated soil. The system is space efficient and generally does not interfere with site operations. The system has the capability to treat a variety of soil types and will accommodate almost any volume of soil. A subsurface BIOFAST system will support heavy ground traffic if properly compacted.

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Solid Phase Biological Treatment*

Technology Name : Solid Phase - Bioremediation

Application :

Ex-situ

Brief Description : Solid phase bioremediation involves the cleaning of soil contaminated with petroleum hydrocarbons and some low-level PAHs. The contaminated soil is processed through a specially designed machine which shreds the soil, adds a compost material, nutrients, and water. The finished product is a fluffy, well blended mixture of soil and organic substrate that has achieved the proper moisture level (70 percent field capacity) and inorganic nutrient level for optimum bioremediation.

Company Name/POC: SBP Technologies, Inc./Dr. James Mueller, Ph.D.

Address : One Sabine Island Drive/Gulf Breeze, Florida 32561

Phone Number : 904 934-9282

Fax Number : 904 934-920

Technology Maturity : Commercial use experience

Performance History : Contact company for performance data.

Comments : The technique is most effective with petroleum hydrocarbons and low molecular weight PAHs. This technology is not effective for inorganic contaminants, (i.e. heavy metals). Based on site specific cases, may need control of volatile emissions during excavation and treatment.

Source of Information : VISITT 3.0

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : Soil Slurry - Sequencing Batch Reactor

Application : Ex-situ

Brief Description : Functionally, the soil slurry-sequencing batch reactor (SS-SBR) system is simply a set of tanks operated on a fill-and-draw basis. Each tank is filled during a discrete period of time and operated as a batch reactor. Reaction times are on the order of days. Indigenous microorganisms associated with the subject soil are used to initially seed the reactor. During normal operation, 5 percent to over 95 percent of the treated slurry can remain in the reactor after draw as an acclimated seed material for the next cycle. Nutrients may be added as necessary.

Company Name/POC: Bio Solutions, Inc./George J. Kehrberger, Ph.D., P.E.

Address : P.O. Box 207/Riverdale, New Jersey 07457

Phone Number : 201 616-1158

Fax Number : 201 616-1930

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

The first full-scale application of Sequencing Batch Reactors (SBRs) was a demonstration study sponsored by the US EPA in 1979 at a wastewater treatment plant in Culver, Indiana. After two years of successful scale operation, the EPA described the SBR as an innovative and alternative (I/A) technology. The Soil Slurry-Sequencing Batch Reactor (SS-SBR) is an extension of SBR technology for treatment of contaminated soils in slurry phase.

Comments : Soil slurry-sequencing batch reactor (SS-SBR) systems are not applicable for treatment of inorganics and non-biodegradable compounds. Particle size is critical and a pre-screening process is necessary. The percent solids in the slurries must be maintained between 20 and 50 percent. Finally, dewatering of the slurry is typically required after biological treatment.

Source of Information : VISITT 3.0

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : Bionergies, Biosmose, Biosurf

Application : In-situ (vadose zone) Off-site Ex-situ
 In-situ (saturated zone)

Brief Description : Bioremediation of organic pollutions (in soils, water, effluents) by using: 1. exogenous specific bacterial consortium (non toxic, environment safe, European Federation of Biotechnology class I in order to control a full, complete and non selective biodegradation; 2. Biofixations (mineral natural support). 3. Biosurfactants (produced by selected bacteria) provide an effective, fast and secure alternative to common place bioremediation because Bionergies controls the biodegradation of the pollutant (and metabolites) by using specialized bacteria and feasibility tests (in labs, on the field).

Company Name/POC: Bionergies Laboratories, Biosurf/M. Jacques FAUDIN

Address : 59/100, rue des 4 termes/B.P. 1009/Z.I. des Paluds/13781 AUBAGNE Cedex, France

Phone Number : 33 42 84 30 07

Fax Number : 33 42 84 23 3

Technology Maturity : Commercial use experience

Performance History : Contact company for performance data.

Comments : Each case is analyzed in order to optimize the treatment and the on site materials and personnel. Bioenergies controls the bacterial action by using exogenous specific bacterial strains, biofixations and biosurfactants. None of the bacteria is genetically engineered. They are classified into class II (one) of the European Federation of Biotechnology, and produced under French and European Community regulations. The company is looking for join-ventures in U.S. in order to cover the environmental and industrial field.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : Bevrox Biotreatment Train Process

Application : On-site Ex-situ

Brief Description : Contaminated material is excavated, derocked, pulverized, and slurried with water containing elevated concentrations of acclimated, cultured bacteria. The slurry is then pumped into the biotreatment digester. Agitation and aeration maintain suspension of solids and dissolved oxygen levels. The aerobic biological degradation continues until the mandated treatment level is achieved. Monitoring of the digester parameters is done on site. After reaching treatment levels, the slurry is pumped to a dewatering system consisting of a hydrocyclone, vibrating filter belt, etc., as appropriate. The damp soil is conveyed to a stockpile. The water, containing the biomass, is recycled to an incubator to "pump up" the concentration of bacteria. The water is then returned to the slurrying system for reuse.

Company Name/POC: Bogart Environmental Services, Inc./Jim League

Address : 3586 N. Mt. Juliet Road/P.O. Box 717/Mt. Juliet, Tennessee 37122

Phone Number : 615 754-2847

Fax Number : 615 754-2843

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

The technology is operational, having been used on contaminated sites since 1984.

Comments : The main consideration is that the material must be excavated. The system is designed for low permeability materials, such as clays, that are not amenable to "in situ" applications. High levels of metals have not inhibited the bioremediation process. Even levels of 400 ppm arsenic have not been detrimental.

Source of Information : VISITT 3.0

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Slurry Phase Biological Treatment*

Technology Name: Slurry Phase Bioremediation

Application: On-site Ex-situ

Brief Description: Slurry-Phase Bioreactors - Bioslurry reactors combine excavated contaminated soils, sludges, or sediments with water and nutrients in above-ground agitated tanks to create a slurry. Mechanical agitation not only introduces oxygen but maximizes the availability of nutrients to the indigenous microorganisms capable of degrading the target compounds. Following treatment, the cleaned soils is separated from the slurry and is replaced on-site. Bioslurry reactors are particularly effective for a site where seasonal climatic changes are unfavorable for solid-phase treatment. Anaerobic slurry reactors can be utilized for the remediation of recalcitrant compounds such as chlorinated aliphatics and substituted aromatics.

Company Name/POC: COGNIS, Inc./Ron Wilson

Address: 2331 Circadian Way/Santa Rosa, California 95407

Phone Number: 707 575-7155

Fax Number: 707 575-783

Technology Maturity: Bench scale testing, only

Performance History: This remediation technology is being developed rapidly and was to have completed pilot plant testing by early 1993. Capability to remediate chlorinated organics within this system will be developed.

Comments: May be coupled with acid extraction to address soils contaminated with metals and organics. Metals which adversely affect bioremediation are removed before the bioreactor step.

Source of Information: VISITT 3.0

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : FyreZyme

Application : On-site Ex-situ

Brief Description : FreZyme is a liquid (aqueous) agent, combining a rich source of bacterial growth-enhancing agents, extracellular enzymes, and bioemulsifiers. Slurry-phase bioremediation adapts soil washing, utilizing FyreZyme as the washing agent and rapidly cleanses petroleum products. It washes soil rapidly and completes bioremediation in staging areas once washing is completed. The wash solution bioremediates in separate holding tanks in a matter of hours.

Company Name/POC: Ecology Technologies International, Inc./Mr. Pete Condy

Address : 1225 So. 48th Street/Suite 2/Tempe, Arizona 85281

Phone Number : 602 985-5524

Fax Number : 602 985-2988

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Comments : FreZyme has been used successfully in the field to cleanse soil contaminated with motor oil and diesel fuel (closed Mobil Oil service station site) and by Marathon Oil for leaking refinery tanks in above ground bermed areas. Polynuclear aromatic hydrocarbons were brought to non-detectable concentrations and TPH of 60,000 ppm to 490 ppm with three FyreZyme applications. Application is continuing for final TPH reduction. Data are available on various applications.

Its main limitations are those which limit bacterial growth, such as temperature extremes, pH below 3 or above 10, and bactericidal contaminants in high concentrations. If temperature is above 100 degrees Fahrenheit, the shelf life of FyreZyme may be shortened to 2 years from 5 years. Enzyme poison must be flooded with FyreZyme before bioremediation will ensue.

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : Biodegradation of VOCs

Application : On-site Ex-situ

Brief Description : Reactor system to biologically degrade trichloroethylene, vinyl chloride, dichloroethylene and related compounds in the vapor phase. The system has been proven to destroy >90 percent of the VOCs while maintaining biocatalytic life over extended periods.

Company Name/POC: Envirogen, Inc./William J. Guarini

Address : 4100 Quakerbridge Rd./Lawrenceville, New Jersey 08648

Phone Number : 609 936-9300

Fax Number : 609 936-922

Technology Maturity : Field demo complete

Performance History : Technology based on successful pilot results in DOE-OTD Argonne National Lab funded project. Currently being field tested at a commercial site in New York State.

Comments : Full-scale operating parameters to be determined. Simple operation, minimal operator attention.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : Biotechnical Processing of Explosives

Application : On-site Ex-situ

Brief Description : EODT Services, Inc., in association with Oak Ridge National Laboratory, has developed several amoeba-bacteria consortia and methods for altering and degrading organic and explosive wastes and contaminants. More practically, this invention relates to protozoan derived consortia comprised of protozoa and bacteria, methods for using protozoa/bacteria as consortia for altering or degrading wastes and production and use of biodispersants derived from protozoa/bacteria consortia. With some pretreatment, soils containing explosive wastes are fed to the slurry phase bioreactor where water and biodispersant are fed with bacteria-consortia.

Company Name/POC: EODT Services, Inc./Paul Greene, Monirul Haque

Address : 10511 Hardin Valley Road/Building C/Knoxville, Tennessee 37932

Phone Number : 423 690-6061

Fax Number : 423 690-6065

Technology Maturity : Commercial use experience

Performance History : The slurry phase bioremediation technology of EODT-S has finished its bench scale and pilot scale demonstration. It has now the capability of full scale remediation of hazardous contaminated soils, water, and explosives. As part of the full-scale capability, EODT-S has built its own mobile Biotechnical Processing Unit. The capacity of this unit is 203 tons of explosive contaminated soil per month. A demonstration of the technology was recently performed at Lone Star Army Ammunition Plant (LSAAP) contaminated soil at Texarkana, Texas, in November 1993.

Comments : There is no use of chemicals in this process. The biodispersant is passive and inert and naturally degradable. Effectiveness of the whole process depends on types of contaminants and their concentrations in soils and wastes. Before any field application of the process, some batch experiments are performed with the samples to establish field protocols.

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : Slurry Phase Bioremediation

Application : Ex-situ

Brief Description : Bioslurry reactor systems aerobically biodegrade aqueous slurries created through the mixing of soils or sludges with water. The most common mode of bioslurry treatment is batch; however, IT can operate several reactors in series to provide semicontinuous flow operation. Aeration is provided through floating, submerged aerators alone, or in conjunction with mechanical mixers. Nutrient addition and pH adjustment are accomplished through metered chemical addition to the reactor vessel. IT prefers to stimulate indigenous bacteria rather than add bacteria to the system. Following aeration, the treated slurry is dewatered via standard dewatering equipment, such as clarifiers or filtration.

Company Name/POC: IT Corporation/Kandi Brown

Address : 312 Directors Drive/Knoxville, Tennessee 37923

Phone Number : 615 690-3211

Fax Number : 615 690-362

Technology Maturity : Pilot plant testing

Performance History : The treatability studies for bioslurry treatment of a creosote-impacted soil included a batch slurry study and a bioslurry reactor study. The batch slurry study produced supporting data for the enhanced operation of the pilot-scale bioslurry reactor. Batch slurry testing was conducted in sealed, 1-L vessels at solids loadings of 30 and 40 percent. The batch study demonstrated total PAH percent removals ranging from 83 to 87 percent; CPAH removals ranged from 71 to 79 percent. Initial PAH concentration in the treatment vessels ranged from 1,100 to 1,600 mg/kg; CPAH concentrations ranged from 390 to 550 mg/kg. The CPAH concentration were reduced to 170 mg/kg at week 3. Following the batch study, a 3-month, pilot-scale bioslurry study was conducted. The 60-L, stainless-steel Eimco Biolift slurry reactor was operated in continuous-flow and batch mode. Following 4 weeks of treatment, PAH and CPAH concentrations averaged 320 and 180 mg/kg, respectively.

Comments : The process may require pretreatment of the waste matrix to produce general characteristics which are appropriate for bioslurry treatment. The contaminant must be transferred to the aqueous phase for biodegradation to take place. The contaminant removal efficiency for petroleum-impacted matrices is generally around 80 percent. Therefore, treated soils may require additional treatment depending on their ultimate disposal.

Source of Information : VISITT 3.0

CONTAMINANTS :

Pesticides/Herbicides

Heavy Metals

PCB

Explosives/Propellants

Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

■ **Nonhalogenated VOC**

☒ Halogenated VOC

■ N/A

TECHNOLOGY TYPE: *Slurry Phase Biological Treatment*

Technology Name : Biotechnology/Bioremediation

Application :	On-site	Ex-situ
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Brief Description : Biological decontamination of soil/wastewater using bioadapted micro-organisms. Microbes use hazardous organic substances as food sources thereby degrading them to nonhazardous end products like CO₂ and H₂O. Achieves a high level of decontamination in a short time; inexpensive.

Company Name/POC: KAM Biotechnology Ltd./Mongi Ferchichi

Address : 9710 187th St., #101/Surrey B.C. V4N 3N6

Phone Number : 604 888-4336

Fax Number : 604 888-6623

Technology Maturity : Commercial use experience

Performance History : Successfully completed decontamination of soils, wastewaters, sludges, transformer oils etc.

Comments : Bacteria cannot degrade all compounds and some are inhibitory to their growth. Equipment is easily transported. Minimal infrastructure required. Most bacterial additives are "not controlled" plus not "hazardous."

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : Biological Sulfate and Metal Removal

Application : On-site Ex-situ

Brief Description : Biologically reduce sulfate to sulfide. Remove metals as insoluble metal sulfide, remove excess sulfide as elemental sulfide. Metal removals >99.1%; Sulfate removals >90.1%.

Company Name/POC: Paques, Inc./Andre de Veg

Address : 486 Thomas Jones Way/Suite 100/Exton, PA 19341 USA

Phone Number : 610 363-9564

Fax Number : 610 363-955

Technology Maturity : Commercial use experience

Performance History : One full scale plant in operation at Zinc Production Facility in the Netherlands. Good operation since start-up in May 1992

Comments : Electron donor required for sulfate reducing bacteria (can be ethanol, hydrogen gas, organic wastes). Highly automated operation possible. Parent company is located in town of Balk, Netherlands.

Source of Information : International TechCon.

CONTAMINANTS :

☒ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : Slurry Phase Bioremediation

Application : Ex-situ

Brief Description : SBP Technologies, Inc., (SBP) has established a unique collection of patented microorganisms for use in bioremediation applications. Based on the nature of the impacted matrix and the site-specific cleanup goals, various bioremediation strategies have been developed for the practical application of these technologies. These strategies include: 1) fixed-film bioreactors for water treatment and 2) soil slurry bioreactors.

Company Name/POC: SBP Technologies, Inc./Dr. James Mueller, Ph.D.

Address : One Sabine Island Drive/Gulf Breeze, Florida 32561-3999

Phone Number : 904 934-9282

Fax Number : 904 934-9201

Technology Maturity : Pilot plant testing

Performance History : The SBP biotreatment strategy has been shown to: 1) effectively and extensively biodegrade (mineralize) high-molecular-weight PAHs, and 2) remove the toxicity and teratogenicity associated with effluent from the treatment train. This result was demonstrated at the American Creosote Works Superfund site, Pensacola, Florida, where system effluent was acceptable for direct discharge off site.

Comments : For soils, soil texture and structure can significantly influence treatment efficacy. All conventional limitations to biological processes apply (e.g., high metal concentrations, temperature, pH nutrient status, oxygen potential, bioavailability, etc.). However, treatment systems that integrate physical separation technologies (e.g., soil washing and filtration) can be designed to handle organic/inorganic waste streams.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : Biolift Reactor

Application : On-site Ex-situ

Brief Description : The reactor uses a rake/thickener mechanism to control settled solid particles by raking them to either a central airlift or multiple airlifts at the tank periphery. Internal or external airlifts will affect the recirculation of soils. Airlift(s) effect(s) internal (external) recirculation of solids. Flexible membrane tube diffusers are provided in a stacked arrangement rotating on the rake arms to effect aeration of the slurry. Depending on the application, one or several mixers are provided. The reactor is gas-sealed and volatile emissions are controlled through gas recirculation allowing for their eventual biodegradation.

Company Name/POC: Tekno Associates/Gunter Brox

Address : 3466 South Westwood Drive/Salt Lake City, Utah 84109

Phone Number : 801 272-2288

Fax Number : 801 272-228

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Equipment was evaluated during the demonstration of Biotrol, Inc.'s soil washer under EPA's SITE Program. The Biolift Reactor has treated creosote contaminated soil for an EPA BDAT study project executed by ECOVA Corporation and for the SBP Site demonstration project at American Creosote Works in Florida. The reactor has also treated BTEX and TPH contaminated soils from the Ninth Avenue Superfund Site.

Comments : Contaminants have to be biodegradable. High metal concentration may be inhibitory. Soil has to be processed into a uniform slurry by applying mineral processing techniques. The reactor does not provide enough kinetic energy to affect slurrying of freshly "as is" excavated soil.

Source of Information : VISITT 3.0

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : Auto-Heating Thermophilic Aerobic Reactor (ATAR)

Application : On-site Ex-situ

Brief Description : A-TAR is a self-heating slurry-phase bioreactor operating in the thermophilic temperature range (45-65 degrees Centigrade) with no external heating support and no nutrient addition. This technology is being developed for accelerated bioremediation soils, sediments and sludges contaminated with biodegradable hazardous organics. The aerobic bioreactor degrades complex organic substrates and the energy released in exothermic reactions is captured to maintain the reactor temperature. Significant biological destruction of polycyclic aromatic hydrocarbon is achieved over a 5-10-day treatment time.

Company Name/POC: Wastewater Technology Centre/Deonarine Phagoo

Address : 867 Lakeshore Road/P.O. Box 5068/Burlington, Ontario, Canada L7R 4L7

Phone Number : 905 336-6478

Fax Number : 905 336-4765

Technology Maturity : Pilot plant testing

Performance History : Bench-scale treatability study on contaminated soils from a manufactured gas plant site. These trials have demonstrated over 90% removals of PAHs at a 5-day retention time for contaminated soil in the feed of up to 10% by weight. Pilot scale experiments were conducted using a 1000 L slurry bioreactor for treating contaminated sediments from Hamilton Harbour and the results demonstrated over 95% removal of total PAHs, about 80% removal of total petroleum hydrocarbon (TPH), and about 70% removal of oil and grease (O&G) over an 8-day reactor retention time, without external heating support.

Comments : Requires high oxygen transfer efficiency and good mixing. Primary applicable for the treatment of contaminated fines in soils, sediment and sludges.

Source of Information : International TechCon

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Slurry Phase Biological Treatment*

Technology Name: Slurry-Phase Bioremediation

Application: On-site Ex-situ

Brief Description: Engineered bioreactor for slurry-phase remediation of contaminated soils, sediments, and or sludges at higher treatment rates than conventional solid phase bioremediation.

Company Name/POC: Wastewater Technology Centre/Kevin Hosler

Address: 867 Lakeshore Road/P.O. Box 5068/Burlington, Ontario, Canada L7R 4L7

Phone Number: 905 336-6021

Fax Number: 905 336-476

Technology Maturity: Bench scale testing, only

Performance History: Contact company for performance data.

Comments: Limited to biologically-degradable contaminants. Will be easy to use at full-scale; available as a transportable unit, fully automated. Scale-up considerations have not yet been fully addressed.

Source of Information: International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☒ SVOC	☐ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment***Technology Name :** Biocat (TM)**Application :** Ex-situ

Brief Description : The Biocat (TM) process comprises the steps of (1) acid phase anaerobic digestion of biomass to produce volatile acids and a partially stabilized sludge; (2) use of the volatile acids as carbon source and electron donors for biological sulfate reduction for removal of acidity, metals and sulfate from acid mine drainage, and to produce acetate; (3) use of the acetate solution as feed for methane phase anaerobic digestion to produce methane and to reduce the organic content of the effluent of the process; and (4) use of the methane to satisfy the energy requirements of the process.

Company Name/POC: Yellowstone Environmental Science, Inc./Mary M. Hunter**Address :** 320 S. Willson Avenue/Bozeman, Montana 59715**Phone Number :** 406 586-3905**Fax Number :** 406 587-5109**Technology Maturity :**

Bench scale testing, only

Performance History: Performance data are available.**Comments :**

Biocat technology is currently in the research phase. Bench-scale testing has been conducted. The full-scale system may be operated in either batch, continuous, or semicontinuous mode, depending on the particular site requirements. The Biocat technology is designed to operate in environments containing sulfuric acid, in addition to other hazardous materials. If sulfuric acid is not present in adequate concentration, additional acid may be required in order for the process to operate.

Source of Information : VISITT 3.0

CONTAMINANTS :

- ☐ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment***Technology Name :** Biocat-II (TM)**Application :** Ex-situ

Brief Description : The process uses natural microorganisms to remove toxic organic and inorganic waste constituents with recovery of metals, sulfur and energy from mixed hazardous wastes. Applications include bioremediation of industrial wastewater, sludges, slurries and contaminated groundwater.

Company Name/POC: Yellowstone Environmental Science, Inc./Mary M. Hunter**Address :** 320 S. Willson Avenue/Bozeman, Montana 59715**Phone Number :** 406 586-3905**Fax Number :** 406 587-510**Technology Maturity :** Bench-scale testing, only

Performance History : Laboratory studies by Yellowstone Environmental Science, Inc. (YES) and others have confirmed removal of the following constituents during the indicated process steps: (1) denitrification: benzene, toluene, ethylbenzene, o-xylene, m-xylene, p-xylene, phenol, o-cresol, p-cresol, and carbon tetrachloride; (2) sulfate-reduction: phenol, p-cresol, and carbon tetrachloride; (3) methanogenesis: benzene, toluene, ethylbenzene, o-xylene, phenol, p-cresol, 1,1,1-trichloroethane (TCA), tetrachloroethylene (PCE), trichloroethylene (TCE), carbon tetrachloride, chloroform, bromoform, methylene chloride, chlorophenols, and trichlorofluoromethane (FREON II); and (4) aerobic respiration: benzene, toluene, phenol, m-cresol, p-cresol, TCE, and vinyl chloride.

Comments : The BIOCAT-II (TM) process is applicable to situations wherein the wastes can be exposed to a sequence of treatment environments. This is most easily accomplished in a series of reactors.

Source of Information : VISITT 3.0

CONTAMINANTS :				
☐ Pesticides/Herbicides	☐ Heavy Metals	☒ PCB	☐ Explosives/Propellants	
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant	
☐ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A		

TECHNOLOGY TYPE: *Chemical Reduction/Oxidation*

Technology Name : Light Activated Reduction of Chemicals (LARC)

Application :	On-site	Ex-situ
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Brief Description : LARC is a patented photochemical process (U.S. Patent No. 4, 144, 152) which uses ultraviolet light and an optimized reducing environment to dehalogenate chlorinated, brominated, and iodinated organic compounds. The photochemical conditions supplied by the LARC reactor lead to a rapid, highly controllable reaction which yields only biphenyl and sodium chloride as the final products from PCBs. No oxygenated derivatives, chlorinated dibenzofurans, or chlorinated dioxins have ever been observed in gas chromatographs or mass spectra of the intermediates or products in the LARC degradation of chlorinated organics.

Company Name/POC: Arctech, Inc./Dr. Daman Walia

Address : 14100 Park Meadow Drive/Chantilly, Virginia 22021

Phone Number : 703 222-0280

Fax Number : 703 222-0299

Technology Maturity : Pilot plant testing

Performance History : LARC is extremely cost-competitive with the existing technologies for treatment of PCBs (significantly lower in cost than incineration). Samples containing in excess of 1,000 ppm of PCBs have been successfully decontaminated to meet federal, state, and local clean-up levels. In a pilot-test study, Arochlor 1260 was reduced from 3,000 ppm to 20 ppm, when treated by the LARC technology.

Comments : The LARC technology is not useful for treatment of metals-only or radioactive wastes. The process is designed specifically for treatment of halogen containing materials. Inorganic materials present in wastes do not interfere with the efficiency of the process.

Source of Information : VISITT 3.0

CONTAMINANTS: ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE: *Chemical Reduction/Oxidation*

Technology Name: Ozo-Detox (TM)

Application: ☐ On-site ☐ Ex-situ

Brief Description: The Ozo-Detox process is an integrated total treatment system with two key process units: 1) froth flotation and/or flocculation to remove hydrophobic contaminants from water and soil, (or an analogous pretreatment step) and 2) ozonation to degrade residual tars and polyaromatic hydrocarbons (PAH). The conditions created by the ARCTECH pilot-scale Ozo-Detox system lead to a rapid oxidation of soil contaminants and over 90 percent destruction of contaminants with minimal contact time.

Company Name/POC: Arctech, Inc./Dr. Daman Walia

Address: 14100 Park Meadow Drive/Chantilly, Virginia 22021

Phone Number: 703 222-0280

Fax Number: 703 222-0229

Technology Maturity: ☐ Pilot plant testing

Performance History: A pilot-scale Ozo-Detox unit has been constructed and is currently being tested with samples from coal gasification sites. The pilot-unit treats 1,000 gallons per day of contaminated materials. In addition, a soil treatment unit with 25-30 percent solids loading is being designed for future testing.

Comments: The Ozo-Detox technology is not applicable to wastes containing only metals, radioactive compounds, and inorganic corrosive materials. The performance of the technology is somewhat limited by the presence of radical scavengers, such as acids.

Source of Information: VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Chemical Reduction/Oxidation*

Technology Name : Gas Phase Chemical Reduction

Application : On-site Ex-situ

Brief Description : The ECO LOGIC Process involves the gas-phase reduction of hazardous organic contaminants. The system is capable of treating any form of organic contamination at any concentration with proven destruction and removal efficiencies (DREs) of at least 99.9999 percent. Contaminants entrained in liquids, soils and bulk solids can be destroyed without the formation of hazardous organic residuals. The system has been verified by various government agencies worldwide including the US EPA through the Superfund Innovative Technology Evaluation program. The ECO LOGIC Process is currently offered as a commercial-scale system for on-site treatment. The closed-loop destruction process ensures that no uncontrolled emissions result while the use of a reducing atmosphere ensures that dioxins and furans are not formed as byproducts. The system is mobile and may be utilized for on-site destruction.

Company Name/POC: ELI Eco Logic International Inc./Jim Nash

Address : 143 Dennis Street/Rockwood, Ontario, Canada NOB2KO

Phone Number : 519 856-9591

Fax Number : 519 856-9235

Technology Maturity : Commercial use experience

Performance History : Development of the technology began in 1986 and proceeded through the bench-scale and laboratory-scale. In 1991, a pilot-scale unit was constructed and tested extensively at Hamilton Harbour, Ontario, Canada. Demonstrations on sediment contaminated with 300,000 ppm PAH and 400 ppm PCBs confirmed DREs of 99.9999 percent. The pilot-scale unit was tested in Bay City, Michigan, the following year for the US EPA and PCB contaminated oil (25 percent PCBs), water and soil. Once again DREs of at least 99.9999 percent were confirmed. Following the Bay City demonstration further modifications were made to the front-end preprocessing units as well as scaling up the technology to a commercial-scale. At the time of this writing, (May 1995) the first commercial-scale unit was operating in Australia on pesticide residuals and PCB contaminated electrical equipment. The second and third commercial-scale units are presently being constructed and will be utilized by General Motors of Canada Ltd. and the steel manufacturing firm Dofasco Inc.

Comments : The ECO LOGIC Process treats only the organic portion of the waste stream. Any inorganic co-contaminants will remain in the treated soil or be separated in the grit and scrubber as metal hydrides, depending on their physical characteristics. Additionally, the radioactive component of a mixed low level waste stream would be captured at various specific locations in the Process. With the ECO LOGIC Process, a mixed waste stream would undergo significant volume reduction and separate the radioactive component into a form that is more amenable to traditional methods of disposal. The ECO LOGIC Process is mobile and mounted on several drop-deck highway trailers. It may be transported to the waste site and set-up within four weeks. Once the on-site waste has been destroyed, the system is simply moved to the next site. The mobility and closed-loop destruction process have garnered significant public acceptance for the technology while being offered at a competitive cost. The ECO LOGIC Process is at an advanced state of development for an alternative remediation technology and is presently offered at a commercial-scale.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Chemical Reduction/Oxidation*

Technology Name : TR-Detox

Application : In-situ (vadose zone)

Ex-situ

Brief Description : The TR-Detox technology utilizes the synergetic application of specific inorganic and organic reagents which readily percolate through contaminated soils. Heavy metals are reduced to their lowest valence state and rendered insoluble as stable organometallic complexes. The key chemical in the TR-Detox technology is sodium polythiocarbonate which has remarkable reducing and precipitating capabilities. The resultant precipitate is essentially insoluble and tends to increase its insolubility with time. The detoxified soils easily achieve the TCLP requirements and are no longer leachable. The TR-Detox technology can also be applied in conjunction with simultaneous biological treatment for the in situ and ex situ destruction of organic contaminants.

Company Name/POC: Etus, Inc./Mark Wernhoff

Address : 1511 kastner Place Building/#1 Technology Drive/Sanford, Florida 32771

Phone Number : 407 321-7910

Fax Number : 407 321-309

Technology Maturity : Commercial use experience

Performance History : ETUS, Inc. has developed numerous chemical and equipment technologies for detoxification, zero-discharge and water reuse assignments throughout the world. The company maintains operations in Japan, South Korea, Europe and Saudi Arabia in addition to its North American Operations. ETUS, Inc. serves directly or indirectly more than 400 of the Fortune 500 companies. ETUS, Inc. participates in the Environmental SOLUTIONS Software Database which is a waste management tool for generators and environmental professionals.

Comments : To date, the TR-Detox technology has been adaptable to most remediation applications containing heavy metals. The reagent mix is altered to the site conditions. The only limitation is the need for initial pilot tests in order to determine the specific formulation.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Chemical Reduction/Oxidation***Technology Name :** Chemical Treatment-Oxidation/Reduction**Application :** On-site Ex-situ

Brief Description : The operating principle is based upon the reaction of either an acid or caustic, with either the pollutant or a mixture of the pollutant and aluminum oxide, to chemically convert the hydrocarbons to carbon and non-hazardous aluminum compounds. The treatment takes place in a heated pressure chamber. Steam and other gases are vented to a separate chamber for further processing if necessary. Residual hazardous materials can be adsorbed by rehydratable alumina and retreated. It is unique as a closed system.

Company Name/POC: G.E.M., Inc./Cleve A. Bond**Address :** P.O. Box 397/Highway 67 South/Malvern, Arkansas 72104**Phone Number :** 501 337-9410**Fax Number :** 501 337-1208**Technology Maturity :**

Bench scale testing, only

Performance History : Not available.**Comments :**

The greatest advantage is that this is a closed system, where nothing is released into the atmosphere during operation, and allows for retreatment in the event that the procedure is not smooth. Pretreatment to reduce the quantity of inert material mixed with the hazardous waste is desirable for economic reasons. It is also undesirable for the waste to contain excess water.

Source of Information : VISITT 3.0

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Chemical Reduction/Oxidation*

Technology Name: In Situ Ozonation

Application: In-situ (vadose zone)
In-situ (saturated zone)

Brief Description: In situ chemical oxidation of organic contaminants includes ozone injection into contaminated aquifers and/or contaminated unsaturated zones. Combines knowledge of ozone oxidation chemistry and gaseous transport through saturated and unsaturated sediments.

Can replace or complement traditional in-situ remediation methods such as pump-and-treat, soil venting, air sparging and in-situ bioremediation. Particularly appropriate for recalcitrant contaminants with limited treatment options such as PAHs, TCE and PCP. Can minimize or eliminate off-gas treatment of VOCs.

Company Name/POC: Groundwater Technology, Inc./Christopher Nelson

Address: 6436 S. Racine Circle/Suite 200/Englewood, Colorado 80111

Phone Number: 303 799-4241

Fax Number: 303 799-427

Technology Maturity:

Field demo complete

Performance History: Not available.

Comments: Equipment includes air compressor, oxygen generator, ozone generators, injection wells, piping, etc. Feasibility and pilot testing required to determine oxidation effectiveness and injection transport limitations. Can also be implemented in combination with in situ reduction technologies such as the utilization of zero-valent iron.

Source of Information: TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Chemical Reduction/Oxidation*

Technology Name : Low Temperature Thermal Desorption

Application :

On-site	Ex-situ
Off-site	

Brief Description : The batch steam distillation/metal extraction treatment process is a two-stage process to remove organics and heavy metals from Superfund soils. The first stage, soil vapor extraction, removes volatile organics from a slurry of the contaminated soil by direct steam injection. The volatile organics are taken overhead, condensed, cooled and collected. For treatment of metals, soil vapor extraction is followed by acid extraction. The soil slurry is washed with hydrochloric acid. Subsequent counter current batch washing with water removes residual acid from the soil. The solids are then separated from the final wash solution by gravimetric sedimentation.

Company Name/POC: IT Corporation/Edward Alperin

Address : 312 Directors Drive/Knoxville, Tennessee 37923

Phone Number : 615 690-3211

Fax Number : 615 690-3626

Technology Maturity : Pilot plant testing

Performance History : Pilot facility being constructed at vendor's location.

Comments : Process as currently designed is a batch process. This limits the process capacity of the system and directs its application to smaller hazardous waste sites. Certain waste contaminants can cause foaming of the slurried soil during the batch steam distillation step. Anti-foaming agents or reduced steam rates can control this phenomena.

Source of Information : VISITT 3.0

CONTAMINANTS :☒ Pesticides/Herbicides☒ Heavy Metals☒ PCB☒ Explosives/Propellants☒ Petroleum Hydrocarbons☒ Radionuclides☒ SVOC☒ Other Contaminant☒ Nonhalogenated VOC☒ Halogenated VOC☒ N/A**TECHNOLOGY TYPE :** *Chemical Reduction/Oxidation***Technology Name :** Peroxide Oxidation of Formaldehyde in Soil**Application :** In-situ (vadose zone)

Brief Description : Organic contaminants in soil are treated in situ by controlled injection of hydrogen peroxide solution into the contaminated zone via a network of injection wells. The hydrogen peroxide oxidizes contaminants to form less toxic compounds. In some cases, contaminants can be oxidized and converted to carbon dioxide. Contaminants amenable to destruction and conversion to carbon dioxide include aldehydes, alcohols, phenols, and ketones. Careful control of oxidant injection is required through site observation and monitoring wells.

Company Name/POC: IT Corporation/Richard W. Helsel**Address :** 312 Directors Drive/Knoxville, Tennessee 37923**Phone Number :** 615 690-3211**Fax Number :** 615 690-362**Technology Maturity :** Commercial use experience

Performance History : This technology has been used to remediate formaldehyde contamination at a railroad emergency, treating the railroad track ballast and soil. It has also been used to remediate formaldehyde contamination in situ caused by underground pipeline leaks in a chemical plant.

Comments : In-situ chemical oxidation is especially applicable to contaminants that are toxic to in-situ biological treatment, such as formaldehyde and phenols, and contaminants which are not easy to volatilize by soil vapor extraction or in-situ stripping, such as alcohols, higher molecular weight ketones, aldehydes, and phenols. In-situ chemical oxidation is limited to soils with high to moderate permeability.

Source of Information : VISITT 3.0

CONTAMINANTS :	☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
	☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
	☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Chemical Reduction/Oxidation*

Technology Name : Fenton's Chemistry (Fe catalyzed H₂O₂)

Application : On-site Ex-situ

Brief Description : Organic chemicals, i.e., aromatics, chlorohydrocarbons, alcohols, acids, aldehydes and amines react completely with OH to form CO₂ and H₂O. Hydroxyl radical is generated by Fe catalyzed hydrogen peroxide in water at atmospheric pressure and temperature. Reaction is controlled by ORP, pH, time temperature and concentration.

Company Name/POC: Technotreat Corporation/Richard J. Bigda

Address : 6216 S. Lewis/Suite 106/Tulsa, Oklahoma 74136

Phone Number : 918 445-0966 **Fax Number :** 918 445-0994

Technology Maturity : Commercial use experience

Performance History : Six Technotreat Fenton's Reactors have been put into service for the treatment of paint stripper waste water containing phenol, formic acid, chrome, methylene chloride, benzene and toluene. References and contacts:
 Aero Corporation: 904-752-7911, Joe Bonds
 KC Aviation: 214-902-7511, Clyde Phillips
 TAP Air Portugal: 011-351-1-841-6022, Abrantes Machado

Comments : Units are skid mounted. 5000 gal/batch capacity system requires about 9' x 20' by 12'h area, requires 12-20 KVA power supply, and compressed air at 69 to 90 psi. Temperatures below 60 degrees Fahrenheit inhibit initiation of reaction. Automated, computer controlled system with proprietary software drives the unit through 55 steps with minimum operator's input or knowledge of chemistry. Various safety shut down devices protect against harm and run-away reactions. Interlocks prevent accidental spills and discharges to environment. Double containment can be incorporated. The system operates at atmospheric pressure and low temp. (100-140 degrees Fahrenheit)

Source of Information : TechCon

CONTAMINANTS:

- ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Soil Washing***Technology Name:** Physical Separation (Soil Washing)**Application:** On-site Ex-situ

Brief Description: Physical processing to reduce the amount of contaminated material requiring downstream treatment or disposal (volume reduction). The process uses readily available equipment from the mineral processing industry. The circuit configuration is tailored to the exploitable physical differences between contaminated and noncontaminated particles that are identified and quantified in a series of characterizing laboratory tests. The tests and subsequent treatment are based on differences in grain size, abrasion, settling velocity, specific gravity, surface chemical properties, magnetic susceptibility and solubility/leachability. The advantage of AEA's approach is that it uses the most appropriate readily available, mineral processing equipment in a configuration that is matched to the exploitable attributes of the contaminants and the "soil" components.

Company Name/POC: AEA Technology/Dr. Mark Neville**Address:** Building 429/Harwell Laboratory/Near Didcot/Oxon, OX11 0RA, UK**Phone Number:** 44 1235 432252**Fax Number:** 44 1235 43227**Technology Maturity:** Pilot plant testing

Performance History: (1) UK Department of the Environment: Contact: Judith Denner Tel: 44 71 276-8348. Research programs over years 1990-1994 into the physical separation of contaminants from a number (8) of contaminated soils. (2) US Environmental Protection Agency: Contact: Norma Lewis Tel: (513) 569-7665, Mary Stinson Tel: (908) 321-6683. Research program 1991-1994 using techniques from the mineral processing industry for the treatment of soil from a former gasworks. Contaminants included heavy metals, PAH and cyanide. (3) European Commission: Reprocessing of Beralit Mineral Tailings. (4) Other projects: are commercially in confidence but include work with contaminated soils and dredged harbour sediment.

Comments: The process is a volume reduction process based on separating a relatively "clean" bulk from contaminated particles. Not all contaminated soils can be treated in this manner, as the contamination may be dispersed over all the particles such that a separated bulk cannot reach the desired "cleanup" targets. The ability to reach the cleanup targets however can be ascertained in the preliminary laboratory characterizing tests. As a volume reduction process, it is therefore limited by the costs associated with disposal or downstream treatment of the contaminated concentrates. The downstream processes, however, can be cost effective as they only apply to the relatively low volume of contaminant concentrates rather than the total soil. The equipment used is readily available mineral processing equipment which could be leased from a number of manufacturers. It can operate on a treatment pad in the open but environmental controls may necessitate erection of a surrounding frame and fabric cover for containment. Operator training is required. The number of operators will depend on the throughput requirements and the degree of control automation required. The organizational structure would involve an overall plant manager, excavation and transport personnel, 2-3 operators, maintenance engineers and support administrative and analytical staff. The tests and the subsequent pilot designs have been developed by adapting techniques that AEA has developed over the last 30 years for the assessment and separation of mineral ores.

Source of Information: International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Soil Washing*

Technology Name : Chemical and Physical Treatment of Soil and Groundwater (CPT)

Application : On-site Ex-situ

Brief Description : Contaminated soil is physically and chemically treated using water and chemicals. The result is clean soil, clean water (for re-use), and a concentrate that might be further treated or deposited.

Company Name/POC: Alba Industrie Umweltschutzservice GmbH/Dr. K. Faber

Address : Rehrhoferweg 160/D29625 Munster, Germany

Phone Number : 051 929 63212

Fax Number : 051 929 6331

Technology Maturity : Commercial use experience

Performance History : Experience in many fields in Switzerland and Germany for more than 15 years. Experience in all areas-chemical weapons, TNT, other toxic materials.

Comments : None.

Source of Information : International TechCon

CONTAMINANTS :

- ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Soil Washing**Technology Name :** Soil Washing**Application :**

On-site Ex-situ
Off-site

Brief Description :

Soil washing is a physical/chemical process that can deal with a wide range of contaminants while substantially reducing the volume of wastes requiring management. The process separates soil particles and focuses treatment on the contaminated fraction. The soil to be treated is initially screened to remove over-size material and a slurry is prepared. The slurry is pumped to a series of hydrocyclones where a separation of coarse- and fine-grained particles is accomplished. Coarse-grained materials are treated using froth flotation, while the fine-grained material is treated using physical, biological, and extraction techniques, as appropriate. Approximately 85% of the soils processed can be returned to the site as clean material; only 8-10% will need to be disposed of as hazardous waste.

Company Name/POC: Alternative Remedial Technologies, Inc./Michael Mann**Address :** 14497 N. Dale Mabry Hwy., Suite 140, Tampa, FL 33618**Phone Number :** 813 264 3571**Fax Number :** 813 962-086**Technology Maturity :** Commercial use experience

Performance History : Contact Alternative Remedial Technologies, Inc., Michael J. Mann, for Performance History Data. The company began operation of the first commercial soil washing project in Winslow Twp., NJ, on approximately 20,000 cu yd of metal-contaminants soils in July 1993.

Comments :

Process works best on soil that is made up of 90% sand and 10% clay or silt. In addition, where other treatment technologies are available, a volume of more than 20,000 tons is required for this method to be economically competitive. The major challenges of this technology are determining the particle size contaminant relationship and the configuration of the full-scale plant. For this reason, a treatability study and a bench-scale study are essential prior to construction of a full-scale plant. The primary benefits of this soil washing system are: the system is cost-effective since treatment is focused only on the contaminated fractions; the system can treat organics and inorganics in the same treatment train; it is a true volume reduction option and directly supports the recycling and reuse of site materials; and the system is consistent with current USEPA directives and policies encouraging the use of innovative technologies. Sludge from the processing of fines through the belt filter press will be contaminated as will the froth from the froth flotation unit. These residuals will generally total 8-10% of the waste stream and will need to be disposed at a RCRA TSDF.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Soil Washing*

Technology Name : Soil Washing

Application : Ex-situ

Brief Description : Soil washing is based on the premise that contaminants associated with the coarse soil fraction are surficial in nature. The objective of the process is to scour the surficial contaminants from the coarse soil particles, and then separate the soil fines (which now contain the contaminants physically abraded from a coarse soil fraction) from the cleaned coarse soil (>200 mesh). Washed soil can be returned to the site. Reduction in contaminant levels of from 90 to 95 percent are expected. Contaminant levels in the washed soil can be reduced even further via polishing operations. Soil washing is a preferred option to stabilization. Soil washing removes contaminants from the coarse soil fraction. This washed soil can then be returned to the site as fill. Stabilization could be used on the residual soil fraction remaining after the soil washing.

Company Name/POC: BioTrol, Inc./Dennis D. Chilcote

Address : 10300 Valley View Road, Suite 107/Eden Prairie, MN 55344-3546

Phone Number : 612 942-8032

Fax Number : 612 942-8526

Technology Maturity : Field demo complete

Performance History : Technology has been demonstrated through the EPA SITE program. This demonstration was successful, meeting expected performance criteria. No significant problems were encountered.

Comments : Major limitation is the fraction of soil that is less than approximately 200 mesh. As this fraction becomes large (30 to 50 percent), the technology becomes less and less cost-effective. Soil washing should be an excellent technology for treating mixed wastes.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Soil Washing*

Technology Name : High Pressure Water Jet

Application : On-site Ex-situ

Brief Description : This technology is an aqueous soil-washing system with a capacity of 100 tons/hr. and uses cyclonic water jets. Treatment capabilities include the removal of heavy metals (Pb 600 to <75ppm; PAHS 450 to <20 ppm; and chlorinated HC's 130 to <0.09ppm).

Company Name/POC: Bodem Sanering B.V./Mr. Bilsma or Mr. Olive

Address : BSN Wetering #2/6002 SM Weert/Netherlands

Phone Number : 011 31 49 504 3035

Fax Number : 011 31 49554 303

Technology Maturity : Commercial use experience

Performance History : Used in Duesseldorf for treating 300,000 tons of contaminated soil

Comments : The normal soil wash limitations exist for this technology: rocks, high clay content. Technology used by Klockner Oecotec but now owned (after patent dispute) by BSN.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Soil Washing*

Technology Name : Soil Washing Pressure jet

Application : On-site Ex-situ

Brief Description : Patented system for "releasing" pollutants from the soil by means of the kinetic energy and power generated by water under a pressure of 150 to 250 bar and a jet spray which attains a speed of 200 - 250 m/s.

Company Name/POC: BodemSanering Nederland BV/L. Biljma

Address : Postbus 10128, 6000 GC Weert/The Netherlands

Phone Number : 011 31 49 504 3035

Fax Number : 011 31 49554 3035

Technology Maturity : Commercial use experience

Performance History : Have experience with a wide range of separation systems.

Comments : None.

Source of Information : International TechCon

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE: *Soil Washing*

Technology Name: ACT*DE*CON/MAG SEP

Application: In-situ (vadose zone) ☐ Ex-situ ☐
In-situ (saturated zone) ☐

Brief Description: ACT*DE*CON (TM) selectively dissolves actinides (e.g., uranium, plutonium, etc.) and some heavy metals from soil into an aqueous solution. The process can be applied in-situ, or ex-situ. For ex-situ applications, the soil fractions can be separated to remove a large volume of noncontaminated large particle soil from a smaller volume of contaminated fines prior to treatment. Once the contamination is in solution, the solution and soil are separated and the contamination recovered from solution. This can be accomplished using the MAG*SEP (TM) process. The MAG*SEP (TM) process uses specially designed particles to selectively adsorb contamination. These particles have a magnetite core which allow them to be recovered by magnetic filtration. The particles can be regenerated and reused. This approach is being used for the Mound site in-situ soil remediation demonstration.

Company Name/POC: Bradtech - US, Inc./Mike Dunn

Address: P.O. Box 767760 /Roswell, GA 30076

Phone Number: 770 640-7059

Fax Number: 770 640-930

Technology Maturity: Field demo complete

Performance History: Currently being implemented for the in-situ soil treatment demonstration at the Mound site (in-situ, with MAG SEP) References: Mound site, Dick Neff (513) 865-3616; Fernald site, Kim Nuhfer (513) 870-0181.

Comments: Not suitable for contamination that is deposited under refractory conditions. The technology is safe and easy to use. The equipment requires minimal space, has minimal power utility requirements, and requires a relatively small staff to operate (the specific conditions determine staffing requirements). Few or no challenges. It is however, necessary to confirm effectiveness for each potential site to assure that the site chemistry will not adversely affect the dissolution chemistry.

Source of Information: TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Soil Washing*

Technology Name : Soil Washing

Application : On-site Ex-situ

Brief Description : Soil-washing is a water-based, ex-situ, volume reduction (concentration) process. The process utilizes specialized physical process componentry to separate soil fines and associated contaminants. Soil-washing is attractive because of its high throughput capabilities and associated low costs. The technology is an ideal pre-treatment step for concentrating contamination from the entire soil matrix into a smaller proportion, thus reducing the volume of soil that has to be further treated.

Company Name/POC: Brice Environmental Services Corporation (BESCORP)/Craig Jones

Address : PO Box 73520/Fairbanks, Alaska 99707

Phone Number : 907 456-1955

Fax Number : 907 452-501

Technology Maturity : Commercial use experience

Performance History : A pilot demonstration was performed near Richland WA in 1991 for Westinghouse HAN, PHL and Foster Wheeler personnel to demonstrate the efficiency of the soil-washing process using Hanford-like soil for separating the - 150 mesh soil fraction. References: R.L. Treat, Foster Wheeler (509) 372-5800; Jim Field, Westinghouse HAN (509) 376-3753. A pilot demonstration performed under the Superfund Program at the ABE Superfund Site in 1992. References: Roger Gaire, Foster Wheeler Enviresponse, (908) 533-4921; High Masters USEPA (908) 321-6678. Bescorp is providing excavation, haulage, and soil-washing services at the Twin Cities Army Ammunition Plant, New Brighton MN. The project commenced in 1993 and is expected to be completed in 1995. To date, ~15,000 tons of soil have been processed. References: Bill Fristad, Cognis, Inc.; (707) 575-7155; Keith Benker, Wenck Associates (612) 479-4206.

Comments : Fines percentage can affect throughput and economics of utilizing soil-washing as a volume reduction process. Water-soluble contaminant types will affect processing cost or prohibit its use. Bescorp's soil-washing plants are mobile and built on standard 10x40 foot trailers. Once on site, erection time is generally only several days. Soil washing is not generally labor-intensive; only requires several operators. Health and safety concerns are minimized because the soil is immersed in water. Soil washing employs modular componentry which can be utilized as required, without costly and time-consuming process modifications.

Source of Information : International TechCon

CONTAMINANTS :				
☐ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants	
☐ Petroleum Hydrocarbons	☒ Radionuclides	☐ SVOC	☐ Other Contaminant	
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A		

TECHNOLOGY TYPE: Soil Washing

Technology Name : Cacitox Soil Washing Process

Application :	On-site	Ex-situ
	Off-site	

Brief Description : The process uses a proprietary reagent "Cacitox" to dissolve actinides and certain heavy metals from soils. Feedstock may be LLW, TRU or mixed waste contaminated soil. Treated material should be at or below limits for LLW. Process residues are suitable for immobilization; e.g., by cementation. Current experience includes the dissolution of Pu, U, Am, Th, Cs, Sr, Cr, Ni, Cu, Zn, As, Cd, and Pb.

Company Name/POC: British Nuclear Fuels plc/Janet Jackson

Address : Risley, Warrington WA3 6AS Cheshire, England

Phone Number : 1925 832735

Fax Number : 1925 835722

Technology Maturity :	Bench scale testing, only
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Performance History : Contact company for performance data.

Comments : Process is not designed to remove organic contaminants but can be used after an organics treatment process. Plant uses proven, commercially available equipment. Skills required are those normally associated with HLW/TRU waste handling. BNFL has extensive expertise in this area. Cost advantage over conventional soil washing (classification) in-situ specific. Advantage increases as throughput and fines content increase. Equipment can be operated with high clay/silt content soils which are unsuitable for treatment by classification. Process does not rely on large particle size fraction or feedstock being relatively uncontaminated in order to achieve required product specification.

Source of Information : International TechCon

CONTAMINANTS:

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE: *Soil Washing*

Technology Name: Soil Washing-TERRAMET

Application: On-site Ex-situ

Brief Description: Soil washing/leaching is a combination of physical and chemical remedial techniques whose goal is to clean contaminated soil and remove and recover the contaminants. In some cases all the soil components can be cleaned, while in others the contaminant can be restricted to a very small fraction. Soil washing/leaching is specifically tailored to a site utilizing the relevant techniques, e. g. particle size separation, attrition, density separation, magnetic separation, flotation and selective leaching. Soil washing/leaching has been shown to be very effective, and cleanup standards as exacting as background residual values can be met.

Company Name/POC: COGNIS, Inc./Dr. William E. Fristad

Address: 2331 Circadian Way/Santa Rosa, California 95407

Phone Number: 707 576-6235

Fax Number: 707 575-783

Technology Maturity: Commercial use experience

Performance History: One full-scale cleanup has been successfully completed, ~15,000 tons of soil at the Twin Cities Army Ammunition Plant (TCAAP). The soil was contaminated by ordnance plus eight heavy metals, primarily Pb, Cu and Hg. The cleanup criteria involved removing all ordnance and the metals-to-background concentrations. Meeting this stringent cleanup criteria meant providing a combined physical and chemical treatment plant operating at high efficiency. The recovered heavy metals were recycled through a secondary lead smelter. Contacts: Darryl Terho, Federal Cartridge Co. (612 633 2301) and Marty McCleery, TCAAP (612 622 2301 extension 651).

Comments: Soil washing is generally most cost effective for sandy soils. Fines can be treated by leaching, but the throughput is slower. If contaminants are spread throughout all soil particle size fractions, and are completely insoluble and chemically difficult to alter in solubility, soil washing/leaching will be difficult; however, this combination of factors is not common. Residuals treatment depends on the contaminants. COGNIS has removed heavy metals from soil and been able to recycle 100 percent of the recovered metal from soil through a secondary smelter. After treatment, the soil was returned on site with no monitoring required and no deed restriction on the property. Recovered radioactive contaminants would require disposal rather than recycle.

Source of Information: TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Soil Washing*

Technology Name : Soil Washing

Application : On-site Ex-situ

Brief Description : Soil washing to remove radionuclide components typically involves front-end screening to remove trash, slurring the solids and acid-leaching the radiocides from the solids. The solids are then removed from the resultant slurry through screening, hydrocyclones and centrifuges. Each size-range-produced solid stream is kept segregated to be separately neutralized, and checked to meet the target nuclide concentration. The fine solids are in contact with the acid for the longest periods, to allow the clays to desorb their nuclides. The equipment train is heavy-duty and consists of modified oil-field equipment. The soil washing is an alternative to stabilization of the entire amount of radionuclide-contaminated soil. In the ideal case, only the removed radionuclide contaminants must be stabilized. In a limiting case, the contaminated soil has been reduced to a fraction of its original volume, and this must be stabilized.

Company Name/POC: FLO TREND Systems, Inc./Gerald Lott

Address : 707 Lehman/Houston, Texas 77018

Phone Number : 713 699-0152

Fax Number : 713 699-8054

Technology Maturity : Commercial use experience

Performance History : Radionuclide washing performed only at laboratory treatability and pilot stage. Organics soil washing is performed at several sites, the largest of which was 11,000 cubic yards of jet-fuel-contaminated soil, which was treated from 3-7000 mg/kg to <100 mg/kg. Clay content and natural humus content can be a problem.

Comments : Clay content (<20 microns) less than 20 percent. The solid separation/material handling is standardly performed. Acid leaching and precipitation of contaminants are similar to inorganic processing units with minor safety hazards. Units can be self-contained to require little outside infrastructure. Stabilization of radionuclides requires substantial infrastructure for permanent storage. Removal of "fines" from aqueous phase requires large equipment and that typically is the bottleneck in the processing rate. Flo Trend has developed a slag-cement mixing and pumping unit for use in the stabilization process. This unit is a full-scale prototype and is in the final testing stages.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Soil Washing*

Technology Name : Mercury Removal

Application : Ex-situ

Brief Description : Contaminant identified as Mercury.

A hydrometallurgical approach has been devised and tested for the removal of mercury-containing solids. In this process, additives are added to water in order to extract the mercury contaminants. This extracting solution selectively reacts with mercury, leaving the solid media unaffected. As a result of the reaction, the mercury is complexed and converted to a high water soluble species; mercury solubility in the extractant can be as high as 25,000 ppm. The additives were selected for their high affinity for mercury relative to indigenous metals (calcium, magnesium, iron, etc.). Following extraction, the solids and the extracting solution are physically separated. The used extracting solution is treated to produce elemental mercury. The solution is then regenerated and recycled back into the process.

Company Name/POC: General Electric, Corp. R&D/Mark Sneeringer

Address : P.O. Box 8, K1-3C3, Schenectady, New York 12301

Phone Number : 518 387-5334

Fax Number : 518 387-761

Technology Maturity : Bench scale testing, only

Performance History : Scale up and testing of process is being accomplished jointly with Metcalf and Eddy, Inc. of Waverfield, Massachusetts. Fabrication and assembly of a mobile pilot scale system is being completed and design of a full scale system (5 to 10 tons/hour capacity) is in progress. Field demonstration of the full scale system is anticipated to begin in 1996. Point of contact at Metcalf and Eddy is Dr. Edward Cichon at (617) 224-6232, Fax (617) 224-6543.

An extracting system has been successfully tested at General Electric's Corporate Research and Development Center on a variety of mercury-containing solids including soils, concrete, brick, plastics, and phosphors from fluorescent lamps. The studies have also shown that a variety of forms of mercury including elemental, organo-, mercurous, and mercuric derivatives can be removed from soils. The mercuric compounds may be in the form of oxides, sulfides, chlorides, or phosphates. Mercury levels ranging from 100 ppm to 10,000 ppm in soil have been reduced to 1 to 25 ppm following treatment. Treated samples pass simulated TCLP tests.

Comments : None.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Soil Washing*

Technology Name : Soil washing - TRUclean

Application : On-site Ex-situ

Brief Description : Gravimetric Separation of Heavy Metals. Advantage - Reduces volume of contamination which must be stored and/or processed for disposal.

Company Name/POC: Lockheed Environmental Technologies Divisions/Randy Smith

Address : 151 N 3rd Ave./Suite 500/Pocatello, ID 83201

Phone Number : 208 234-3526

Fax Number : 208 234-3550

Technology Maturity : Commercial use experience

Performance History : Contact Lockheed Environmental Systems and Technology Company for this information.

Comments : Can be completely self-contained. Gravimetric separation can be augmented with chemical separation and thermal treatment.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Soil Washing*

Technology Name : Hydraulic Soil Washing (HYDROSEP)

Application : On-site ☒ Ex-situ ☒

Brief Description : HYDROSEP is a series of water-based hydraulic separation systems for contaminated soils and sediments. HYDROSEP systems isolate fine-grained soil and sediment fraction, thereby concentrating contaminants. HYDROSEP may be used alone or in conjunction with METALEX and ORGANOEX extraction technologies. Oversize, clean soil and sediments may be returned to the site. HYDROSEP systems either reduce the volume of soil/sediment requiring ultimate treatment or eliminate the need for treatment.

Company Name/POC: Metcalf and Eddy, Inc./Pier Mantovani

Address : 30 Harvard Mill Square/Wakefield, MA 01880

Phone Number : 617 246-5200

Fax Number : 617 245-629

Technology Maturity : Commercial use experience

Performance History : HYDROSEP utilized on over 10 jobs with soil or sediment volumes ranging from 2,000 to over 200,000 cu yds. Effective treatability studies and selection of the appropriate HYDROSEP system have avoided significant field problems.

Comments : A high clay content (>50 percent) in the intended feed soil may result in higher unit costs than alternative remedial techniques. HYDROSEP systems run with a combination of chemical process engineers, analytical chemists, and skilled equipment operators and mechanics. The HYDROSEP systems have been designed to accommodate a wide range of site conditions through use of modular unit operations. Clean, oversize materials are generally returned to the site. HYDROSEP systems are configured to maximize the volume of clean, oversize material. Water used in the separation process is treated on-site and recycled to the extent practical. Fine materials containing the target contaminants are managed according to prescribed methods when configuring the HYDROSEP system. Such methods include: METALEX, ORGANOEX, biodegradation, thermal desorption, stabilization/fixation/vitrification.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☐ SVOC	☐ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Soil Washing*

Technology Name : Optimizing Separation

Application : On-site Ex-situ

Brief Description : What: Optimizing the separation of clean vs non-clean soil through optimizing the performance of hydrocyclones for the specific soil and the contamination present by changing the shape and the operation of the hydrocyclones.
How: Run tests with plant (300-500 ton) for the different locations. Make information available for large scale operation (process data, efficiency, quantities clean and non-clean).
How well: Because of full-scale operation and "large" quantities, reliable answers are generated. The advantage of this technology is that the performance of existing soil cleaning technologies can be optimized.

Company Name/POC: Promeco B.V./ A.J. M. Broeders

Address : P.O. Box 94/574 OAB/Beek En Donk, The Netherlands

Phone Number : 31 492963903 **Fax Number :** 31 492465025

Technology Maturity : Commercial use experience

Performance History : Contact Promeco for list of references.

Comments : Contaminants that stick to coarse material cannot be concentrated in the fines. Reduction of waste volumes are accomplished by optimization of the separation. In cooperation with KEMA hydrocyclones are very often used as part of a wet cleaning operation for contaminated soils. The efficiency of hydrocyclones is a very important part of the total efficiency of wet soil cleaning. The requirements for the most efficient removal of the contaminations must be met by looking for the desired cut point in the particles size separation. Particle size-distributions vary by site and distribution of the contaminants. Choosing the cut point of the separation is a strategic decision for the cleaning strategy for each project. Searching the right cut point can only be done at a processing scale of 1:1, with relative high quantities. Once the optimum is found, the performance of hydrocyclones can be changed easily to meet the requirements of separation.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Soil Washing***Technology Name :** Ranator Detoxification Process (RDP)**Application :** On-site Ex-situ

Brief Description : On-site and non-destructive remediation, by separation of chemical substance such as PCB's, creosote, dioxins, oil and other petroleum products from soil, sludge, sediments and other contaminated material, by taking advantage of the very special physical and chemical properties of the substances in a three-step process with process chemicals recirculated in closed systems. The contaminating substances are recovered as a concentrate.

Company Name/POC: Ranator AB/Torgny A. Mellin**Address :** Roslagsvagen 101, hus/15, S - 104 05/ Stockholm, Sweden**Phone Number :** 46 8 153880**Fax Number :** 46 8 159717**Technology Maturity :** Pilot plant testing

Performance History : RDP was successfully tested on a pilot plant test scale (50-100 kg/hr) in 1994, supported by the Swedish EPA. Presently a full-scale RDP test plant is in the final construction phase, scheduled for operations in June - August 1995 on a creosote contaminated, first reference object in Sweden. The test with the full scale RDP plant will provide data relevant to several of the questions in this form; during fall 1995 more details of RDP performance will be available. The project results show that the contaminant separation from the material easily may be regulated during treatment; thus, the degree of decontamination can reach as close to 100% as is required.

Comments : RDP is not capable of heavy metal decontamination, with a possible exception of mercury (R&D in progress); fine-grained material with very high organic content reduces the RDP efficiency. An industrial RDP plant is mobile and designed according to the module principle, in order to permit transport to any contaminated area, in suitable size and productivity, for on-site decontamination operations.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Soil Washing*

Technology Name : Radioactive Soil Washing and Particle Separation (RSWAPS)

Application : On-site Ex-situ
Off-site

Brief Description : The RSWAPS system reduces the volume of radionuclide-contaminated soil by separating discrete soil-size particles containing unacceptable levels of contamination from those with acceptable levels. Separation is accomplished by particle sizing, using wet sieving and hydroclassification in conjunction with vigorous soil washing to enhance particle segregation. Effluent clarification permits recycling of the wash water. During field tests, soil fractions representing > 50% of the total soil and containing radium with acceptable levels of radioactivity, were separated from contaminated soils. Recent modifications have increased the plant's throughput capacity and added units that permit more effective, continual operation over sustained periods of time with minimum operator interaction.

Company Name/POC: SC&A/Charles R. Phillips

Address : 1000 Monticello Court/Montgomery, Alabama 36117

Phone Number : 334 272-2234 **Fax Number :** 334 213-0407

Technology Maturity : Field demo complete

Performance History : The RSWAPS field-scale pilot system has been tested twice with non-contaminated and contaminated soils and is scheduled for additional testing following modifications to refine its operation, enhance its capacity, and expand its range of operational parameters. The original tests were performed at a feed rate of one to two tons/hr. Operation continued for over eight hours with minimum operator interaction before the plant was shut down voluntarily. The plant is currently being prepared for additional tests to demonstrate its separation capabilities.

Comments : The field-scale pilot plant as presently configured is designed to operate at up to 5 tons/hr. The system is capable of processing soils with various particle-size compositions, but soils with excess clay material (>40%) may be difficult to separate. Four product streams are produced. The minimum particle-size cut is -200 mesh size (0.075mm). The plant is essentially self-contained, requiring only analytical support facilities to monitor the radionuclide content of the product streams. It is mounted on four trailers and may be transported to a site by the highway system. RSWAPS was tested at a federal facility requiring no permits; use at other sites may require permits.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Soil Washing*

Technology Name : Soil Washing

Application :

On-site

Ex-situ

Brief Description :

The various processes used in soil washing break the silt and clay away from the coarser fractions and scrub the coarser fractions, resulting in clean sand. The initial breakdown process is done by vibrating screens and then by attrition scrubbers. This clean sand can usually be backfilled on site. The fine fraction which contains the contaminants can then either be processed by an alternative technology or dewatered and disposed of off site. Process water is cleaned of contaminants and recycled for further use in the system.

Company Name/POC: Smith Environmental Technologies Corp./Dave Ettlers

Address : 304 Inverness Way South/Suite 200/Englewood, Colorado 80112

Phone Number : 303 790-1747

Fax Number : 303 799-018

Technology Maturity : Commercial use experience

Performance History :

Salt removal system for Petroleum Environmental Research Foundation; Bench-scale treatability - removal of thorium and plutonium from soil for the U.S. Department of Energy; Gould Superfund site - battery waste and lead contaminated soil; Tonalli Battery Superfund Site Proof of Process for RI/FS; Pesticide removal for W.R. Grace bench-scale treatability; pesticide removal for confidential client; PCP and carcinogenic PAH removal for confidential client.

Comments:

Specific removal efficiencies are dependent upon the type and form of a contaminant as well as the type and grain size distribution of the contaminated soil. Sand fractions can often be cleaned to less than 1 ppm final contaminant concentrations, while silt/clay fractions may only be cleaned to less than 50 ppm. Soil washing systems are usually not technology-limited, but may not be cost effective for difficult to remove or low contaminant levels (less than .5 ppm).

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☐ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Soil Washing*

Technology Name : Soil Washing

Application :

On-site	Ex-situ
Off-site	

Brief Description : This technology achieves soil, sediment, and sludge treatment for volume reduction or recycle. Treatment removes hydrocarbons, heavy metals, and radionuclides from contaminated media. It utilizes a patented system with countercurrent augers augmented by high pressure, heated water and co-surfactants as needed according to requirements as determined by treatability tests in the company's in-house lab. Full-scale performance with the technology has achieved state and federal cleanup standards at competitive prices. Advantages include limited or no emissions, volume reduction, low water usage, 60' x 60' footprint, and simultaneous hydrocarbon/metals treatment.

Company Name/POC: TVIES, Inc./W. R. (Randy) Hall

Address : 2835 Holmes Road/Houston, Texas 77051

Phone Number : 713 799-5243

Fax Number : 713 799-5548

Technology Maturity : Commercial use experience

Performance History : Performance Data are Available.

HYDROCARBONS: (3, 500-15,000 tons) successfully achieved cleanup requirements in all cases. Problems included consistency in contamination level and soil/media particle size of feed, and water treatment/recycle if large swings in contamination level are experienced.

NORM: (3, 2-500 bbls) treated to <5pCi/gm with volume reduction of 70-95 percent.

HEAVY METALS: (2, 100-800 tons) achieved state cleanup standard.

Comments : Process is modular and as such, it is very flexible. Most functions are automated and labor intensity is not high. Equipment is not complex and tolerances are not high. Operation/maintenance and supplies/equipment are readily available and easy to install. Current feed rates are 10-40 tons/hr. Could achieve higher rates with added modules. Higher capacity or greater efficiency equates to lower cost. Considered BDAT for heavy metals and low-level radionuclides.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Soil Washing***Technology Name :** Soil Washing**Application :** On-site Ex-situ

Brief Description : The process uses well known mineral-handling technology to separate the contaminated material into two or more fractions. The fractions are cleaned, using physical (e.g., scrubbing heat, pressure jets) and chemical steps (e.g., pH adjustment, oxidation). The washing fluid may be water or water with chelating agents or surfactants, acids or bases, depending on the contaminant to be cleaned. The equipment is mobile and operates continuously. The process works best on particles greater than 270 mesh (approximately 0.05 mm).

Company Name/POC: West PAC Environmental, Inc./Mark McCullough**Address :** P.O. Box 80743 (zipcode 98108)/54 South Dawson Street/Seattle, Washington 98134**Phone Number :** 206 762-1190**Fax Number :** 206 762-936**Technology Maturity :** Commercial use experience

Performance History : Metals such as lead and arsenic have been treated with up to 95 percent reduction. TPHs have been treated, reducing levels from over 50,000 ppm to 300 ppm. West PAC has pilot-, treatability-, and production-level equipment on hand. Over the last five years, West PAC has conducted research and development work on soil washing for total petroleum hydrocarbons (TPH) and metal removal.

Comments : Efficient cleaning of the finer or clay fractions (<270 mesh) has required a combination of soil washing with another technology, such as solidification, bioremediation, or simply disposal of the fine fraction. Complex waste mixtures make fluid formulation of the washing fluid difficult. Based on tests, to date, the mixture of metals with organics has been identified as problematic.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Soil Washing*

Technology Name : Westinghouse Soil Washing System

Application : On-site Ex-situ

Brief Description : The Westinghouse Soil Washing Process (WSWP) can treat soils contaminated with organics, heavy metals, radionuclides, and combinations of contaminants. The full-scale units are integrated process trains which use equipment originally developed for the mining industry. The process is arranged to form three functional units: an initial screening and wash of coarse materials; breakup of the remaining solids followed by a thorough wash; a high intensity leaching and separation of the contaminated fines from the clean soil.

Company Name/POC: Westinghouse Remediation Services, Inc./William E. Norton, P.E.

Address : 675 Park North Boulevard/Building F/Suite 100/Clarkston, Georgia 30021

Phone Number : 404 299-4736

Fax Number : 404 296-9752

Technology Maturity : Commercial use experience

Performance History : Westinghouse has completed a major soil washing project which involved remediation of 16,000 cubic yards of material contaminated with metals at a site near Bruni, Texas. In addition, Westinghouse has completed bench-, and full-scale pilot testing for the remediation of a wood treating site. Westinghouse has also successfully performed numerous bench-, and pilot-scale treatability studies.

Comments : Westinghouse maintains two full-scale soil washing units. Both process a continuous feed of soil, the larger unit at 20 tons per hour, and the smaller one from 2 to 4 tons per hour. Both units are trailer-mounted and can be easily mobilized. This technology has been proven effective in handling soils that are difficult to wash, such as clays. Aqueous-based, biodegradable leachates are used so that soil washing residuals will not pose future contamination problems.

Source of Information : VISITT 3.0

CONTAMINANTS :☒ Pesticides/Herbicides☒ Heavy Metals☒ PCB☒ Explosives/Propellants☒ Petroleum Hydrocarbons☒ Radionuclides☒ SVOC☒ Other Contaminant☒ Nonhalogenated VOC☒ Halogenated VOC☒ N/A**TECHNOLOGY TYPE :** *Solidification/Stabilization (Ex Situ)***Technology Name :** Customized Grout Applications for Waste Management**Application :**

On-site

Ex-situ

Off-site

Brief Description :

The company offers design and specification of customized grout formulations and mobile and fixed mixing plants to carry out void filling of drums containing solid wastes, plastics, etc. End products are large containers of decommissioned waste from soil stabilization or hydraulic cut-offs that sensibly meet the present regulations.

Company Name/POC: A-Z WASTE TEK Ltd./David J. Brown**Address :** 32A Pooch Rd/Upton Poole/Dorset England BH16 5JB**Phone Number :** 01144 1202 624985**Fax Number :** 01144 1202 62517**Technology Maturity :** Commercial use experience**Performance History :**

DJ Brown/A-Z is the originator of designs of many of the acceptable cement based grouts. Currently used in the UK nuclear industry. A-Z has extended designs/specifications into a second generation of high performance grouting systems that have greater flexibility, longer working times and better end product performances.

Comments :

Technology uses readily available equipment. Organic wastes can be a problem. A-Z can demonstrate the acceptability to grout containers with solid or decommissioned wastes from 200 liters to large ISO freight sizes. In its own laboratories A-Z have designed and demonstrated novel grouts and grouting systems to handle:

Thickened slurries

Solid simulated asbestos waste

To produce special absorbents

Synergized performance grouts

Source of Information : International TechCon

☐ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☒ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

Technology Name : Polymerization of Heavy Metal Ions

Application :	On-site	Ex-situ
	Off-site	

Brief Description : Process uses a polymerized sulfide agent to chemically and physically stabilize heavy metal ions. The final waste product meets U.S. EPA leaching criteria. Stabilized product is low in volume and is chemically inert.

Company Name/POC: ADTECHS, Inc. (a wholly owned subsidiary of JGC Corp.)/Ken Sauda

Address : 2411 Dulles Corner Park/Suite 520/Herndon, Virginia 22071

Phone Number : 703 713-9000

Fax Number : 703 713-9101

Technology Maturity : Commercial use experience

Performance History : This process has been in use for 10 years for chemically binding heavy metals in municipal incinerator effluent streams. It is now also being used for processing electronics and electroplating manufacturing wastes. This process has been used for 10 years in Japan to fix heavy metal ions in process waste streams. It will work with radioactive or non-radioactive metal ions. Full scale, operational systems have been in service for several years.

Comments : Materials handling and processing equipment are required, depending on the through-put rates and material form. May require soil washing and crushing equipment. Does require tanks for precipitation of waste dissolved water. Heavy metal ions must be wetted or in solution to react with the polymer. The basic challenge is the handling of the contaminated material.

Source of Information : TechCon

CONTAMINANTS :

- ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Solidification/Stabilization (Ex Situ)**Technology Name :** Heitkamp Process of Solidification**Application :**

On-site Ex-situ
Off-site

Brief Description : The Heitkamp Process is a patented solidification process for hazardous organics, metals, and radionuclides in soil, sediments, and sludges.**Company Name/POC:** Heitkamp Umwelttechnik GmbH**Address :** Heinrichstr 67/44805 Bochum, Germany**Phone Number :** 49 234 87905 236**Fax Number :** 49 234 87905 11**Technology Maturity :** Commercial use experience**Performance History :** The Heitkamp Process - Immobilization of contaminants by solidification was developed in 1986. The year of issue of the patent grant was 1989. From 1987 to 1995 22 projects were carried out with hazardous organics and heavy metals contaminated soils and sludges. In 1994 tests with radioactive contaminated overburden of uranium mines were performed. The result of these experiments was a reduction of the mobile radioactive components down to 3 percent.**Comments :** The mobile equipment is easy to handle, highly flexible and requires only short mobilization (1 week). No fixed installed infrastructure needed for the mobile equipment. The capacity depends on size and type of equipment (mobile around 250 t/d, portable 1,000 t/d, field erected more than 1,000 t/d).**Source of Information :** International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☒ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Solidification/Stabilization (Ex Situ)*

Technology Name : Phoenix Ash Technology (P.A.T.)

Application : On-site Ex-situ

Brief Description : This is a mobile or fixed-based ex-situ treatment technology that can be designed and built in a variety of capacities. The technology employs well established pozzolanic reaction chemistry to encapsulate a wide variety of potential waste streams. The P.A.T. technology uses C-grade fly ash from coal-fired power plants to encapsulate wastes into a fly-ash matrix in a form the size of standard construction bricks. Fly ash and waste are mixed and compressed into waste/ash bricks. The product shows significant leach resistance, low permeability, high compressive strength, resistance to spalling and cracking, and low thermal conductivity. The final waste form produced has been shown to pass the TCLP test and to have potential recycling applications in a variety of construction formats. The produced brick has potential application in construction of on site vaults for long term storage of bricks containing waste. The process is relatively inexpensive, operates at ambient temperatures, has a high loading rate, uses abundant and cheap fly ash, and produces a block configuration with high leach resistance and structural strength. The bricks have short cure times of approximately 15 minutes and have an advantage in not requiring special containers for storage.

Company Name/POC: Informatic Inc./John Theis/Mike Riddle

Address : 1900 Randolph Road, SE/Suite A/Albuquerque, New Mexico 87106

Phone Number : 505 248-1191

Fax Number : 505 248-1196

Technology Maturity : Commercial use experience

Performance History : Performance Data are Available.

Commercial application - 900 tons of mine tailings at the Shiny Rock Mining Co site near Salem Oregon mine site in October 1992. Testing conducted at ORNL during 1993; shows TCLP results for metals similar to cement-based solidification/stabilization, Roger Spence (MMES ORNL 615-574-6782. Testing conducted at LANL in 1993, Karl Standhammer, 505-667-9333. Bruce King (Dr.) NETAC, 412-826-5511 wrote study for EPA on the results of stabilizing sodium salts into final waste forms.

Comments : The feed material to the process requires reactive grade Class C fly ash. The waste stream is restricted to a maximum of 20 percent moisture. Higher levels of moisture content can be pre-treated using additional fly ash which is an inert material. Additional data is needed to fully define the range of materials that can be treated using this technology. In addition, the current level of regulatory acceptance associated with the technology needs to be more fully defined. In particular, the final waste form has the technical potential to be utilized in construction of on-site vaults for long term repositories. Another alternative that should be explored more fully is the use of the bricks containing waste in recycling or resource recovery applications. This technology is based on the use of pozzolanic reactions in stabilization/solidification. These reactions are a well established process in construction applications going back in history more than 2,000 years and are noted for their long term stability. The Phoenix Ash Technology [PAT] employs these reactions but is a newly developed technology with a very limited track record. It can frequently be considered as similar to cementitious reactions which are frequently rejected because of the containment strategy, volume growth, limited long term stability, and long cure times. The PAT technology provides rapid cure times, volume reduction potential and very long term stability. The technology has been used to remediate a small lead-mill-tailings site in Oregon using a mobile treatment configuration with a capacity of 40 tons/day [8 hour shift]. An 80 ton/day [8 hour shift] unit has been built and is currently available from TIDE to be used in providing field services.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : Solidification/Stabilization (Ex Situ)**Technology Name :** Radwaste Cementation and Process Control**Application :**

On-site Ex-situ
Off-site

Brief Description :

The quality of cemented waste has to be proven. Process control is preferable to end control. The advantage of process control is that during operation the system can be improved. Various on-line measuring techniques have been developed to check the mechanical, chemical and radiological properties during the cementation process.

Company Name/POC: KEMA Nederland B.V./H.A.W. Cornelissen**Address :** P.O. Box 9035, NL-6800 ET/ARNHEM, The Netherlands**Phone Number :** 31 2635 63370**Fax Number :** 31 2644 2363**Technology Maturity :**

Field demo complete

Performance History : During a four year European project, measurement techniques and procedures were developed and validated at a radwaste campaign at a BWR power plant.**Comments :**

None.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Solidification/Stabilization (Ex Situ)*

Technology Name : Stabilization/Solidification

Application : On-site Ex-situ

Brief Description : Severson (in conjunction with VFL Technology of Malvern, PA) works extensively with a variety of reagents (both individually and in combination) to meet treatment criteria. The stabilization process uses generic custom reagents which chemically react with contaminated materials to immobilize contaminants and prevent leaching. The technique has been widely used in many applications. The advantages of S/S is the relatively inexpensive price and wide acceptance for a variety of situations.

Company Name/POC: Severson Extraction Technology, Inc./Philip R. DeLuca

Address : 2749 Lockport Road/Niagara Falls, NY 14302-0396

Phone Number : 716 284-0431

Fax Number : 716 284-1796

Technology Maturity : Commercial use experience

Performance History : Contact company for performance history data.

Comments : The technique has been widely used on soils and sludges. Applicability to DOE needs can be determined with a high degree of accuracy through treatability studies. Although VFL has conducted some treatability studies on low-level radioactive and mixed wastes, more detailed studies need to be done. The firm operates a full-service laboratory facility capable of conducting detailed treatability work.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Solidification/Stabilization (Ex Situ)*

Technology Name : Molecular Bonding System

Application : On-site Ex-situ

Brief Description : The Molecular Bonding System (MBS) is a patented process that stabilizes heavy metals in soils, sludges and ash. The MBS process chemically renders leachable metal ions inert by bonding them to non-leachable molecules. MBS powder is added to excavated soil or sludge in a pug-mill operation. Moisture is added to enhance mixing. Curing is immediate and the soil is conveyed to a retention bin where, once dried, it is either returned to the site or disposed of off-site at subtitle "D" landfills.

Company Name/POC: Solucorp Inc./Michael DeLuca

Address : 520 Victor Street/Saddle Brook, New Jersey 07663

Phone Number : 201 368-7902

Fax Number : 201 368-852

Technology Maturity : Commercial use experience

Performance History : MBS has been performed on bench-scale, pilot, and commercial projects and in all cases has successfully reduced contaminated levels to non-detectable or well below EPA acceptable limits. Depending on the size of the equipment, the system can treat between 20-100 tons/hr. Curing time is immediate.

Comments : The total system is ~75 feet long, 10 feet high except for the silo, which is 33 feet high and 16 feet wide. This equipment is powered by a diesel generator. As 15-20 percent moisture is required, a water source is necessary. Two workers and one supervisor are required to operate machinery. The MBS technology is not suitable for treating contaminated liquids. Treated material can be returned to the site in basically the same form. Material is easily transported since the handling characteristics are not changed. Curing time is immediate.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Solidification/Stabilization (Ex Situ)*

Technology Name : Stabilization/Solidification

Application : Off-site Ex-situ

Brief Description : STC Omega specializes in the development and application of technologies for the treatment of organic and inorganic contaminated soils, sludges and wastewaters. STC Omega's chemical fixation and solidification technologies have been utilized successfully to treat over 500,000 cubic yards of contaminated soils and sludges on >30 full-scale hazardous waste remediation projects across the U. S. and in Italy. STC Omega's technologies have been applied to industrial in-process treatment, hazardous waste site remediation projects, RCRA Landban treatment in a Part B permitted hazardous waste landfill facility, and organic and inorganic industrial wastewater treatment systems. Technology allows treatment to be performed in-situ. Full-scale treatment performance can be determined effectively on a laboratory- and pilot-scale basis before full scale.

Company Name/POC: STC Omega, Inc./Greg Maupin

Address : 7650 E. Redfield Road/Suite D5/Scottsdale, Arizona 85260

Phone Number : 602 948-7100

Fax Number : 602 991-3173

Technology Maturity : Commercial use experience

Performance History : Performance Data are Available.

Comments : This technology is quite versatile. It has been used inside buildings, in rural areas with minimal access to power, and normal construction sites. Soil matrix such as stiff clay can reduce the treatment rate production. STC Omega has been successful in treating all types of soil matrices. STC Omega treatment can be provided with standard rental construction equipment. Main attribute after treatment is significantly reducing the leachability and mobilization of contaminants. This reduction can be determined with such tests as the EPA TCLP and American Nuclear Society ANS 16-1.

Source of Information : TechCon

CONTAMINANTS:

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Solidification/Stabilization (Ex Situ)**Technology Name :** Stabilization/Solidification**Application :** On-site Ex-situ**Brief Description :** Use of generic low-cost cementing additives to produce monolithic stabilized waste forms of residual leachability.**Company Name/POC:** Wastewater Technology Centre/Rockcliffe Research Management/Julia Stegemann**Address :** 867 Lakeshore Rd./P.O. Box 5068/Burlington, Ontario, L7R 4L7, Canada**Phone Number :** 905 336-4738 **Fax Number :** 905 336-476**Technology Maturity :** Commercial use experience**Performance History :** Considerable body of work conducted in support of Ontario Waste Management Corporation Facility design 1985-1992. Call contact for additional references.**Comments :** WTC/RRM has extensive information development capability. Would need to work with contractor for full-scale application.**Source of Information :** International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Chemical Extraction***Technology Name :** Low Energy Extraction Process (LEEP)**Application :** On-site Ex-situ

Brief Description : LEEP (Low Energy Extraction Process), a patented process, uses common organic solvents to extract and concentrate organic pollutants from soil, sediments, and sludges. After a pre-treatment step, the solid matrix is washed using a unique dual solvent approach. A combination of proprietary hydrophilic and hydrophobic solvents guarantees the efficient removal of the contaminants. The extracted pollutants are concentrated in a sacrificial solvent by liquid-liquid extraction or by distillation and are removed from the process for off-site disposal or recycling. The leaching solvents are internally recycled and the treated soil can be used as clean fill at the site.

Company Name/POC: Art International, Inc./Werner Steiner, Genya Mallach**Address :** 100 Ford Road/Denville, New Jersey 07834**Phone Number :** 201 627-7601**Fax Number :** 201 627-6524**Technology Maturity :** Pilot plant testing**Performance History :** Performance data are available.

LEEP was accepted into the SITE Emerging Technologies Program, and has been successfully demonstrated at bench- and pilot-scales. Bench-scale treatability studies are routinely conducted for government and private clients. Treatment of tar contaminated soil from manufactured gas plant sites containing up to 5 percent tar has been successfully demonstrated in pilot-plant tests. A 200-pound per hour pilot plant has been used in the test program for scaling-up the commercial size plant. Operating permits have been obtained under TSCA, and RCRA. This removal efficiency of organic contaminants is as high as 99 percent and the volume reduction of the original waste is over 90 percent.

Comments : LEEP is a high efficiency mobile process for removal of virtually any organic pollutants from soil, sediments, and sludges. The matrix can contain particle sizes down to the submicron range and water concentration from a few percent up to 90 percent. This process can remediate organic pollutants and is not applicable for inorganics such as heavy metals. The process is designed for zero air emissions.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Chemical Extraction***Technology Name :** Corpex Technology**Application :**

On-site

Ex-situ

Off-site

Brief Description :

Corpex Technologies Inc. has developed and acquired patents on certain innovative chelation chemicals with unique capabilities for control and recovery of radioactive and other types of hazardous metal ions from soils, concrete, steel, and other materials. Corpex Technologies Inc. products can be applied in a soil wash process that can be targeted specifically to complex and remove undesirable and toxic ions or radionuclides and permit the soil to be returned clean to its site. The process is either batch or semicontinuous and takes place; typically above ground. Corpex Technologies Inc. patented formulations can remove such contaminants, usually at neutral pH, without the use of acids or caustics, and are effective over a wide range of temperatures. The chemicals can be oxidized after the cleaning process and no undesirable residues are left — only water, carbon dioxide, carbon monoxide, and nitrogen.

Company Name/POC: Corpex Technologies, Inc./John K. Pirotte**Address :** 5400 S. Miami Boulevard/Suite 154/Morrisville, North Carolina 27560**Phone Number :** 919 941-0847**Fax Number :** 919 941-065**Technology Maturity :**

Bench scale testing, only

Performance History : The effectiveness of Corpex Technologies Inc. chemicals has been proven in a variety of difficult industrial and environmental situations; however, full-scale field application systems will require engineering development. Corpex Technologies Inc. has studied a variety of approaches to scaling up its processes and believes existing field application technology can be modified relatively easily to accommodate them.

Comments :

There are no currently known alternative chemical means to selectively dissolve radioactive contaminants in soils. Corpex Technologies Inc. chemicals, however, have demonstrated the ability to dissolve both deposits of radioactive metals as well as other toxic heavy metals locked in compounds. Solutions used in the decontamination process can be destroyed, resulting in greater than 99.99 percent destruction of all organics present. The destruction process results in precipitation of contaminants, which can then be removed by filtration and ion exchange, for further processing.

Source of Information : VISITT 3.0

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☒ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☒ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Chemical Extraction*

Technology Name : Carver-Greenfield Process

Application : Ex-situ

Brief Description : The Carver-Greenfield (C-G) Process can be used to treat sludges, soils, and other water-bearing wastes containing hazardous compounds, including polychlorinated biphenyls (PCB), polycyclic aromatics (PNA), and dioxins. This unique process efficiently separates hazardous solid/liquid feed materials into three product streams convenient for disposal: (1) a clean, dry solid, (2) a water product virtually free of solids and oils, and (3) a concentrated mixture of the extracted compounds. The recovered solvent is reused in the process. The full-scale system is normally continuous, but can be operated in a batch or semicontinuous mode depending on the particular process/capacity requirements.

Company Name/POC: Dehydro-Tech Corp./Theodore D. Trowbridge

Address : 6 Great Meadow Lane/East Hanover, New Jersey 07936

Phone Number : 201 887-2182

Fax Number : 201 887-2548

Technology Maturity : Pilot plant testing

Performance History : Performance data are available.

The successful pilot plant demonstration under the SITE Program was carried out in summer 1991 to separate oily drilling muds into their constituent oil, water, and solid phases. Other soil remediation tests have also been carried out.

Comments : Feeds to the process must include solids (5 to 95 percent), water (5 to 95 percent) and oil soluble contaminants (percentage level to over 75 percent) to maximize its capability. Note that the technology separates and concentrates feeds into solids, water and oil-soluble streams but does not destroy them. In the last 30 years, over 80 commercial C-G Process facilities have been licensed in a dozen countries to solve waste disposal problems in a wide variety of fields.

Source of Information : VISITT 3.0

CONTAMINANTS :☐ Pesticides/Herbicides☒ Heavy Metals☐ PCB☐ Explosives/Propellants☐ Petroleum Hydrocarbons☐ Radionuclides☐ SVOC☐ Other Contaminant☐ Nonhalogenated VOC☐ Halogenated VOC☐ N/A**TECHNOLOGY TYPE :** *Chemical Extraction***Technology Name :** Metals Recovery & Recycling System**Application :**

On-site

Ex-situ

Brief Description :

This process is unique in that (1) regulated metal contaminants are selectively extracted while non-regulated metals remain in the treated soil, (2) metal contaminants are discharged from the process as a 50 percent to 99 percent pure concentrate suitable for and consistent with regulatory requirements for recycling and (3) all soil fractions are remediated on site; therefore no import of backfill soil and no off-site management of any soil fraction is necessary. The process is semicontinuous and consists of three key treatment steps: physical separation, chemical extraction and liquids processing.

Company Name/POC: Environmental Technologies International/Troy DuGuay**Address :** P.O. Box 453/Shillington, Pennsylvania 19607**Phone Number :** 610 796-9102**Fax Number :** 610 796-145**Technology Maturity :** Commercial use experience

Performance History : To date, the technology has successfully remediated soils contaminated with mercury, lead, chromium, cadmium, copper, nickel, and zinc. The Metals Recovery and Recycling System is recognized as a recycling technology as defined by RCRA regulations. State approvals to operate the system under recycling exemptions have been obtained. Experience in remediation of cadmium, lead, and arsenic in soils at Sacramento Army Base.

Comments :

The technology is designed to remediate soils which are contaminated with regulated metals. The presence of non-friable porous material, organic compounds and, non-regulated metals are of significant concern when applying this process. None of these three aspects make the application of the system impossible. However, they may increase the cost.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Chemical Extraction*

Technology Name : GRS Solvent Extraction

Application :

On-site	Ex-situ
Off-site	

Brief Description : GRS Solvent Extraction treats soils and sediments contaminated with heavy organics, in a mobile plant. An organic solvent extracts the contaminants in a solid-liquid contactor. The soil is then rinsed and dried at low temperature. The solvent is recycled on site. The concentrated contaminants are incinerated off site. Extraction efficiency is 98-99 percent.

Company Name/POC: GRS/G. Pottecher

Address : 13 Villa Croix Nivert/75015 Paris, France

Phone Number : 33 1 53 69 61 80

Fax Number : 33 4734 6855

Technology Maturity : Field demo complete

Performance History : More than 15 pilot scale studies have been completed. One commercial job for GAZ de France (100 t at 20g/kg PAH) Contact: Mr. Vercamer 33 1 49 22 52 39. Efficiency has been demonstrated with PAH, PCB, motor oil, heavy fuel. The process potentially applies to pesticides, dioxins and most heavy organics.

Comments : Effectiveness, feed rate and operation cost are impacted by the amount of fine particles and water in the soil. A treatability study enables GRS to quantify the process performance. The process generates no effluent. Treated soil or sediment can be returned to the site. In France they can also be recycled, e.g., as vegetal soil or fill material. Grain size is reduced to below 4 mm.

Source of Information : International TechCon

CONTAMINANTS :

- ☒ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : Chemical Extraction**Technology Name :** Acid Extraction**Application :**

On-site Ex-situ
Off-site

Brief Description : The batch steam distillation/metal extraction treatment process is a two-stage process to remove organics and heavy metals from Superfund soils. The first stage, soil vapor extraction, removes volatile organics from a slurry of the contaminated soil by direct steam injection. The volatile organics are taken overhead, condensed, cooled and collected. For treatment of metals, soil vapor extraction is followed by acid extraction. The soil slurry is washed with hydrochloric acid. Subsequent counter current batch washing with water removes residual acid from the soil. The solids are then separated from the final wash solution by gravimetric sedimentation.

Company Name/POC: IT Corporation/Edward Alperin**Address :** 312 Directors Drive/Knoxville, Tennessee 37923**Phone Number :** 615 690-3211**Fax Number :** 615 690-362**Technology Maturity :** Pilot plant testing**Performance History :** Pilot facility being constructed at vendor's location.

Comments : Process as currently designed is a batch process. This limits the process capacity of the system and directs its application to smaller hazardous waste sites. Certain waste contaminants can cause foaming of the slurried soil during the batch steam distillation step. Anti-foaming agents or reduced steam rates can control this phenomena.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Chemical Extraction***Technology Name :** Acid Extraction**Application :** Ex-situ

Brief Description : Lockheed offers a variety of chemical extraction remediation systems tailored to the client's need and is continually developing new techniques for characterization and remediation of wastes. The approach used for a given contamination problem is site specific. In many cases of contamination, the material requires treatment with suitable acidic media in order to remove the contaminant of concern. The selection of the appropriate solvent for use and the conditions of the leaching are again site specific. The selection of the approach and the accompanying leach conditions necessary are key to the development of the most economic solution to the particular problem.

Company Name/POC: Lockheed Environmental Technologies Divisions/Randy Smith**Address :** 151 N 3rd Ave./Suite 500/Pocatello, ID 83201**Phone Number :** 208 234-3526**Fax Number :** 208 234-3550**Technology Maturity :** Commercial use experience

Performance History : Lockheed has successfully designed, constructed and operated batch and continuous treatment facilities. Typical projects are China Lake Naval Air Weapons Center, and Idaho National Engineering Laboratory Pit 9. Lockheed has also treated wastes from battery recycling and disposal, chloro-alkali manufacturing, electroplating, metal ore mining and smelting, petroleum refinery, inorganic chemical manufacturing, semiconductor manufacturing, rubber manufacturing and landfill sites. Lockheed has performed remediation at RCRA, CERCLA, TSCA, DOD, DOE, and state sites. Projects have ranged from bench scale to treatability studies to full scale.

Comments : The process utilizes physical separation techniques, if appropriate, to isolate the fractions of concern in minimal volumes. The contaminant is further removed by acidic treatment when that is found to be effective. That operation can be concurrent or counter current as conditions dictate. The soluble element/elements of concern are further isolated using other hydrometallurgical techniques appropriate to the situation.

Source of Information : VISITT 3.0

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Chemical Extraction*

Technology Name: Metals Extraction (METALEX)

Application: On-site ☒ Ex-situ ☒
Off-site ☒

Brief Description: METALEX is a series of extraction technologies for metal-contaminated soils and sediments. Each technology represents a formulation specific to the type and mixture of metal contaminants. METALEX may be used alone or in conjunction with HYDROSEP soil washing systems.

Company Name/POC: Metcalf and Eddy, Inc./Pier Mantovani

Address: 30 Harvard Mill Square/Wakefield, MA 01880

Phone Number: 617 246-5200

Fax Number: 617 245-629

Technology Maturity: Field demo complete

Performance History: METALEX is being used on jobs with soil or sediment volumes ranging from 2,000 to 200,000 cu yds. All jobs are initiated with treatability tests to select the optimum METALEX formulation.

Comments: Design requirements which impact use include the length and number of transfer units (extraction, stages), and initial type and mixture of metal contaminants. METALEX systems run with a combination of chemical/process engineers, analytical chemists, and skilled equipment operators and mechanics. With adequate treatability testing and site characterization the METALEX technology is relatively easy to use. Solids subjected to METALEX and meeting site specific criteria are returned to the site. METALEX solutions are treated to isolate target metals for recovery and further treatment by stabilization/fixation/vitrification. METALEX solutions are recycled to the head of the process to the maximum extent practical.

Source of Information: International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☐ Heavy Metals	☒ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☒ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Chemical Extraction*

Technology Name : RCC Solvent Extraction

Application : On-site Ex-situ

Brief Description : This technology extracts PCBs, pesticides and PAHs from soils, sludges, and sediments; produces water suitable for discharge; reduces waste volumes 90 - 99 percent+; treated solids can be returned to the site; and reduces the organic concentrations below TCLP limits. No air emissions.

Company Name/POC: Resource Conservation Company (a Halliburton Company)/Lanny Weimer

Address : 3630 Cornus Lane/Elliott City, Maryland 21042

Phone Number : 301 596-6066

Fax Number : 410 465-2887

Technology Maturity : Field demo complete.

Performance History : RCC has designed, constructed and operated three pilot plants and one commercial-scale unit (70 tons/day). The commercial scale unit is designed to process only pumpable sludges and sediments. The current pilot plant and future commercial-scale units will be configured to treat pumpable and non-pumpable (soils and filter cake) wastes.

Comments : Modular systems designed to be suitable for meeting a variety of site area and utility conditions. Typically, a 75-100 ton/day will require a 75 x 100-foot area and 400 amp electrical service. System operates at ambient pressure and moderate temperatures; bench scale treatability testing required for all applications. Can process soil, sludge and sediment containing clay and silt without increased difficulty. Process operates at near ambient pressures and moderate temperatures (up to 212 degrees Fahrenheit). Operation is stable and does not require specialized skills. Waste volume reduction (removing water and organics) can be 90 - 99 percent in sludges and soils.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Chemical Extraction*

Technology Name : Terra-Kleen

Application : On-site Ex-situ

Brief Description : The Terra-Kleen unit is a mobile batch processing system which removes undesired organics from soil, sediment and debris. Soil is typically dewatered prior to processing. After dewatering, the soil is mixed with solvent to dissolve organic contaminants. The solvent is then removed from the soil which removes the organics. This process is repeated until target contaminant levels are reached. The process results in a concentrated organic waste stream which is drummed for off-site disposal, a treated soil stream which may be reused at the site or sent for further processing, and a clean solvent stream which is recycled in the Terra-Kleen Unit. This system can be used to remove semi-volatile and nonvolatile organic contaminants from soil. Current technologies that this system could replace are incineration and thermal desorption. Most significant advantage is lower cost. Another advantage is that oversized material does not have to be separated from the soil matrix.

Company Name/POC: Terra-Kleen Corporation/Alan Cash

Address : 7321 North Hammond Avenue/Oklahoma City, Oklahoma 73132

Phone Number : 619 792-2985

Fax Number :

Technology Maturity : Commercial use experience

Performance History : Completed 1 Superfund site, currently working on NPL site in Maine; have also worked for industry.

Reference: Mark Meckus, 513-569-7676 (USEPA SITE Program, Risk Reduction Engineering Laboratory)

Reference: Scott Engle, 513-241-0149 (PRL Environmental Management)

Comments : The technology has problems with clay and high water content.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *High Temperature Thermal Desorption*

Technology Name : Hrubout (TM)

Application : In-situ (vadose zone) Ex-situ

Brief Description : The HRUBOUT process is a mobile thermal treatment process that removes volatile and semivolatile organic compounds from contaminated soils. In the process, heated air is injected into the soil below the zone of contamination, evaporating the soil moisture and removing the VOCs and SVOCs. Once the water is evaporated, the soil porosity and permeability are increased, allowing for increases in pressure and temperature. Low-volatility hydrocarbons can then be removed by slow oxidation at temperatures of approximately 800 degrees Fahrenheit.

Company Name/POC: HRUBETZ Environmental Services, Inc./Albert Hrubetz

Address : 5949 Sherry Lane/Suite 525/Dallas, Texas 75225

Phone Number : 214 363-7833

Fax Number : 214 691-8545

Technology Maturity : Field demo complete

Performance History : Performance data are available.

Early research and development activity led to the development of the first prototype commercial unit in August 1990. The unit was subjected to nearly three months of continuous operation at a test site. Results confirmed bench-scale tests. The process was approved by the Texas Water Commission in December 1991. The VOC destruction rate is a minimum of 99.5 percent.

Comments : There are no waste streams produced, thus eliminating the need for further treatment. The process eliminates the need to landfill soils and therefore, reduces potential future liability. The process cannot remove metals from soils.

Source of Information : VISITT 3.0

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *High Temperature Thermal Desorption*

Technology Name: Thermal Desorption System

Application: On-site Ex-situ

Brief Description: Use of two stage process to remove a wide variety of contaminants from soils, sediments, and sludges. System components consist of rotary kiln, soil discharge/dust suppression system, cyclone, quench tower, baghouse, ID fan and stack. In the rotary kiln, heat volatilizes contaminants from the soils at temperatures ranging from 600 to 1000 degrees Fahrenheit. The volatilized contaminants are then destroyed in a high efficiency afterburner. Off-gases are cooled and filtered prior to discharge. Clean soils can be re-used as backfill. The system is suitable for a wide range of feed characteristics, from dry gravel to high moisture tars to clays.

Company Name/POC: Maxymillian Technologies, Inc./Neal Maxymillian (Boston)/John Anthony (HQ)

Address: 1801 East St./Pittsfield, Massachusetts 01201

Phone Number: 413 499-3050

Fax Number: 413 443-051

Technology Maturity: Commercial use experience

Performance History: Performance data are available.

The system has processed over 250,000 tons of petroleum contaminated soils, many with heavy clays and high moisture content. The system is currently processing PAH contaminated soils at a coal tar site. The system processes soil with high tar content.

Comments: The system can be limited by the BTU value of the feed. Additionally, certain contaminants, such as metals, limit throughput if scrubbing technology is not employed.

Boston contact number: 617-557-6077

Source of Information: VISITT 3.0

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *High Temperature Thermal Desorption*

Technology Name : Mercury Recovery Services (MRS)

Application : On-site Ex-situ

Brief Description : In this process, the contaminated feed is blended with a proprietary additive which promotes decomposition of stable mercury compounds and loaded into a batch-operated furnace for processing. Thermal processing is divided into two stages: feed drying and mercury desorption. By staging the process in this manner, the process does not result in a water-mercury waste stream as water is maintained in vapor phase throughout the gas handling system. Metallic mercury is condensed from the carrier gas during the second stage of the process. All process air is filtered through a series of gas filtration columns containing sulfur-impregnated carbon.

Company Name/POC: Pittsburgh Mineral & Environmental Tech/William F. Sutton

Address : 700 Fifth Avenue/New Brighton, Pennsylvania 15066

Phone Number : 412 843-5000

Fax Number : 412 843-5353

Technology Maturity : Field demo complete

Performance History : Three process products: Mercury-free solids (<1 ppm total Hg); Metallic Mercury (>99 percent total Hg); and Mercury-free process gas exhaust. Capable of recovering metallic mercury from numerous mercury compounds including oxides, sulfides, chlorides, etc. Treatability demonstrations has been performed on contaminated soils (sand, clays, carbonates) and wastes from chlor-alkali facilities (K106, D009).

Comments : Contaminant identified as : Mercury

No liquid process effluent stream; designated as recycling by numerous regulatory agencies; applicable to contaminated soils, sludges (K106), debris (D009); applicable to sandy, clayey, and loamy soil types; performance not dependent upon feed Hg content.

Although the process has been designated as recycling; it also meets the BDAT requirements for mercury contaminated wastes.

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *High Temperature Thermal Desorption*

Technology Name : HT-6 Thermal Distillation

Application : On-site Ex-situ

Brief Description : HT-6 can operate up to 2,200 degrees Fahrenheit. The desired material temperature is reached gradually as it progresses through the system. In the first zone, most of the water is vaporized along with a portion of the light hydrocarbons; in the second zone the remainder of the light ends and water are vaporized along with a portion of the heavy hydrocarbons; in the third zone almost all of the remaining hydrocarbons are vaporized and the thermal desorption is complete. After passing through the third zone, the solid product leaves the HT-6 system through an exit port and is transported by the screw conveyor to a collection bin for ultimate disposal. The final product is inert, chemically stable and meets all federal, state, and local landban restriction criteria.

Company Name/POC: Seaview Thermal Systems/William Packer

Address : P.O. Box 3015/Blue Bell, Pennsylvania 19422

Phone Number : 215 654-9800

Fax Number : 215 654-966

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

EPA has approved this technology as a recycling process when used for processing oil bearing hazardous wastes. In other words, it is exempt from RCRA Part B permit application requirements. It is the BDAT equivalent to incineration. The process has been demonstrated on a full-scale basis for the removal of all volatile and semivolatile organics and the subsequent recovery of these constituents. Pilot scale demonstrations on the degradation of PCB's have been completed and document DRE percentages of 99.9999 percent. A mobile PCB/chlorinated organic treatment unit will be available in the first quarter of 1994.

Comments : The HT-6 process achieves treatment standards without oxidation, such as occurs in incineration. The resulting advantages are: 1) significant reduction in SO₂, NO_x, CO_x emissions; 2) no byproducts of combustion; 3) no dioxin precursors generated from processing and degrading PCBs; 4) no increase in leachability of metals; 5) no toxic metal particulate emissions; 6) simplified permitting; 7) modular, skid mounted, and transportable; 8) versatile on variations in waste (from liquids up to contaminated soils); and 9) no Btu limit or maximum. This technology, in and by itself, is not applicable to metal-only wastes, with the exception of mercury.

Source of Information : VISITT 3.0

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *High Temperature Thermal Desorption***Technology Name :** SAREX MX-1500 & MX-2000/2500 Thermal Processors**Application :** On-site Ex-situ

Brief Description : The SAREX "Process Train" is a mobile, trailer mounted, modular system designed for on-site, on-line treatment of oil/water/solids matrix materials. It utilizes centrifuge action to separate the oil and the water from the solids and low and high temperatures to desorb the toxic constituents from the material. The centrifuge separates the oil, water and solids and discharges the solids to the MX-2000. The oil and water are discharged into settling tanks from which they can be reclaimed and recycled. A specially designed SAREX Vapor Recovery System (VRS) recovers and treats vapors generated during the "Process Train" operation. The vapors are collected in the unit's vapor domes and routed through collection pipes to the VRS. The VRS removes particulate matter, and condenses water and hydrocarbon into separate phases. The organics can be reclaimed and recycled to an appropriate end user for reuse. The water can also be reclaimed, recycled and reused.

Company Name/POC: Separation and Recovery Systems, Inc./Brad Miller**Address :** 1762 McGaw Avenue/Irvine, California 92714-4962**Phone Number :** 714 261-8860**Fax Number :** 714 261-6010**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.

The MX-2500 has been on the marketplace for a number of years and is presently processing over 1,000 tons per month of refinery sludge at five different petroleum refineries around the U.S. The MX-1500 centrifuge system is also a proven technology, as it processed over 1,000,000 feed barrels of material in the last 10 years. The SRS treatment processes have been approved the New Jersey Department of Environmental Quality and the Bay Area and South Coast Air Quality Management Districts.

Comments : The system is limited to treating contaminants that have nominal boiling points that are less than 900 degrees Fahrenheit; the MX-2500 requires that the feed material must be dried to have less than 10 percent of moisture before entering the system. Therefore, in most situations, sludges must be centrifuged using the MX-1500 and dried using the MX-2000 before entering the MX-2500 BDAT system; the SAREX treatment train requires steam, fresh water, a small amount of nitrogen gas, and 400 amps of electricity for operation. Sometimes, these utilities are not readily available at abandoned sites to be remediated; if the material is sludge-like, additional fluids may need to be added (water, kerosene, or diesel) to improve separation in the centrifuge.

Source of Information : VISITT 3.0

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *High Temperature Thermal Desorption*

Technology Name: Soiltech ATP System

Application: On-site Ex-situ
Off-site

Brief Description: The SoilTech ATP Sytem removes organic contaminants from feed material through thermal desorption in an indirectly fired rotary kiln. It can be used in conjunction with a dehalogenation process. The SoilTech ATP System is continuous and provides preheating of incoming feed material in the preheat zone and desorption of contaminants in the anoxic retort zone at temperatures over 1,000 degrees Fahrenheit. Oxidation of decontaminated coked products takes place in the combustion zone and process heat is efficiently reused through indirect heat transfer from hot treated solids in the cooling zone to the incoming feed material in the preheat zone. Ancillary systems condense the vapors desorbed from the retort zone. The resulting liquid products are water and oil and can be chemically decontaminated on site, recycled, or sent off site for treatment.

Company Name/POC: Soiltech ATP Systems, Inc./Dave Ettlers

Address: 304 Inverness Way South/Suite 200/Englewood, Colorado 80112

Phone Number: 303 790-1747

Fax Number: 303 799-018

Technology Maturity: Commercial use experience

Performance History: Performance data are available.

SoilTech has commercially treated PCB and phenol contaminated soils and successfully demonstrated treatment of a long list of other contaminants. These include: refinery wastes, coal tar wastes, wood treating wastes, dioxin/furan-impacted soils, VOC and SVOC contaminated material, and many more. In 1990 and 1991, the SoilTech ATP System was successfully applied to treat 42,000 tons of PCB-contaminated soil at the Wide Beach Superfund Site in Brant, New York. In June 1992, SoilTech completed work at the Waukegan Harbor Superfund Site in Waukegan, Illinois; 12,700 tons of PCB contaminated soil and sediments were treated. SoilTech is now remediating 12,000 tons of VOC, PAH, and pesticide contaminated soil at the Pristine Superfund Site in Reading, Ohio.

Comments: The SoilTech ATP System is suitable for treatment of organic or oily waste in concentrations up to 25 percent by weight. Higher contaminant concentrations may require blending of feed material prior to treatment. High moisture content (greater than 20 percent) and/or high silt/clay content (greater than 20 to 30 percent) may reduce the process throughput and increase treatment costs.

Source of Information: VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Low Temperature Thermal Desorption***Technology Name :** Thermal Desorption**Application :** On-site Ex-situ

Brief Description : Low Temperature Thermal Desorption-Off-Gas Treatment Technology uses heat in a controlled environment to volatilize various organic compounds, which can, therefore, be removed from the soil. The processes are planned and designed to avoid combustion by using lower temperatures, usually 500 to 800 degrees Fahrenheit, in conjunction with a reduced-oxygen atmosphere in the primary treatment chamber. The off-gases combined with fine particulate matter are then channelled through a multi-cone particulate separator and baghouse where they are separated and then oxidized in the secondary treatment chamber. The off gases are subjected to high temperatures ranging between 1400 and 1850 degrees Fahrenheit with an approximate lag time of 2 seconds.

Company Name/POC: Pet-Con Soil Remediation, Inc./Tom LaBudde**Address :** P.O. Box 205/Spring Green, Wisconsin 53588**Phone Number :** 608 588-7365**Fax Number :** 608 588-2530**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.

Comments : Without exception the performance of the technology has exceeded the Wisconsin Department of Natural Resources (WDNR) cleanup standards of 10 ppm Gasoline Range Organics (GRO) and 10 ppm Diesel Range Organics (DRO). Pet-Con Soil Remediation has completed the largest thermal remediation project in the State of Wisconsin. Most of the project was performed during the winter months, but it is preferable not to operate in sub-zero temperatures.

The technology is limited to GRO and DRO contaminated sites. There are very few physical limiting factors other than being able to set up our equipment on a relatively flat 150 feet by 150 feet parcel. Additional space is needed to temporarily store treated soils that can be moved after post-burn analytical analyses to confirm our cleanup performance.

Source of Information : VISITT 3.0

CONTAMINANTS:

- ☒ Pesticides/Herbicides ☐ Heavy Metals ☒ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE: *Low Temperature Thermal Desorption***Technology Name:** Desorption and Vapor Extraction (DAVE) System**Application:** On-site Ex-situ

Brief Description: RSI's low temperature, high volume Desorption and Vapor Extraction (DAVE) system separates toxic and hazardous waste from soil, sludge and sediments. The process is designed to separate and capture both volatile and semi-volatile organic contaminants from host materials. Nonvolatile inorganic contaminants (such as metals) in the waste feed do not inhibit the process, but are not removed. The clean processed soil (98 to 99 percent or more of incoming feed after rehydration) is returned to the excavation site or used for clean fill. The contaminants are captured and shipped off site for recycling or final disposal. This is accomplished in a closed process, with continuous, real time monitoring and numerous back-up systems.

Company Name/POC: Recycling Science International Inc./William C. Meenan**Address:** 175 West Jackson Blvd./Suite A1910/Chicago, Illinois 60604**Phone Number:** 312 663-4242**Fax Number:** 312 663-426**Technology Maturity:** Commercial use experience

Performance History: Tested - Numerous EPA, state and local government supervised tests of the DAVE System have verified treatment capabilities. The DAVE System can treat soils, sludges and sediments contaminated with PCB, PAHs pesticides, VOCs semivolatile organics such as tetraethyl lead and mercury. This process can operate at 40 percent - 60 percent below incineration costs. Treated products from the DAVE system include: water suitable for discharge, oil that may be recycled as fuel, and solids that can be returned to the site as backfill. The process can reduce the initial volume of contaminated material be more than 95 percent. The DAVE system can process 240 to 1,500 tons per day in a portable configuration. Capabilities of 5,000 tons per day can be achieved in a fixed site, non portable mode.

Comments: Materials which cannot be treated include tars, and substances which form tars at low temperatures and relatively short exposure times. Examples of the latter are some oxygenated petroleum products, polymer precursors, etc. Nonvolatile inorganic contaminants, such as metals, do not inhibit the process but are not removed. The DAVE System treatment process is most effective on matrices that are non-adsorptive and of low porosity.

Source of Information: VISITT 3.0

CONTAMINANTS :☐ Pesticides/Herbicides☐ Heavy Metals☒ PCB☐ Explosives/Propellants☒ Petroleum Hydrocarbons☐ Radionuclides☒ SVOC☐ Other Contaminant☒ Nonhalogenated VOC☒ Halogenated VOC☐ N/A**TECHNOLOGY TYPE :** *Low Temperature Thermal Desorption***Technology Name :** Low Temperature Thermal Treatment**Application :**

On-site

Ex-situ

Off-site

Brief Description :

The LT3 is a soil treatment system that indirectly heats the soil, causing volatilization of the organic compounds. The cleaned soil is then available for backfill or other treatment steps (i.e., stabilization). The organic vapors are vented to a condensation system that concentrates the organics into liquid for off-site disposal, recycling, or use as a waste fuel.

Company Name/POC: Roy F. Weston, Inc./Michael G. Cosmos**Address :** 1 Weston Way/West Chester, PA 19380**Phone Number :** 610 701-7423**Fax Number :** 610 701-5035**Technology Maturity :** Commercial use experience**Performance History :** Contact company representatives for Performance Data.**Comments :**

The technology is applicable to soil, sediments, and sludges that can be handled as a solid. Moisture content increases costs. The process will not affect heavy metals or inorganics. The LT3 is immediately implementable for full-scale use. The LT3 has been on four remediation projects. The system is trailer-mounted for transportability. Transportability has been demonstrated by using on-site power generation and propane fuel use.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Low Temperature Thermal Desorption*

Technology Name : Thermal Desorption/Catalytic Oxidation

Application : On-site Ex-situ
Off-site

Brief Description : Soil is indirectly heated to 200-450 degrees C in a rotary kiln under a nitrogen blanket. Water and organics are volatilized and then condensed downstream. The water is treated and used to wet the clean soil, the organic phase is collected for later treatment. Volatile organics, PCBs, petroleum hydrocarbons, and chlorinated hydrocarbons are effectively removed. X*TRAX is ideally suited for treatment of large amounts of soil containing trace organic contaminants. Less expensive than incineration. Cleaner than other rotary kiln methods that use direct heating. Nitrogen blanket minimizes degradation of organics. Especially well-suited for treatment of PCBs.

Company Name/POC: Rust Remedial Services/John Westcott

Address : Clemson Technical Center/100 Technology Drive/Clemson Research Park/Anderson, SC 29625

Phone Number : 803 646 2413

Fax Number : 803 646-531

Technology Maturity : Commercial use experience

Performance History : Pilot over 75 successful treatability studies conducted at C.W.M.
Pilot DOE Oak Ridge Gaseous Diffusion Plant - Mixed Wastes.
Pilot CWM California Kettleman Hills - RCRA, PCBs >99 percent removal.
Full-Resolve Superfund Site, Dartmouth, MA - PCBs
Pilot - 4.5 tons/day
Contact Carl Swanstrum (708) 513-4500.

Comments : Amount to be treated should be greater than or equal to 5000 cu. yds. to be economically treated. Unit is easy to use, takes up minimal space and has minimal utility requirements. Requires 1 operator with moderate technical background and 2 technicians to operate. Equipment for unit is available in the U.S. through Rust Remedial Services; however, Rust does not sell the equipment. The contaminant volume is greatly reduced by desorbing from the feed and concentrating.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Low Temperature Thermal Desorption*

Technology Name : Vacuum Assisted Thermal Desorption/Catalytic Oxidation

Application : On-site Ex-situ

Brief Description : Soil is heated to 250 degrees Celsius in a rotary kiln under vacuum. Water and volatiles are volatilized and carried downstream. The water/organic stream is run through a catalytic oxidizer. Organic and inorganic compounds are oxidized into innocuous compounds. Soil is processed in batches. Technology has been designed to be cost-effective at small facilities (200-2000 cubic meters), a large number of which exist at DOE sites. The VAC*TRAX is small, mobile, and requires minimal mobilization and demobilization activities. The vacuum reduces the required heating time.

Company Name/POC: Rust Remedial Services/John Westcott

Address : Clemson Technical Center/100 Technology Drive/Clemson Research Park/Anderson, SC 29625

Phone Number : 803 646 2413

Fax Number : 803 646-5311

Technology Maturity : Pilot plant testing

Performance History : Successfully applied at bench-scale. Contact Carl Swanstrm 708/513-4500.

Comments : Best suited for volumes ranging from 200-2000 cubic meters of waste. Unit is easy to use, takes up minimal space, has minimal utility requirements, and requires 1-2 people of moderate technical ability to operate. Equipment for unit is available in the U.S. through Rust Remedial Services; however, Rust does not sell the equipment.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Low Temperature Thermal Desorption*

Technology Name : SAREX MX-1500 & MX-2000/2500 Thermal Processors

Application : On-site Ex-situ

Brief Description : The SAREX "Process Train" is a mobile, trailer mounted, modular system designed for on-site, on-line treatment of oil/water/solids matrix materials. It utilizes centrifuge action to separate the oil and the water from the solids and low and high temperatures to desorb the toxic constituents from the material. The centrifuge separates the oil, water and solids and discharges the solids to the MX-2000. The oil and water are discharged into settling tanks from which they can be reclaimed and recycled. A specially designed SAREX Vapor Recovery System (VRS) recovers and treats vapors generated during the "Process Train" operation. The vapors are collected in the unit's vapor domes and routed through collection pipes to the VRS. The VRS removes particulate matter, and condenses water and hydrocarbon into separate phases. The organics can be reclaimed and recycled to an appropriate end user for reuse. The water can also be reclaimed, recycled and reused.

Company Name/POC: Separation and Recovery Systems, Inc./Brad Miller

Address : 1762 McGaw Avenue/Irvine, California 92714-4962

Phone Number : 714 261-8860

Fax Number : 714 261-601

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

The MX-2500 has been on the marketplace for a number of years and is presently processing over 1,000 tons per month of refinery sludge at five different petroleum refineries around the U.S. The MX-1500 centrifuge system is also a proven technology, as it processed over 1,000,000 feed barrels of material in the last 10 years. The SRS treatment processes have been approved the New Jersey Department of Environmental Quality and the Bay Area and South Coast Air Quality Management Districts.

Comments : The system is limited to treating contaminants that have nominal boiling points that are less than 900 degrees Fahrenheit; the MX-2500 requires that the feed material must be dried to have less than 10 percent of moisture before entering the system. Therefore, in most situations, sludges must be centrifuged using the MX-1500 and dried using the MX-2000 before entering the MX-2500 BDAT system; the SAREX treatment train requires steam, fresh water, a small amount of nitrogen gas, and 400 amps of electricity for operation. Sometimes, these utilities are not readily available at abandoned sites to be remediated; if the material is sludge-like, additional fluids may need to be added (water, kerosene, or diesel) to improve separation in the centrifuge.

Source of Information : VISITT 3.0

CONTAMINANTS :☒ Pesticides/Herbicides☒ Heavy Metals☒ PCB☒ Explosives/Propellants☒ Petroleum Hydrocarbons☒ Radionuclides☒ SVOC☒ Other Contaminant☒ Nonhalogenated VOC☒ Halogenated VOC☒ N/A**TECHNOLOGY TYPE :** *Low Temperature Thermal Desorption***Technology Name :** LTTD With Heat Recovery**Application :** On-site . Ex-situ**Brief Description :** The continuous soil treatment systems consist of a material feed/preparation unit, rotary drum (Primary Treatment Unit), and a processed material pugmill mixer system. These components are followed by the exhaust gas treatment systems which consist of a multi-tube cyclonic separator and afterburner (Secondary Treatment Unit) followed by the system heat exchanger, baghouse, induced draft fan, stack and stack monitor.**Company Name/POC:** Soil Purification, Inc./Wendell R. Feltman, P.E.**Address :** ASTEC/P.O. Box 72515/Chattanooga, Tennessee 37407**Phone Number :** 706 861-0069**Fax Number :** 706 861-2051**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.**Comments :** 18 systems constructed, 1 in design, and 2 under construction. This technology is effective for materials contaminated with volatile and semivolatile organic compounds. Contaminant concentrations can be a rate-limiting factor. ASTEC soil purification plants have been applied to sites where the maximum concentrations of contaminants in the soils is 0 to 4 percent by weight (soils of varying concentrations are blended to obtain a uniform concentration which is typically in the 1 to 2 percent range). Some projects require special considerations for processing soils with high contaminant levels. This has been achieved with special sensing and control systems to monitor and control the lower explosive limit (LEL) within the process.**Source of Information :** VISITT 3.0

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Low Temperature Thermal Desorption*

Technology Name: Mobile Solid Waste Desorption

Application: On-site Ex-situ

Brief Description: Texarome's ex-situ continuous desorption process uses highly superheated steam (adjusted up to 900 degrees Fahrenheit) as a conveying and stripping gas in a pneumatic type conveying system to treat contaminated wastes, such as soils, sediments, sludges, and difficult emulsions containing volatile and semivolatile contaminants of any kind, together with water. An elaborate and proprietary way (patent pending) of running pipes within the conveying system allows for a true countercurrent flow, as well as multi-stage dispersion and separation of the gas phases and the solid phase, to make the efficient mass transfer separation task possible.

Company Name/POC: Texarome, Inc./Guéric R. Boucard

Address: 1.5 Miles East Highway 337/P.O. Box 157/Leaky, Texas 78873

Phone Number: 210 232-6079 **Fax Number:** 210 232-571

Technology Maturity: Pilot plant testing

Performance History: Performance data are available.

In 1982, a 4 ton per day pilot plant was set up in the Texas Hill Country to extract Cedarwood Oil from the native Texas Cedar. The project was moved to Leakey, Texas in 1984 and the pilot plant was scaled up to a 12 ton per day of commercial size plant. To date, this plant has been successfully operating around the clock. The EPA SITE demonstration unit tentatively scheduled for late Fall 1993 will be 25 ton per day unit improved and modified to operate between 340-900 degrees Fahrenheit and strip toxic solid waste.

Comments: The main limitations of this process is necessity of sifting debris, and reducing the particle size of the material to be treated to a uniform 35 mesh and under (less than 0.016 inches). Non porous solids such as sand could be treated in larger particle sizes of up to 10 mesh (less than 0.65 inches), because contaminants are easily flashed from the surface. Non-flowable solids, such as 100 percent putty-like clays, or gummy solids are also a problem. Such materials would have to be thoroughly mixed with dry sand into a semi-flowable solid with an angle of repose of at least 60 degrees before treatment.

Source of Information: VISITT 3.0

CONTAMINANTS :☒ Pesticides/Herbicides☒ Heavy Metals☒ PCB☒ Explosives/Propellants☒ Petroleum Hydrocarbons☒ Radionuclides☒ SVOC☒ Other Contaminant☒ Nonhalogenated VOC☒ Halogenated VOC☒ N/A**TECHNOLOGY TYPE :** *Low Temperature Thermal Desorption***Technology Name :** RF Driven Thermal Processing**Application :**

On-site

Ex-situ

Off-site

Brief Description : Thermal desorption unit can be used to dewater sludges and precipitates, and to remove organics by devolatilization.**Company Name/POC:** Westinghouse Communications/D.L. Keairns**Address :** 1310 Beulah Rd./Pittsburgh, Pennsylvania 15235**Phone Number :** 412 256 1954**Fax Number :** 412 256-1348**Technology Maturity :**

Field demo complete

Performance History : Has been used by Texaco for oil field enhancement; field demonstration planned at Savannah River.**Comments :** Mobile unit is self-contained. Water table may be problem for soils (minor). Low boiling point VOC may have cheaper routes such as soil vapor extraction.**Source of Information :** TechCon

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Pyrolysis*

Technology Name: Product control systems (PCS) Flash Pyrolysis

Application: On-site ☒ Ex-situ ☒
Off-site ☒

Brief Description: Indirect thermal decomposition (dry distillation, vacuum flash pyrolysis) of solid hazardous organic/inorganic waste in reductive environment. Main components: indirectly heated rotary reactor (operating up to 1500 F); indirectly cooled multi venturi scrubber.

Company Name/POC: Product Control Ltd./G. Edward Someus

Address: La Plaiderie/P.O. Box 79/St. Peter Port/Guernsey, C.I., United Kingdom

Phone Number: 1481 726 426

Fax Number: 1481 726 52

Technology Maturity: Pilot plant testing

Performance History: Contact Product Control Ltd. for performance history data.

Comments: A benchmark of a good safe treatment technology is a high DRE efficiency. Pilot-scale testing demonstrated that the PCS process was more than capable of this. No possibility of dioxin or furan formation and cost efficient technical solution for utilization of heavy metals based on the reductive thermal treatment. The small reactor size and the capability to recirculate process gas-vapors from the decomposition process makes the process equipment, especially the flue gas treatment unit, small, technically simple, and safer. The PCS process is suitable for many types of waste, sorted and unsorted, as well as, all those that are economically decomposable by dry distillation under any range of 1,000 C. The special patented feature of the PCS indirect heated rotary reactor and other vital apparatus components makes viable the process of continuous process control and monitoring of the destruction efficiency. The PCS technology is limited for: (1) treatment of liquids (water, flammable liquids and solvents) (2) treatment of solid material over 45 percent moisture content, (3) explosives and/or materials with highly oxidizing character under heat treatment, (4) materials which can not be decomposed by thermal treatment at 600 C (1,112 F), and (5) nuclear waste with high radioactivity. The PCS technology is at the full scale demonstration and commercialization phase of the development.

Source of Information: International TechCon

CONTAMINANTS :☒ Pesticides/Herbicides☒ Heavy Metals☐ PCB☐ Explosives/Propellants☒ Petroleum Hydrocarbons☒ Radionuclides☐ SVOC☐ Other Contaminant☒ Nonhalogenated VOC☒ Halogenated VOC☐ N/A**TECHNOLOGY TYPE :** *Vitrification (Ex Situ)***Technology Name :** DC Graphite Arc**Application :**

Ex-situ

Brief Description :

DC Graphite Arc technology is a high-temperature graphite-arc-based technology which is used to destroy organic materials, and melt ceramics and metal at temperatures >1600 degrees Celcius. The system operates in a sealed furnace. Volume reduction and stabilization of products are realized. Applicable to soils and mixed waste.

Company Name/POC: Electro-Pyrolysis, Inc./Charles H. Titus**Address :** 996 Old Eagle School Road/Suite 1118/Wayne, Pennsylvania 19087**Phone Number :** 610 687-9070**Fax Number :** 610 964-8570**Technology Maturity :**

Pilot plant testing

Performance History : Performance data are available.

A 3000 pound/hour unit has been built; Prototype 100 pound/hour in operation at MIT; Prototype 500 pound/hour in construction.

Comments :

Useful for all types of solid waste. However, a cost penalty is paid for energy for high water content waste.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Vitrification (Ex Situ)*

Technology Name : Vitrification

Application : On-site Ex-situ

Brief Description : Vitrification processes wastes into stable, non-degradable, chemically durable glass that is highly leach resistant. GTS Duratek joule heated Duramelter (TM) produces a waste form that reduces the volume of waste up to 75 percent. This vitrification process is designed for the treatment of the contaminated fraction left from soil washing. Vitrification replaces grouting with cement. Grouting increases the volume of the waste treated; vitrification, on the other hand, decreases the volume of the waste processed and produces a more stable waste form.

Company Name/POC: GTS Duretek, Inc./William Greenman

Address : 8955 Gillford Road/Suite 200/Columbia, Maryland 21046

Phone Number : 410 312-5100

Fax Number : 301 621-821

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

GTS Duratek and its primary subcontractor, the Vitreous State Laboratory at the Catholic University of America, have performed numerous laboratory-scale research projects for both government and private industry. Some of these projects are: Construction of commercial units is being completed at both Barnwell, North Carolina, and the DOE Savannah River Site (SRS). Start up of the Barnwell unit is anticipated by the end of the 1995 calendar year. Testing is scheduled to begin at SRS in December 1995, with the start up of the unit scheduled for January 1996. Minimum Additive Waste Stabilization Program/Fernald-Phase 1/Fernald, Ohio/Dr. Mitchell Erickson CMT/Argonne National Laboratory/708 972 7772/FAX 708 252 5912. Vitrification Development Studies for OU1 Wastes/Fernald, Ohio/Rod Gimpel/513 738 6112/ FAX 513 738 6184. Development of a Combined Soil Wash/In-Furnace Vitrification System for Soil Remediation at DOE Sites/Weldon Spring, Oak Ridge/Dr. Mitchell Erickson, CMT/Argonne National Laboratory/708 972 7772/FAX 708 252 5912

Comments : This technology is not applicable to metal-only wastes or to wastes that are predominately organic. Approximate minimum limits are at present about 5 weight percent metals or total organic carbon. In general, implementing this technology is straightforward. The melter design and operation are relatively constant as is the required training of personnel (melter operators, etc.). The offgas system is the only component of the vitrification process which may change appreciably from site to site. The biggest challenge in implementing this technology is understanding the waste-specific chemistry involved and applying it to the design of the offgas system (fluorides, sulfates, etc.). Secondary waste generation can also present a challenge. In the system currently operating, secondary waste is fed back into the melter. Another challenge is developing a glass composition for specific wastes that is capable of high waste loading which is also cost-effective (minimum additives), durable, and processable. The ideal glass is that which can be processed below 1200 degrees celsius and still meet all of the above requirements. If it cannot be processed below 1200 degrees celsius, the melter may require redesign incorporating exotic metals and high temperature electrodes. Construction of commercial units is being completed at both Barnwell, North Carolina, and the DOE Savannah River Site (SRS). Start up of the Barnwell unit is anticipated by the end of calendar year 1995. Testing is scheduled to begin at SRS in December 1995, with start up of the unit scheduled for January 1996.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Vitrification (Ex Situ)***Technology Name :** McNeill Vitrification Process

Application :

On-site Ex-situ
Off-site

Brief Description : Waste material is mixed with glass-making raw materials and then fed (continuously) into an adapted glass furnace. Inorganic material is dissolved into the molten glass bath and organics fully combust. In commercial trials of 240 tonnes/day the technology has been proven to be completely successful in the destruction of wastes, both organic & nonorganic.

Company Name/POC: Vert LTD./Keith McNeill**Address :** Unit 7, Stadium Court/Parkgate, Rotherham S62 6EW, UK**Phone Number :** 1709 720651**Fax Number :** 1709 720851**Technology Maturity :** Commercial use experience

Performance History : The technology has been tested at all levels from bench top to 240 tonnes/day commercial trials. All environmental assessments were carried out by AEA technology's National Environmental Technology Centre (netcen) and the process has had HMIP approval. All trials were success. Problems tend to be that the technology is too early for the UK market where landfilling is cheap.

Comments : The process requires a constant feed, 24 hours a day, 7 days a week. The process can treat a multitude of wastes including the backend residues of other environmental processes, such as soil washing. Plants can be built to size requirements, in-situ, centralized (240T/day) or mobile (20T/day). It's a complete recycling technology with release from "duty of care". Works with fibers (e.g. asbestos), sands, phosphates, all types of ash. A static plant can process up to 240 tonnes/day.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Co-Metabolic Processes*

Technology Name : Bioventing by Global Environmental Inc.

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Anoxic air is injected through well points into the vadose zone. The resulting air flow through the contaminated soils accelerates the volatilization of high vapor pressure halocarbons. The vaporized halocarbons migrate toward the ground surface. As the vapors move upward, they are biodegraded through a co-metabolic process using a supplemental substrate and nutrients to enhance bioactivity. Aliphatic hydrocarbons or acetate are the usual substrates.

Company Name/POC: Global Environmental Engineering/Robert H. Douglas

Address : 2640 Aero Park Dr./Traverse City, MI 49686

Phone Number : 616 947-1000

Fax Number : 619 947-104

Technology Maturity :

Performance History : Bioventing has been used successfully for remediating hydrocarbon-contaminated vadose and capillary fringe soils at the USCG Air Station in Traverse City, MI. Contaminant concentrations were reduced to below regulatory cleanup standards. Halocarbon treatment by use of an introduced co-metabolic substrate has been successfully used for groundwater remediation at Moffit Naval Air Station in California and at a site in St. Joseph, MI.

Comments : Bioventing can be applied to a wide variety of physical locations, but generally requires an open area with at least 6-12" of loamy top soil and minimal infrastructure which may inhibit or redirect air flow from below and infiltration from the surface. General labor can be used for most construction activities such as trenching and piping with on-site technical supervision. Electrical hook-up requires skilled labor. Construction requires 2-4 weeks. A bioventing project will consist of a field technician to monitor, maintain, and sample the system, a project engineer to evaluate system performance, and a project manager to assure compliance and coordinate all associated activities such as contractors, regulatory reporting, health and safety measures, etc. Global provides a whole range of soil and groundwater environmental services.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Co-Metabolic Processes***Technology Name :** Biological Treatment of Chlorinated Solvents**Application :** In-situ (saturated zone)**Brief Description :** Biodegradation of chlorinated solvents in groundwater or soil matrix is achieved with this technology via cometabolic mechanism. The process is able to achieve >99 percent reduction from concentrations up to 2000 ppb.**Company Name/POC:** Walsh & Associates/Dr. Bill Mahaffey**Address :** 4888 Pearl East Circle/Suite 108/Boulder, CO 80301-2975**Phone Number :** 303 670-2875**Fax Number :** 303 443-0367**Technology Maturity :** Field demo complete**Performance History :** Performance data are Available.**Comments :** The process is easily implementable by a field technician and/or operators. Technical support by a staff microbiologist (Clay Walton) is also required. Mobilization/demobilization and system startup time is minimal, with the exception of establishment of viable, specific biological populations.**Source of Information :** TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Electrical Separation*

Technology Name : Electrokinetical Heavy Metals Extraction

Application : In-situ (vadose zone)

Brief Description : This technology extracts heavy metals from soil by electrokinesis. Additionally, the technology cleanses soil polluted by hydrocarbon components (Diesel/Light fuel), PAHs and chlorinated solvents through biological biodegradation.

Company Name/POC: A.S. Bioteknisk Jordrens/Soren Schiotz

Address : 10. Maglehojvej/DK 4400 Kalundborg, Denmark

Phone Number : 45 5350 4668

Fax Number : 45 5350 449

Technology Maturity : Commercial use experience

Performance History : Contact company for performance history.

Comments : The general attitude in Denmark is that polluted soils should be cleansed if possible. This company is well known in the public mind. Since its foundation in 1986 as the first company of its kind on the industrial scale, the company has had a major share of the Danish market. The management is on an advisory board to the Danish Minister for the Environment.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Electrical Separation*

Technology Name : Electrokinetics

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : When direct current is passed through a low permeability soil, the aqueous phase is observed to move from the positive electrode to the negative electrode. This is commonly referred to as electroosmosis. Soil contaminants such as heavy metals (Cs, Sr, Zn, Cd, U, etc.) and organic materials (gasoline, TCE, benzene, etc.) may be removed along with the aqueous phase as it is "pumped" through the soil. Electrokinetic permeabilities for aqueous systems in clays have been demonstrated to be up to one thousand times over normal hydraulic permeabilities.

Company Name/POC: Electro-Petroleum, Inc./Dr. J. Kenneth Wittle

Address : 996 Old Eagle School Road/Suite 1118/Wayne, Pennsylvania 19087

Phone Number : 610 687-9070

Fax Number : 610 964-8570

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Field experience in oil field application for oil recovery, mud pit dewatering.

Comments : Applicable to contaminated soils and usable to depths of several hundred feet. Works best in soil with >10 percent clay.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Electrical Separation*

Technology Name : Electrochemical Migration

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : A square array of anodes and cathodes are placed in the ground. An ionic carrier solution is added to the anode cell and a potential is applied. The carrier ions migrate into the soil where they displace contaminant ions. The contaminant ions continue to carry the current to the cathodes where they are deposited in solid form on the cathode.

Company Name/POC: Rust Remedial Services/John Westcott

Address : Clemson Technical Center, 100 technology Drive, Clemson Research Park/ Anderson, SC 29625

Phone Number : 803 646-2413

Fax Number : 803 646-531

Technology Maturity :

Bench scale testing, only

Performance History : Bench scale testing performed for patent development.

Comments : Soil must contain some moisture. Equipment for unit is available in the U.S. through Rust Remedial Services, however, Rust does not sell the equipment.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Oxygen Enhancement with Air Sparging*

Technology Name : Subsurface Volatilization and Ventilation System

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : SVVS (Trademark) provides in situ aeration and bioremediation of contaminated soils and groundwater. The heart of the process is sparging (saturated zone air injection) and vacuum extraction. This volatilizes contaminants and increases dissolved oxygen in groundwater and soil moisture, stimulating bioremediation.

Company Name/POC: Brown & Root Environmental (previously known as Halliburton NUS Env. Corp.)/Mark Spencer

Address : 4100 Clinton Drive/Houston, Texas 77020

Phone Number : 713 676-3011

Fax Number : 713 676-4109

Technology Maturity : Commercial use experience

Performance History : Over 40 installations have demonstrated success at rapid soil and groundwater remediation. Performance contaminant removal rates achieved in all cases. Difficulties in building up dissolved oxygen on some areas of some sites. Problem rectified by redirecting air to reticent areas and/or additional sampling wells. References from Sharon Russell, B&R, 10200 Bellaire Blvd., Houston, TX 77072, phone 713/575-3361 (fax: 575-4691); Conoco Remediation, Laurel Hendricks, 713/293-5513; Conoco Convenience Store, Escambia County, Pensacola, FL, Gordon Richmond, no phone number given; Conoco, Pinellas Park, Clearwater, FL, Keith Coffman, phone 713/293-3593.

Comments : System tends to be installation-intensive in that many wells may have to be installed if the site is large. System is flexible in operation. Biggest challenge is expanding the technology into non-petroleum hydrocarbon contaminants, especially chlorinated hydrocarbons. Several projects involving chlorinated are on-line, including a demonstration under the EPA "SITE" program.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Air Sparging**Technology Name :** In Situ Soil Ventilation and Heating

Application :
 In-situ (vadose zone)
 In-situ (saturated zone)

Brief Description : The technology heats and air sparges the saturated and unsaturated zone causing evaporation and biodegradation of hazardous organics. Furthermore, the method causes fluidization of low viscosity hazardous contaminants. The method has been proven to "remove" 90 percent of the total content of hazardous components.

Company Name/POC: Carl Bro Energy & Environment/Nils Bull/Torsten Toksvad**Address :** Granskoven 8/DK-2600 Glostrup, Denmark**Phone Number :** 45 43 48 66 11**Fax Number :** 45 43 96 44 11**Technology Maturity :** Commercial use experience**Performance History :** Contact company for performance history.**Comments :** None.**Source of Information :** International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Air Sparging*

Technology Name : SparTech

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Introduces air bubbling streams into groundwater through injection wells. Causes reduction in concentration of VOCs in aquifer and capillary fringe. Gases other than atmospheric air (N₂, CO₂, etc.) can be used to enhance or retard biological, chemical, or physical processes in groundwater or capillary fringe. Replaces or enhances groundwater pumping for aquifer restoration. Enhances soil vapor extraction for capillary fringe treatment.

Company Name/POC: MWR, Inc., Division of ETG Environmental, Inc./Frederick C. Payne, PhD

Address : 7707 Rickle Road/Lansing, Michigan 48917

Phone Number : 517 322-9311

Fax Number : 517 322-2936

Technology Maturity : Commercial use experience

Performance History : 10 projects (2 complete, 5 in-progress, 3 installation phase).
Groundwater concentrations have been reduced to health-based closure levels.
Call F. Payne for confidential client contact information.

Comments : This is a small-footprint, field-mobile unit. Surface area requirement approximately 100 square feet. Power required (100 Amp, 220-volt, single-phase). Air discharge source control may be required. Capable of closed-loop operation. Aquifer sparging requires moderate to high pneumatic conductivity, without significant contrasting permeability stratification in the treatment zone. The design, installation and operation of aquifer sparging systems requires experience. Critical factors include depth in aquifer and length of air release points, air release rate, and air point field configuration. The technology is not applicable to heavy clays or in sites where injected air can escape laterally from recovery wells. Contaminants with high water solubility may be difficult to remove.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Air Sparging*

Technology Name : Air-Sparging Vapor Extraction

Application : In-situ (vadose zone)

Brief Description : Sparge Vac is an effective method for remediation of vadose-zone soils and groundwater containing volatile and semi-volatile compounds. This method is more effective than the pump and treat technology because the volatile and semi-volatile components desorb much more readily into the gas phase than they do to the surrounding groundwater. This technology is particularly effective where large quantities of groundwater must be treated. Vapor extraction wells are installed into the vadose zone of the area of contamination with special care taken in the selection of well screening depths.

Company Name/POC: Terra Vac/James Malot/Bruce Bosshard

Address : 356 Fortaleza St., P.O. Box 1591/San Juan, P.R. 00902-1591

Phone Number : 809 723-9171

Fax Number :

Technology Maturity : Commercial use experience

Performance History : Contact company representative for performance summary and client list. Job size has ranged from small gas station projects to major superfund sites. Contaminants that have been recovered by this technology include: Benzene, toluene, xylenes, ethylbenzene, hexane, chloroform, methylene chloride, tetrachloroethylene, trichloroethylene, dichloroethylene, ethyl acetate, cyclohexane, methyl ethyl ketone, methyl isobutyl ketone, methanol, acetone, pyridine, tetrahydrofuran, dimethylfuran, carbon tetrachloride, trichloroethane, methyl methacrylate, decane, chlorobenzene, dichlorobenzene, trichloropropane, gasoline, jet fuel, Stoddard Solvent, diesel, kerosene, and heavy naphthas.

Comments : Contaminant must be volatile or semi-volatile for this technology to perform correctly. Contaminants which complex with the soil matrix are not effectively remediated using this technology. Some lithologies are not conducive to this type of treatment: for example, a layer of low permeability soil overlying the saturated zone may prevent the injected air from being scavenged by the vapor extraction system above it. The most difficult part of this technology is the proper selection of sparging well spacing and depth. Factors such as petrophysical characteristics of the saturated zone, the chemical reactions occurring between the sparging gas, soil and water as well as the hydrologic conditions on and off-site will all affect the influence the sparging well will have on the contaminant in the groundwater. The proper sparge gas must be selected to enhance the remediation while avoiding undesired groundwater chemistry changes.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Dual Phase Extraction*

Technology Name : FE-Active (TM)

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : The process can be described in four steps. In the first step, pneumatic fracturing is performed using an air compressor. Expandable packers are used to seal the borehole or well. The second step of the process involves lowering the water table by dewatering the saturated zone using continuous pumping. The next step strips VOCs from the saturated zone by injecting air below the water table and generating bubbles which strip the VOCs from the groundwater; this promotes air flow within the dewatering zone. The final step in the system, vapor extraction, relies on the strong tendency of volatile contaminants to volatilize. Once the vapors are recovered by the system, they can be treated.

Company Name/POC: First Environment, Inc./Rick Dorrier

Address : 90 Riverdale Road/Riverdale, New Jersey 07457

Phone Number : 201 616-9700

Fax Number : 201 616-1930

Technology Maturity : Commercial use experience

Performance History : A cleanup plan, including the FE Active (TM) was submitted to New Jersey regulators in September 1990. Cleanup using the FE Active (TM) system, began in the summer of 1992 and extended to two months. The system had been successful for mobilizing, volatilizing, and removing chlorinated hydrocarbons and other volatile contaminants from four locations at the New Jersey Site.

Comments : The system is mobile and can be adapted for a variety of site-specific conditions. Set-up and operation of the system typically takes one to two weeks. The FE Active (TM) system is not applicable to non-volatiles, inorganic or radioactive wastes in groundwater or soil. The efficiency of VOC extraction is dependent on the contaminants vapor pressure and Henry's Law constants.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Hot Water or Steam Flushing/Stripping***Technology Name :** AQUADETOX/SVE Integrated System

Application : In-situ (vadose zone) Ex-situ
 In-situ (saturated zone)

Brief Description : A low-pressure steam-stripping technology for the removal of volatile organic compounds (VOCs) from the groundwater, and a soil vapor extraction (SVE) system that treats VOCs from the soil. This system is capable of simultaneously cleaning soil and groundwater without emitting pollutants into the air. The advantages include a closed-loop system with no air emissions (reduced cost) and a removal efficiency in excess of 99.9 percent for groundwater and >99 percent for soil vapor treatment.

Company Name/POC: DOW Environmental/C.J. Davenport**Address :** 15204 Omega Drive/Suite 200/Rockville, Maryland 02850**Phone Number :** 713 978-3107**Fax Number :** 713 978-295**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.

Approximately 45 to 50 units are in operation as of September 1993 ranging in size from 5 to 3,000 gpm with the average unit at 300 gpm. Unit experiences typical facility start-up problems which have been routinely resolved. More persistent problems which require pretreatment have been caused by high alkalinity of groundwater, biofouling, and high iron content, and scaling in the unit. Reference: Lockheed Aeronautical Systems Co., David Jensen (818) 847-0792; Exxon, Gary Hope (713) 425-5793.

Comments : SVE portion of unit requires fairly porous soils. The AQUADETOX system is completely computer controlled and after installed and tested requires only one trained operator. The operator will receive training from AWD along with detailed manuals of operation. The training is minimal and no unusual personnel skills are required.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Hot Water or Steam Flushing/Stripping*

Technology Name : Integrated Steam Stripping/Condensation

Application : On-site Ex-situ

Brief Description : Integrated treatment system would reinject treated off-gases to increase subsurface gradients and augment removal. Condensation produces concentrated liquid organic phase.

Company Name/POC: Radian Corporation/Joe Milanowski

Address : 10150 West National Ave./Milwaukee, Wisconsin 53227

Phone Number : 414 327-9955

Fax Number : 414 327-2129

Technology Maturity : Pilot plant testing

Performance History : Hill AFB, Utah

Comments : Energy required to produce the steam off-gases. Aqueous-phase organics require additional treatment.

Presence of residual contaminants (i.e., nonvolatiles and metals) are better removed by other processes.

Source of Information : TechCon

CONTAMINANTS:

☐ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☒ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE: *Passive Treatment Walls***Technology Name:** Electrochemical Barriers**Application:** In-situ (vadose zone)
In-situ (saturated zone)**Brief Description:** Electrokinetic (EK) "fences" - underground permeable (to H₂O) barrier (to metal ion and nuclides)**Company Name/POC:** Geokinetics/Dr. Lageman**Address:** Dannenberg 16, 7461 TK/Rijssen, NL**Phone Number:** 05480-40584**Fax Number:** 5485 4069**Technology Maturity:** Commercial use experience**Performance History:** Conceptual, based on proven EK technology. Contact company for performance data.**Comments:** Extent of barrier wall can be up to 100m deep and 1/2km wide.**Source of Information:** International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Containment*

Technology Name : Cryogenics

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Provides temporary, interim and long-term barrier or containment by freezing moisture in ground structure. This is an effective technique well proven for the containment of volatile products.

Company Name/POC : CDS Research Ltd./Dr. Zohar Meratfa

Address : 20 Brookbank Ave./North Vancouver, B.C. V7J2B8, Canada

Phone Number : 604 985-2865

Fax Number : 604 985-2812

Technology Maturity : Commercial use experience

Performance History : Not applied to nuclear waste. Demonstration project required.

Comments : This is a containment/barrier technology, whereby contaminants are prevented from migrating to contaminated areas. Requires directional drilling, otherwise no serious challenge.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Containment***Technology Name :** Treatment Agents for In-Situ Infiltration

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : This technology uses modified natural clays (MNCs) to immobilize target contaminants such as heavy metals, radionuclides, and organics. The MNCs can be directly mixed into the material containing the contaminants or can be molded or injected to form in-situ barriers, preventing contaminant migration. MNCs drastically reduce contaminant migration by restricting hydraulic conductivity through a barrier constructed of MNCs and by providing reactive surfaces for contaminant adsorption and immobilization. MNCs, especially combined with binding agents, will impede the flow of contaminated-laden soil moisture and groundwater.

Company Name/POC: Fluid Tech, Inc./Dean Rowsell**Address :** 4335 West Tropicana Avenue/Suite 3/Las Vegas, NV 89103**Phone Number :** 702 871 1884**Fax Number :** 702 871-362**Technology Maturity :** Pilot plant testing**Performance History :** In-situ immobilization currently under R&D.

Comments : Treatability testing is required to formulate reagent for waste streams of peculiar characteristics (high salt concentrations, high level of chelating or complexing agents). Acidic, basic, reductive, and oxidative waste streams may require pretreatment. Slurried clay is easy to work with, requires less infrastructure than grout, and can be applied in many environments and remains stable (clays form in soils). The greatest challenge to this technology is bringing an awareness of the use of the technology to potential users. Matching MNC to the need in very complex environments requires bench testing. Finally, finding reliable data is difficult for comparison of critical factors such as volume expansion, thermodynamic stability in soils, susceptibility to freeze/thaw cycle stresses, stability to heat or radioactive decay, and energy usage, product cost, and final waste form disposal charges.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Containment*

Technology Name : Cut Off Walls/Hydrodynamic Isolation

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : The method isolates and fixates hazardous waste through the use of bentonite, slurry, synthetic and clay membranes, hydrodynamic barriers, caps and liners.

Company Name/POC: GZA Geoenvironmental, Inc./John J. Balco

Address : 320 Needham Street/Newton Upper Falls, Massachusetts 02164

Phone Number : 617 969-0700

Fax Number : 615 965-7769

Technology Maturity : Commercial use experience

Performance History : Performance data area available.

Technology with/without heating used on 9 sites (250 m [squared] to 22,000 m [squared]) in Holland, Germany and Denmark. First project initiated in 1992 and two projects are in operation in Copenhagen. Projects are successful except 1 which did not function, due to flooding of the area. Clients include oil companies (BP) and OM, Denmark.

Comments : The main limitation for the technology is the presence of very low permeable layers like clay, unless the contamination is mainly limited to fissures or fractures in the low permeable layer. The technology is simple to use with high flexibility to work with highly varying volume and areal distribution of contamination. The technology is self-running, but needs monitoring to secure a cost beneficial operation and the necessary documentation of the remediation activities to the relevant authorities. The company has 4 units.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Containment***Technology Name :** Artificial Ground Freezing

Application : In-situ (vadose zone)
 In-situ (saturated zone)

Brief Description : Serves the same function as a slurry wall or trench. Provides considerably less residual soil and can be installed to greater depths at a significantly lower price.

Company Name/POC: Layne-Northwest Company/Dr. Sopko**Address :** W229 N5005 DuPlainville Rd./Pewaukee, WI 53072**Phone Number :** 414 246-4646**Fax Number :** 414 246-478**Technology Maturity :** Commercial use experience

Performance History : Ground freezing has been successfully used on over 100 underground construction projects and one environmental application. The reference contact for this application is: E.O. Mixon, Project Manager, J.F. Shea Company, Inc. (414) 643-5140.

Comments : The barrier can be installed using rotary techniques from truck-mounted drilling equipment. After installation of the system, the freezing is completed by using either a portable or permanent refrigeration plant. The system must be routinely checked and requires constant electrical services for the first 8 weeks; then intermittently during the long-term approach. The most significant disadvantage of ground freezing is that it does require the constant use of refrigeration. This use, however, is substantially less than that typically used in construction applications since there would be no exposed face of the wall. A ground freezing system can be installed in virtually any type of soil conditions. The most significant component of any ground freezing system, both in time and costs, is the drilling and installation of the freeze pipes. The method of drilling varies depending on the soil type, the presence of rocks and boulders and the depth and angle of the freeze pipes. The major infrastructure requirement is the availability of electrical power. The greatest challenge facing ground freezing as a technology is development of site specific quality control plans and programs. The concept of creating a frozen barrier is quite simple; however, review of the underground construction projects that experienced problems clearly indicates that the problems could have been avoided, by implementing close tolerances in refrigeration pipe spacing, survey instrument calibration, comprehensive monitoring of the coolant temperature and distribution system and the use of experienced drilling and supervisory personnel in the field.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Containment*

Technology Name : Subsurface Frozen Soil Barriers

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Frozen soil barriers are an alternative to conventional containment systems such as steel, concrete slurry walls, or grout curtains. The technology replaces conventional containment systems where complete containment (on all sides and below) is desired. Diffusion rates for contaminant migration in frozen soil are orders of magnitude lower than sheet piling, grout walls, geomembranes and other conventional materials. With a core temperature of -35C and a thickness of 40-50 feet thick, contaminants are unable to move beyond the frozen zone. Frozen soil barriers can be used in combination with in-situ remediation technologies, ensuring no releases whatsoever from the site. Barriers may then be thawed returning the site to an undisturbed original condition. Technologies include: CRYOCELL, ISOCELL and CRYOSWEEP.

Company Name/POC: RKK, Ltd./Ron King

Address : 16404 Smokey Point Boulevard/Suite 303/Arlington, Washington 98223

Phone Number : 370 653-4844

Fax Number : 360 653-7456

Technology Maturity :

Performance History : Ground freezing has successfully been employed since the 1860s. This technology has been used in civil engineering practices for over a century for groundwater control and structural strength for excavation support.

Comments : Ground freezing represents a superior containment method for hazardous waste at depths of up to 2,000 feet. Conventional methods are generally limited to 100 feet or less. Containment of plumes >2,000 represent a potential limitation of frozen soil barriers.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Containment***Technology Name :** Tongues Jointing for Excavation Pit and Covered Excavation

Application :
 In-situ (vadose zone)
 In-situ (saturated zone)

Brief Description : Sheet piles are put into ground around the excavation site. After removing the soil in a first depth, a sheet pile retaining wall is installed. A sheet pile driver pushes the pile dike into the ground and the second sheet pile can be installed on top. Soil removal can now be carried out to the second depth and so on. Because of a maximum height of <3.5 m, this excavation-system could be used for enclosed excavation to avoid emissions.

Company Name/POC: Umweltschutz Nord GmbH/Hans-Peter Ratzke**Address :** Industrie Park 6, 27767 Ganderkesee/ Germany**Phone Number :** 49 4222 47 106**Fax Number :** 49 4222 47 142**Technology Maturity :** Commercial use experience

Performance History : Umweltschutz Nord GmbH & Co. has developed this sheet piling technology during a project of treatment of organic halogenated compounds from soil.

Comments : Limitations are expected by rocky underground. This technology is advisable and recommended for excavation areas with deep excavation pits and where hazardous gas emissions are expected.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Vacuum Vapor Extraction*

Technology Name : Vapor Extraction

Application : In-situ (vadose zone)

Brief Description : Vapor extraction is an effective method for remediation of vadose-zone soils containing volatiles and semi-volatile compounds. Vapor extraction wells are installed into the area of contamination with special care taken in the selection of well-screening depths. Terra Vac's extensive soil-permeability database of previous projects and its careful analysis of petrophysical data obtained from soil samples make it possible to determine an effective radius of influence which corresponds closely with that observed in the field. This prevents the necessity for a costly pilot test. By matching the depth of the well screening with the known lithology and soil characteristics, it is possible to remediate various portions of the lithology separately or simultaneously.

Company Name/POC: Terra Vac/Steven Thompson, Bruce Bosshard

Address : 356 Fortaleza St./P.O. Box 1591/San Juan, P.R. 00902-1591

Phone Number : 809 723-9171

Fax Number :

Technology Maturity : Commercial use experience

Performance History : Performance Data are available.

Contact company representative for performance summary and client list. Job size has ranged from small gas station projects to major superfund sites. This technique has been successful in each location where it was applied. Contaminants that have been recovered by this technology include: Benzene, toluene, xylenes, ethylbenzene, hexane, chloroform, methylene chloride, tetrachloroethylene, trichloroethylene, dichloroethylene, ethyl acetate, cyclohexane, methyl ethyl ketone, methyl isobutyl ketone, methanol, acetone, pyridine, tetrahydrofuran, dimethylfuran, carbon tetrachloride, trichloroethane, methyl methacrylate, decane, chlorobenzene, dichlorobenzene, trichloropropane, gasoline, jet fuel, Stoddard Solvent, diesel, kerosene, and heavy naphthas.

Comments : Contaminant must be volatile or semi-volatile for this technology to perform correctly. Contaminants which complex with the soil matrix are not effectively remediated using this technology.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Vacuum Vapor Extraction***Technology Name :** VACU-POINT

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Vacuum vapor extraction rapidly removes contamination from soil and groundwater and produces rapid site cleanup. In some cases, WES has remediated sites under 90 days. This technology has been tested and proven reliable and is now accepted by Florida Department of Environmental Protection (FDEP) as a short-term remedial technique.

Company Name/POC: W.E.S. Environmental Division/Anthony DeLoach**Address :** 6389 Tower Lane/Sarasota, Florida 34240**Phone Number :** 941 371-7617**Fax Number :** 941 378-521**Technology Maturity :** Commercial use experience Field demo complete

Performance History : WES has successfully demonstrated and pilot-tested more than 12 projects and installed four systems which have either remediated or reduced contaminants completely.

Chevron USA - 45 GPM, no problems. W.D. Howard 404 984-3085
 Amoco Oil - 4 projects, 1-100 GPM no problems. Bill Batts 813 661-4839
 Chevron USA - 55 GPM, no problems. John Machen 404 984-3192

Comments :

This technology works well in sandy and tighter clay conditions. If water disposal after treatment is not possible, this creates a problem. For use where both groundwater and saturated soil are contaminated and the client wishes to reduce cleanup time at an accelerated rate. Examples include landfills, industrial sites, pipeline leaks, underground storage tanks, and fuel spills. VACU-POINT is a patented and trademarked technology developed by W.E.S. Environmental Division for the rapid cleanup of contaminated water and soil. To date, the State of Florida has classified this technology as a "Short-Term Remedial Approach" to site restoration.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Bioreactors*

Technology Name : Bionergies, Biosmose, Biosurf

Application : In-situ (vadose zone) Off-site Ex-situ
In-situ (saturated zone)

Brief Description : Bioremediation of organic pollutions (in soils, water, effluents) by using: 1. exogenous specific bacterial consortium (non toxic, environment safe, European Federation of Biotechnology class I in order to control a full, complete and non selective biodegradation. 2. Biofixations (mineral natural support). 3. Biosurfactants (produced by selected bacteria) provide an effective, fast and secure alternative to common place bioremediation because Bionergies controls the biodegradation of the pollutant (and metabolites) by using specialized bacteria and feasibility tests (in labs, on the field).

Company Name/POC: Bionergies Laboratories, Biosurf/M. Jacques FAUDIN

Address : 59/100, rue des 4 termes/B.P. 1009/Z.I. des Paluds/13781 AUBAGNE Cedex, France

Phone Number : 33 42 84 30 07

Fax Number : 33 42 84 23 33

Technology Maturity : Commercial use experience

Performance History : Contact company for performance data.

Comments : Each case is analyzed in order to optimize the treatment and the on site materials and personnel. Bioenergies controls the bacterial action by using exogenous specific bacterial strains, biofixations and biosurfactants. None of the bacteria is genetically engineered. They are classified into class I (one) of the European Federation of Biotechnology, and produced under French and European Community regulations. The company is looking for join-ventures in U.S. in order to cover the environmental and industrial field.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Bioreactors***Technology Name :** Anaerobic Metal Removal Technology (AMR)**Application :**

On-site Ex-situ
 Off-site

Brief Description :

The AMR process was developed to release, separate and remove toxic metal contaminants in solids (soils, sediments, sludges) and can simultaneously bioremediate organic pollutants. The AMR technology involves the use of indigenous anaerobic heterotrophic denitrifying microbial populations which are resistant to and will aid in the solubilization of metal sulfides in the presence of other organic pollutants. AMR technology operates in the absence of oxygen, thereby eliminating the need for aeration. The process produces no acid which eliminates the secondary pollution problems. The addition of a low-cost and readily available soluble alternate electron acceptor source (nitrate) allows the system to be operated at low cost.

Company Name/POC: Geo-Microbial Technologies, Inc./D.O. Hitzman**Address :** P.O. Box 132, East Main Street/Ochelata, Oklahoma 74051**Phone Number :** 918 535-2281**Fax Number :** 918 535-256**Technology Maturity :**

Bench scale testing, only

Performance History : Development for removal of metals from spent coal liquification catalysts (DOE contracts).

Comments : The elimination of oxygen requirements allows broad usage. Microbial ecology would be easily manipulated by minimum alternate electron acceptor amendments. The system has broad potential applications with minimum requirements for implementation. The ease and flexibility of amendment addition and use of indigenous microflora expand the range of applications.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Bioreactors*

Technology Name : Biological Groundwater Treatment (Biopur)

Application : On-site Ex-situ

Brief Description : Biological treatment of contaminated groundwater and soil vapor in a fixed film bioreactor.

Company Name/POC: Maple Environmental Services Ltd./John Haanstra

Address : 201 County Court Blvd/Suite 600/Brampton, Ontario 16W 4L2

Phone Number : 905 457-6444

Fax Number : 905 457-2498

Technology Maturity : Commercial use experience

Performance History : First successful pilot installation in 1989. Since then 40-50 full scale applications.

Comments : After start up and commissioning a minimal amount of maintenance is required. Can be remotely monitored by computer modem. A skilled equipment operator can maintain system on a part time (1 hr/day) basis. Biopur system is well proven. The present challenge to design system suitable for the treatment of complex chlorinated hydrocarbons, contaminated groundwater, and soil vapor.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Bioreactors***Technology Name :** Biological Soil Treatment Plant

Application : On-site Ex-situ
 Off-site

Brief Description : The biological soil treatment plant consists of a bioreactor for treatment of oil and light tar contaminated soil for reduction of the pollution from 3% oil down to 0.01-0.1% with-in a few weeks. The plant can also be used for treatment of soil polluted with light organic compounds such as benzene, phenols and some pesticides. The technology is based on biological degradation of the pollutants.

Company Name/POC: Newcon A/S/J. Mollekilde**Address :** Ternevey 20/DK-4000 Roskilde**Phone Number :** 45 42353616**Fax Number :** 45 4235154**Technology Maturity :** Commercial use experience

Performance History : The biological soil treatment plant was developed in 1991. Newcon A/S treated 45,000 tons oil and tar contaminated soil with one plant. Newcon A/S has one plant in operation and is planning to increase capacity with two more plants in Denmark this year.

Comments : The plant is constructed so it can easily be moved from one place to another.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Membrane Separation*

Technology Name : Spiral Wound Membrane Technology

Application : In-situ (saturated zone) Ex-situ

Brief Description : Spiral-wound membrane technology offers a cost-effective, energy-efficient method of making separations using the principles of osmosis. The technology used by Desalination Systems, Inc. allows for the recovery and reuse of waste stream constituents from acids to metals. SWMT needs no additional chemicals, making this technology environmentally friendly. A highly trained operator is unnecessary. There are no additional sludge costs with membrane technology. A membrane system is a small fraction of the cost of installing a Dissolved Air Flotation (DAF) device.

Company Name/POC: Desalination Systems, Inc./Bridgete Owens

Address : 760 Shadowridge Dr./Vista, California 92083

Phone Number : 619 598-3334

Fax Number : 619 598-3335

Technology Maturity : Commercial use experience

Performance History : Performance data are available from the company.

Comments : SSWM systems are small compared to other technologies such as DAF. Membrane systems require electricity to run the motor and pump. SWM systems need little support services from an outside operator. These systems can also be located outdoors. A SWM system can be used easily. A technician can be trained in a few hours to take readings, if needed, and watch the system. The membrane system is flexible in that it can be installed inside or outside the facility, so no large infrastructures need to be built. The size of a membrane system is so small that it fits almost anywhere.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☒ SVOC	☐ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Electron Beam*

Technology Name : Electron Beam Hazardous Waste Treatment (E-Beam)

Application : On-site Ex-situ

Brief Description : The process is based on aqueous radiation chemistry and it is non-selective in the destruction of organic chemicals because strongly reducing reactive species; and strongly oxidizing reactive species, are formed at the same time and in approximately the same concentration in solution. The reactive transients initiate thousands of chemical reactions capable of destroying hazardous compounds in aqueous solution, in most cases, mineralizing them to carbon dioxide, water, and salt. High energy electron beam treatment of hazardous waste can be used to replace UV/O₃, UV/H₂O₂, and other advanced oxidation processes (AOPs), and in some cases incineration.

Company Name/POC: High Voltage Environmental Applications, Inc./William J. Cooper, Pres., Mike Nickelsen

Address : 9562 Doral Boulevard/Miami, Florida 33178

Phone Number : 305 593-5330

Fax Number : 305 593-007

Technology Maturity : Commercial use experience

Performance History : In addition to controlled (single solute) feasibility studies, feasibility studies on two multi-source hazardous waste leachates have been conducted which have shown that the process is economical for the ultimate destruction of hazardous waste leachates. HVEA waste treatment systems are part of the US EPA SITE Program, and are available for use on Superfund sites. HVEA's mobile systems were to be demonstrated on solvent contamination ground water under the SITE program in the fall '93 at Savannah River, South Carolina.

Comments : HVEA's electron beam treatment systems require (1) site location the size of a tractor trailer, (2) a mechanism for delivering the waste to the treatment system, i.e., well pumps, etc., (3) three phase electrical power, (4) 120 VAC electrical power, (5) effluent line and site. Soils, sediments, and sludges must be suspended in an aqueous matrix. The electron beam treatment systems are ineffective in treating heavy metals. HVEA electron beam treatment systems are available in different sizes, to effectively address any size problem. Units are modular in design; therefore, several systems can be interfaced to enhance treatment capability. Systems are completely automated and require only one technician per 8 hr shift. High initial capital cost.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☒ SVOC	☐ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Other*

Technology Name : In-Situ Electro-Enhanced Remediation/Electrofrac

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : In situ electro-thermal treatment uses volatilization, pyrolysis and fusion to treat the soil. This technology replaces excavation of soil.

Company Name/POC: Bio-Electrics, Inc./E. Sarapuu

Address : 1301 Woodswether/Kansas City, Missouri 64105

Phone Number : 816 474-4895

Fax Number : 816 842-1245

Technology Maturity : Pilot plant testing

Performance History : Refer to EPA's VISITT 3.0 Database.

Comments : Qualified engineering personnel required for problem evaluation. This technology was originally developed for in situ processing of mineral fuels. This technology cannot be used for under-water decontamination.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Other***Technology Name :** Soil Extraction**Application :**

On-site

Ex-situ

Brief Description : Chemical extraction of radionuclides in soil; carbonate and magnetic separation to <35 pCi/g uranium and 25 pCi/pg plutonium.**Company Name/POC:** Bradtec, LTD/Philip Tucker (UK)**Address :** University of the West of England/Gold Harbour Lane/Bristol BS-16 1QY, United Kingdom**Phone Number :** 0272 763937**Fax Number :** 44 117 976 389**Technology Maturity :**

Pilot plant testing

Performance History : Rust Remediation Inc. has introduced technology at Hanford. Relatively new and unproven; however, it is a promising technology.**Comments :** Uses standard equipment. Field testing, and proof of efficiency on clay soils is needed. Actively being marketed in U.S. by Rust International Inc.**Source of Information :** International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : Other

Technology Name : In-Pulp Decontamination of Contaminated Soil

Application : Ex-situ

Brief Description : This treatment process employs in-pulp technology to extract organic and inorganic contaminants from soils, sediments, etc. Resin-in-pulp (RIP) is normally used for metal contaminants while carbon-in-pulp (CIP) is used for organics. These processes are applied commercially in the metallurgical field for recovering minor metals such as gold and uranium. Incoming material is crushed and screened and then leached. The pulp is separated into a coarse and fines fraction and the coarse fraction is washed to remove the leach liquor. Coarse materials that are readily leached may be processed without in-pulp treatment. The fines are treated by the in-pulp adsorption thus avoiding a difficult washing step and in some cases enhancing the leach. The contaminants are recovered from the adsorbant in a concentrated form for further treatment, disposal, or recovery.

Company Name/POC: Davy International/George Rowden

Address : Ashmore House/Richardson Rd./Stockton-on-Tees, Cleveland/T5183RE England

Phone Number : 1642 602221

Fax Number : 1642 341001

Technology Maturity : Pilot plant testing

Performance History : In-pulp technology used in the process was developed by Davy for metals extraction from ores and concentrates and has been successfully operated on the pilot-and commercial-scale since the mid 1980's. A collaborative development has been carried out to apply this technology soil treatment since 1990 with a Danish company (KKM) under the EC Euroenviron program. The technology has also been accepted into the EPA SITE Program. The project is initially developing a process for cleaning soils contaminated with toxic heavy metals, e.g., Cu, Cr, As, Hg, Pb, Zn etc.

Comments : Although similar plants can be used to treat a wide range of contaminants, each soil or sediment type will require its own definition of the chemical process steps. Two or more extraction stages may be required for some combinations of contaminants owing to their different chemical behavior.

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Other*

Technology Name : Delft Centrifuge

Application :

On-site

Ex-situ

Off-site

Brief Description : World's largest centrifuge for accelerated soil testing. 15 meter arm, 5000 kg sample at 300g gravity.

Company Name/POC: Delft Geotechnics/Mr. Viergever

Address : #2, Stieltjesweg/Delft, Netherlands/P.O. Box 69/2600 AB 2628CK

Phone Number : 011 31 15 269 3500

Fax Number : 15 261 0821

Technology Maturity : Commercial use experience

Performance History : Contact Delft Geotechnics for performance data

Comments : Samples can be run in Holland. Transfer of technology will take time. No U.S. subsidiary.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : Other

Technology Name : RECLAIM (TM) In Situ VOCs Partitioning/Extraction

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : "RECLAIM" passive remediation is accomplished by exposing "RECLAIM" porous polymer (proprietary material) to solution-phase and/or vapor-phase volatile organics. This exposure is most often achieved through the placement of stainless mesh containers that hold the spherical beads of "RECLAIM" polymer as a unit ("canister") in monitoring or recovery wells that access VOC-contaminated soil, groundwater, or both. "RECLAIM" is an extremely hydrophobic material, very stable chemically and thermally. It adsorbs and concentrates VOCs based on partial pressures available, achieving concentrations as much as 2,000 times greater on the polymer body than in the atmosphere of the well.

Company Name/POC: Environmental Fuel Systems, Inc./Cal Chapman

Address : P.O. Box 1899/709 Main Street/Bandera, Texas 78003

Phone Number : 210 796-7767

Fax Number : 210 796-7484

Technology Maturity : Commercial use experience

Performance History : The company has performed "RECLAIM" service commercially at eighteen sites with VOC contamination in soil and/or groundwater for periods up to seven months. TPH and BTEX levels have been reduced provided no new contaminants have been introduced. The radius of influence for the RECLAIM canister has been estimated based on weights of fuel residues recovered, and periodic TPH and BTEX measurements through the treatment time frame. It appears that well grids of 40 feet are sufficient for sandy soil/water clean-up; well grid spacing tightens with lower permeabilities. At sites still dispensing fuel, a number of spills and leaks have been isolated and products often identified through gas chromatographic testing of condensates.

Comments : "RECLAIM" passive remediation is limited by the permeability of geologic structures, concentrations and vapor pressures of contaminants available, and hydraulic gradient. As these decrease, the rate of recovery decreases (as is the case with all clean-up methods). The service is labor- and travel-intensive, as a technician must provide periodic service and support at a site on a periodic basis (as with other approaches). When comparing rates of recovery of the passive "RECLAIM" approach for active methods such as vapor extraction or groundwater pumping and treatment, "RECLAIM" is usually found to be a slower process, but it is much less expensive. "RECLAIM" is only effective with organics.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Other**Technology Name :** Ex Situ Soil Remediation Equipment**Application :**

Ex-situ

Brief Description :

Portec/Construction Equipment Division (CED) offers predesigned ex situ soil remediation equipment and also offers to manufacture equipment for the soil remediation market. Preconditioning (including crushing and screening), soil washing, mixing, conveying, storage, and slurry makeup systems are readily available. Other types of specialized equipment can be engineered and manufactured under a variety of contract arrangements.

Company Name/POC: Portec, Inc./Jim Lincoln**Address :** 700 West 21st Street/P.O. Box 20/Yankton, South Dakota 57078-0220**Phone Number :** 605 665-8770**Fax Number :** 605 665-885**Technology Maturity :** Commercial use experience

Performance History : In 1992 a Model 53 portable pugmill plant was used, on site, to modify the physical properties of a wide variety of liquid hazardous wastes. Also in 1992 Portec Portable Blender has been used to incorporate a proprietary chemical mixture for the treatment of hydrocarbon contaminated soil. Again in 1992 another Model 53 unit was used to chemically precondition PCB contaminated wastes for final thermal treatment.

Comments :

Portec/CED equipment is not a technology and therefore has no technical limitations. It is possible that equipment designed and manufactured by Portec/CED could be used for many remediation applications. However, the majority of equipment currently being offered is best suited for those technologies that require ex situ treatment.

Source of Information : VISITT 3.0

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☒ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Other*

Technology Name : Magnetic Separation

Application : On-site Ex-situ

Brief Description : The technology removes magnetic objects from shooting ranges.

Company Name/POC: Slaggrödukt/Hans Larsson

Address : Box 244/ 30104 Halmstad, Sweden

Phone Number : 4660 122072

Fax Number : 4660 121062

Technology Maturity : Bench scale testing, only

Performance History : Contact company for performance data.

Comments : None.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : Vacuum Assisted Scarification Technology for Surface Soil Collection

Application : On-site ☒ Ex-situ ☒

Brief Description : The mobile vacuum system collects surface contaminated soils. It is currently configured to collect soils developed to a depth of 1 to 4 inches, similar to those found in the arid southwest. The soils can either be deposited in a dump truck or into bags. The exhaust air stream passes through a 0.1 micron filter and therefore all particles are collected at a 99.999% collection efficiency to prevent cross contamination to other areas. It is the largest mobile vacuum unit in the industry and has performed successfully in many varied environmental applications since 1987.

Company Name/POC: JVI Environmental Inc./Rick Helwig

Address : 1343 South Schmuhl Road/ New Lenox, IL 60451

Phone Number : 815 485-0979

Fax Number : 815 485-098

Technology Maturity : Commercial use experience

Performance History : Performance history for JVI projects: 1) Commonwealth Edison Company, Various Locations: Crawford Station, Chicago, Illinois - Fist Station, Chicago, Illinois - State Line Station, State Line, Indiana - Joliet 29, Joliet, Illinois, vacuuming and bagging of asbestos, large quantities, over \$1,000,000.00 total. Contact Name: Mr. Tom Maiman, Exec. Vice President, 312 294-7301. 2) Quantum Chemical, Morris, Illinois, vacuuming and bagging of asbestos, Contact Name: Mr. Ken Jacobson, 815 942-7011. 3) Urban Engineering, Great Lakes Naval Training Station, Hangar 1, vacuuming and bagging of asbestos. Contact Name: Mr. Brenden Reidy, 708 425-4809. 4) Ozinga Redi-Mix, Mokena, Illinois, vacuuming of Portland Cement at Redi-Mix Plant. Contact Name: Mr. Rich Deboer, 708 388-6200.

Comments : The HEPA filter mobile vacuum system can operate in a more varied terrain than any other surface soils collection technology. This includes valleys, crevices, areas where rock outcroppings exist as well as flat surfaces. Soil characteristics such as density, moisture content, and grain size would be beneficial. It can be used as the primary or a complementary technology to other systems such as a pavement remover. The unit can be pulled across contaminated areas by truck, tractor, or caterpillar with a broad suction nozzle attached across the blade. A suction nozzle has been designed for uniform vacuum across a 6-foot blade. An alternative configuration can be used for manual pickup by attaching 4 to 6 vacuum hoses. This mode of collection would result in a minimum of surface disturbance. The unit would use balloon tires for soft soils. All equipment is available for immediate use. Existing vegetation in areas with surface contamination is a problem. If the unit is pulled by a caterpillar tractor and the inlet nozzle is attached to the blade, the surface vegetation would need to be removed prior to vacuuming. However, if a minimum of surface vegetation and disturbance is desired, vacuum hoses could be used for manual collection from two parts on each side of the unit.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Recycle*

Technology Name : Recycle of Metal and Cyanide Ions

Application : Ex-situ

Brief Description : A metal contaminated site is excavated the same way precious metals are mined. The dirt is piled on a liner or pad. Cyanide is sprayed on the dirt and collected when it reaches the liner. The metal-cyanide solution is stripped of the cyanide and the metals are filtered. Recycle of metal and cyanide ions by means of Acidification- Volatilization and Recovery (AVR) is a viable method to reduce the cost of cleanup. The above-ground process begins when the solution or slurry is pumped into the stripping column. Acid is then metered into the column forming HCN. HCN gas is swept into the adsorption column of caustic thereby making sodium cyanide available for reuse. System is closed loop with double wall constructed for potential gas entrapment. Monitors and alarms are placed at critical points.

Company Name/POC: Viking Industries/Don T. Pearson

Address : 3441 Adams Rd./Murfreesboro, Tennessee 37130

Phone Number : 615 890-1018

Fax Number : 615 890-9932

Technology Maturity : Pilot plant testing

Performance History : Separation of metal cations leads to the more efficient removals in uncomplexed form. Dependent on the effluent; efficiencies of 97.3 to 100 percent were achieved. Cyanide complexed metals treated: nickel chloride, [NiCl₂]; cadmium sulfate [CdSO₄]; copper sulfate, [CuSO₄]; ferrous nitrite, [Fe(NO₃)₃]; zinc sulfate, [ZnSO₄]; and a mixture of all F007, F008, F009, F010, F011, F012 wastes.

Comments : The waste must be pumpable. The process is based on liquid flowing down a packed column against a counter-current flow of air sweeping gas to an adsorption column. The process is applicable only for sludge containing cyanide.

Source of Information : VISITT 3.0

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Dust Control***Technology Name :** Long Duration Foam**Application :**

On-site

Ex-situ

Brief Description :

Rusmar Long Duration foam is applied over an emitting surface to control odors, VOC's, dust and other emissions. The foam creates a continuous barrier between the surface and the atmosphere. Rusmar Long Duration Foam Technology is very effective in controlling any emission. Long Duration Foam is utilized in place of soils, tarps and other cover materials to control odors, VOC's, dust, windblown emissions, etc. Long Duration Foam completely covers any surface to which it is applied and it will conform to irregular and vertical surfaces. Long Duration Foam can be applied quickly, easily and provides a superior barrier to emissions than soil or tarps. It is non-toxic, non-hazardous, non-flammable and biodegradable.

Company Name/POC: Rusmar Incorporated/Laura White**Address :** 216 Garfield Avenue/West Chester, Pennsylvania 19380**Phone Number :** 610 436-4314**Fax Number :** 610 436-843**Technology Maturity :** Commercial use experience**Performance History :**

Rusmar Long Duration Foam has been used throughout the United States and abroad for a variety of applications including: remediation projects, Superfund projects, lagoon and pond closures. It has been used as odor control on a liquid surface, for dust and VOC's suppression, emergency response, vapor and odor suppression in industrial applications and erosion control and to prevent surface water infiltration on stock piled soils. Additionally, Long Duration Foam has been used for in transit odor control on sludge filled containers and dust control during demolition of asbestos contaminated buildings.

Comments :

Some of the Long Duration Foam products require water to dilute the product prior to use. The water must have less than 300 PPM of hardness. The smaller Pneumatic Foam Units are trailer mounted and require a piece of equipment to tow them around the site. During months of freezing weather, all Long Duration Foam products must be protected from freezing. The Pneumatic Foam Units are completely self contained and require no outside source of power. During freezing weather, a source of electricity is required to operate the freeze protection system on the larger Pneumatic Foam Units. There are no application temperature limitations on Long Duration Foam Products. Care must be exercised when applying AC-900 Series products with respect to weather, a heavy rain will not allow the membrane to form. After the first day, AC-900 Series products are unaffected by weather, i.e., rain, snow, wind, etc. Long Duration Foam is easily applied utilizing a Rusmar Incorporated Pneumatic Foam Unit. Long Duration Foam is a single component material requiring non chemical mixing and no post application cleanup. The Pneumatic Foam Units are simple and easy to operate; they require no special training. Long Duration Foam is available with durations ranging from a few hours to six months. The Pneumatic Foam Units are available in a variety of sizes ranging from a small skid mounted unit to a large self propelled track mounted unit. These units are available for purchase or rental. Long Duration Foam and Pneumatic Foam Units have been in use in the field for the past nine years. They do not face any general challenges. Long Duration Foam can be applied at a rate of 500 square feet per minute and requires only one operator.

Source of Information : TechCon

Process Water

Treatment

Process Water

Treatment

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☒ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : Bionergies, Biosmose, Biosurf

Application : In-situ (vadose zone) Off-site Ex-situ
In-situ (saturated zone)

Brief Description : Bioremediation of organic pollutions (in soils, water, effluents) by using: 1. exogenous specific bacterial consortium (non toxic, environment safe, European Federation of Biotechnology class I in order to control a full, complete and non selective biodegradation. 2. Biofixations (mineral natural support). 3. Biosurfactants (produced by selected bacteria) provide an effective, fast and secure alternative to common place bioremediation because Bionergies controls the biodegradation of the pollutant (and metabolites) by using specialized bacteria and feasibility tests (in labs, on the field).

Company Name/POC: Bionergies Laboratories, Biosurf/M. Jacques FAUDIN

Address : 59/100, rue des 4 termes/B.P. 1009/Z.I. des Paluds/13781 AUBAGNE Cedex, France

Phone Number : 33 42 84 30 07

Fax Number : 33 42 84 23 33

Technology Maturity : Commercial use experience

Performance History : Contact company for performance data.

Comments : Each case is analyzed in order to optimize the treatment and the on site materials and personnel. Bioenergies controls the bacterial action by using exogenous specific bacterial strains, biofixations and biosurfactants. None of the bacteria is genetically engineered. They are classified into class I (one) of the European Federation of Biotechnology, and produced under French and European Community regulations. The company is looking for join-ventures in U.S. in order to cover the environmental and industrial field.

Source of Information : International TechCon

CONTAMINANTS :☐ Pesticides/Herbicides☐ Heavy Metals☐ PCB☐ Explosives/Propellants☒ Petroleum Hydrocarbons☐ Radionuclides☐ SVOC☐ Other Contaminant☐ Nonhalogenated VOC☐ Halogenated VOC☐ N/A**TECHNOLOGY TYPE :** *Biodegradation (In Situ)***Technology Name :** Biocatalytic Contaminant Degradation (BCD)**Application :** In-situ (vadose zone)

Ex-situ

In-situ (saturated zone)

Brief Description :

ECO-TEC, Inc. (ETI), utilizes "Enviromech Gold", (EMG), a proprietary biocatalyst to dramatically accelerate the biodegradation of petroleum hydrocarbons and other biodegradable contaminants. The biocatalytic contaminant degradation (BCD) process can be applied to soil or groundwater, ex situ or in situ. A

pH-balanced microbial inoculum (BMI) consisting of water, EMG, indigenous microbes, contaminant specific microbes (if needed) and all trace minerals and nutrients required for microbial proliferation is created.

Company Name/POC: ECO-TEC, Inc./Ecology Technology, Inc./Herbert R. Pearse**Address :** P.O. Box 1113/Issaquah, Washington 98027-1113**Phone Number :** 206 392-0304**Fax Number :** 206 392-057**Technology Maturity :** Commercial use experience**Performance History :** The Biocatalytic contaminant degradation, (BCD), technology has been successfully demonstrated many times on full-scale remediation projects in Washington State.**Comments :**

Generally, BCD technology can be applied to various sites and media, and can be implemented utilizing equipment that is readily available. Since many variable parameters exist between sites, no one BMI or application technology is best suited to all situations. The BCD process will be modified to meet site-specific criteria. The Biocatalytic contaminant degradation, (BCD), process is not the one cure for all remediation problems, although it can be utilized in conjunction with other remediation technologies. The BCD process is limited by the availability of oxygen, range of temperature and the availability of moisture. All of these limiting factors can be controlled in modern site remediation operations.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : Phytostabilized Bioremediation

Application :
In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Uses enhanced biotechnology to degrade organics - e.g., phenol, PCB, dioxin and inorganics - nitrate, ammonia etc. The technology can be used in a soil matrix to treat flowing groundwater/effluent or by direct planting into soil. Non-stabilized bioremediated and many types of conventional water treatment. Microorganisms (fungi and bacteria) which develop in the planted soil are responsible for most of the treatment. The root and rhizone systems of the reeds bring air into the soil surrounding them while further away the environment is anaerobic creating a unique mosaic of treatment spheres which facilitates the impressive ability of reed beds to remove complex and previously intractable pollutants. The majority of treatment is by soil microbes but certain contaminants (such as heavy metals, sulphur and phosphorous) are removed via soil processes.

Company Name/POC: OEEL Ltd/ESU Ltd/ Lucian S. Gill

Address : 4 Cumberland House/Greenide Land/Lidget Green/Bradford W.Yorkshire BD89TF England

Phone Number : 1274 480033 **Fax Number :** 1274 483003

Technology Maturity : Commercial use experience

Performance History : Over 500 applications worldwide including PCB, Pesticide, Dioxins, Organics - including solvents, phenolics, PAH's, ammonia, nitrates, cyanide etc., sewage, farm slurries, metal entrapment/extraction.

Comments : Requires adaptation and monitoring over the first 3 years to maturity but then continues in some cases with little or no attention. Requires larger land areas than conventional "packaged" systems. Requires three years adaption period. Once adapted is extremely flexible and will readapt to changes in input. The technique involves genetics selection of plant types to withstand toxic material. The plant/soil/bacterial matrix is then adapted to the site conditions and once stabilized - continues to treat the toxic material indefinitely. Effluent/groundwater is fed into a basin containing the PL/SO/BAC matrix. Plants are allowed to develop and penetrate their rhizomes into the toxic soil. Because each site has a unique problem, no hard rule for system costs can be given. Smallest system - 10 sq. meters, largest 20 hectares; volume 1 m(cubed) per day to 5000 m(cubed) per day.

Source of Information : International TechCon

CONTAMINANTS :

- ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Biodegradation (In Situ)**Technology Name :** Mixflo (TM)**Application :** On-site

Brief Description : Praxair's MIXFLO System dissolves oxygen into a slurry from a lagoon in a two-stage process. In the first stage, slurry is pumped from the lagoon and pressurized to between 2 and 4 atmospheres. Pure oxygen gas is injected into the slurry. The resulting mixture passes through a pipeline contactor in which approximately 60 percent of the injected oxygen dissolves. In the second stage, the oxygen/slurry mixture is reinjected into the lagoon through a liquid/liquid eductor which ingests unoxygenated slurry from the lagoon and mixes it with the oxygenated slurry. This technology can also be used to assist a slurry-phase bioremediation system.

Company Name/POC: Praxair, Inc./Gary E. Storms**Address:** Linde Division/39 Old Ridgeburg Rd./Danbury, CN 06810**Phone Number:** 203 837-2000**Fax Number :** 203 837-250**Technology Maturity :** Commercial use experience

Performance History : Over 150 secondary wastewater treatment installations, including both tanks and lagoons, are successfully using this technology in Europe and South America. A full-scale in situ lagoon phase bioremediation began in early 1992 at the French, Ltd. Superfund site in Crosby, Texas using the MIXFLO technology. The technology met all its design expectations and the remediation was completed ahead of schedule.

Comments : Praxair's MIXFLO System is compatible with all aerobic lagoon phase bioremediation processes that would otherwise use air. This technology is only applicable to slurry-phase type of bioremediation. Therefore, as an in situ process, it is applicable to lagoons, pits, ponds, etc. Slurry must be pumpable and pass through a 1/2-inch mesh.

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Composting*

Technology Name : Bioremediation

Application : On-site Ex-situ

Brief Description : The initial steps of this technology consist of excavating contaminated soil/sediment or collection of contaminated waters for treatment. The contaminated material is then mixed with composting materials as a mixture formulated to yield the desired carbon to nitrogen ratio to result in optimal composting conditions. Air is circulated through the compost via perforated pipe in the compost bed. Temperature is controlled by the rate of air flow through the compost and pH is monitored regularly to ensure optimal composting conditions. Moisture is added as required to maintain a nominal 60% moisture in the compost and mixing is carried out on a weekly basis. Composting of energetic materials (explosives and propellants) is completed within a 4- to 6-week time period.

Company Name/POC: Arctech, Inc./Dr. Daman Walia

Address : 14100 Park Meadow Drive/Chantilly, Virginia 22021

Phone Number : 703 222-0280

Fax Number : 703 222-0299

Technology Maturity : Commercial use experience

Performance History : Arctech has recently demonstrated its composting technology on radioactive energetics (explosives and propellants).

Comments : This technology is not applicable to volatile organics, solvents or inorganic metal contaminants due to the release of volatiles as a result of the heat generated during composting and/or due to the activity of the microorganisms in creating volatile organics, for example methyl mercury.

Source of Information : VISITT 3.0

CONTAMINANTS: ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE: *Solid Phase Biological Treatment*

Technology Name: Biocatalytic Contaminant Degradation (BCD)

Application: ☐ On-site ☐ Ex-situ

Brief Description: ECO-TEC, Inc. (ETI), utilizes "Enviomech Gold", (EMG), a proprietary biocatalyst to dramatically accelerate the biodegradation of petroleum hydrocarbons and other biodegradable contaminants. The biocatalytic contaminant degradation (BCD) process can be applied to soil or groundwater, ex situ or in-situ. A pH-balanced microbial inoculum (BMI) consisting of water, EMG, indigenous microbes, contaminant specific microbes (if needed) and all trace minerals and nutrients required for microbial proliferation is created.

Company Name/POC: ECO-TEC, Inc./Ecology Technology, Inc./Herbert R. Pearse

Address: P.O. Box 1113/Issaquah, Washington 98027-1113

Phone Number: 206 392-0304

Fax Number: 206 392-057

Technology Maturity: Commercial use experience

Performance History: The Biocatalytic contaminant degradation, (BCD), technology has been successfully demonstrated many times on full-scale remediation projects in Washington State.

Comments: Generally, BCD technology can be applied to various sites and media, and can be implemented utilizing equipment that is readily available. Since many variable parameters exist between sites, no one BMI or application technology is best suited to all situations. The BCD process will be modified to meet site-specific criteria. The Biocatalytic contaminant degradation, (BCD), process is not the one cure for all remediation problems, although it can be utilized in conjunction with other remediation technologies. The BCD process is limited by the availability of oxygen, range of temperature and the availability of moisture. All of these limiting factors can be controlled in modern site remediation operations.

Source of Information: VISITT 3.0

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : Biodegradation of VOCs

Application : On-site Ex-situ

Brief Description : Reactor system to biologically degrade trichloroethylene, vinyl chloride, dichloroethylene and related compounds in the vapor phase. The system has been proven to destroy >90 percent of the VOCs while maintaining biocatalytic life over extended periods.

Company Name/POC: Envirogen, Inc./William J. Guarini

Address : 4100 Quakerbridge Rd./Lawrenceville, New Jersey 08648

Phone Number : 609 936-9300

Fax Number : 609 936-9221

Technology Maturity : Field demo complete

Performance History : Technology based on successful pilot results in DOE-OTD Argonne National Lab funded project. Currently being field tested at a commercial site in New York State.

Comments : Full-scale operating parameters to be determined. Simple operation, minimal operator attention.

Source of Information : TechCon

CONTAMINANTS.:

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : Slurry Phase Biological Treatment

Technology Name : Biotechnical Processing of Explosives

Application :	On-site	Ex-situ
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Brief Description : EODT Services, Inc., in association with Oak Ridge National Laboratory, has developed several amoeba-bacteria consortia and methods for altering and degrading organic and explosive wastes and contaminants. More practically, this invention relates to protozoan derived consortia comprised of protozoa and bacteria; methods for using protozoa/bacteria as consortia for altering or degrading wastes and production and use of biodispersants derived from protozoa/bacteria consortia. With some pretreatment, soils containing explosive wastes are fed to the slurry phase bioreactor where water and biodispersant are fed with bacteria-consortia.

Company Name/POC: EODT Services, Inc./Paul Greene, Monirul Haque

Address : 10511 Hardin Valley Road/Building C/Knoxville, Tennessee 37932

Phone Number : 423 690-6061

Fax Number : 423 690-606

Technology Maturity :- Commercial use experience-

Performance History: The slurry phase bioremediation technology of EODT-S has finished its bench scale and pilot scale demonstration. It has now the capability of full scale remediation of hazardous contaminated soils, water, and explosives. As part of the full-scale capability, EODT-S has built its own mobile Biotechnical Processing Unit. The capacity of this unit is 203 tons of explosive contaminated soil per month. A demonstration of the technology was recently performed at Lone Star Army Ammunition Plant (LSAAP) contaminated soil at Texarkana, Texas, in November 1993.

Comments :	There is no use of chemicals in this process. The biodispersant is passive and inert and naturally degradable. Effectiveness of the whole process depends on types of contaminants and their concentrations in soils and wastes. Before any field application of the process, some batch experiments are performed with the samples to establish field protocols.
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Source of Information : VISITT 3.0

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☒ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : Biotechnology/Bioremediation

Application : On-site Ex-situ

Brief Description : Biological decontamination of soil/wastewater using bioadapted micro-organisms. Microbes use hazardous organic substances as food sources thereby degrading them to nonhazardous end products like CO₂ and H₂O. Achieves a high level of decontamination in a short time; inexpensive.

Company Name/POC: KAM Biotechnology Ltd./Mongi Ferchichi

Address : 9710 187th St., #101/Surrey B.C. V4N 3N6

Phone Number : 604 888-4336

Fax Number : 604 888-6623

Technology Maturity : Commercial use experience

Performance History : Successfully completed decontamination of soils, wastewaters, sludges, transformer oils etc.

Comments : Bacteria cannot degrade all compounds and some are in fact inhibitory to their growth. Equipment easily transported. Minimal infrastructure required. Most bacterial additives are "not controlled" plus not "hazardous."

Source of Information : International TechCon

CONTAMINANTS:

- ☒ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE: *Slurry Phase Biological Treatment*

Technology Name : Slurry Phase Bioremediation

Application :

Ex-situ

Brief Description : SBP Technologies, Inc., (SBP) has established a unique collection of patented microorganisms for use in bioremediation applications. Based on the nature of the impacted matrix and the site-specific cleanup goals, various bioremediation strategies have been developed for the practical application of these technologies. These strategies include: 1) fixed-film bioreactors for water treatment and 2) soil slurry bioreactors.

Company Name/POC: SBP Technologies, Inc./Dr. James Mueller/Ph.D.

Address : One Sabine Island Drive/Gulf Breeze, Florida 32561-3999

Phone Number : 904 934-9282

Fax Number : 904 934-920

Technology Maturity :

Pilot plant testing

Performance History : The SBP biotreatment strategy has been shown to: 1) effectively and extensively biodegrade (mineralize) high-molecular-weight PAHs, and 2) remove the toxicity and teratogenicity associated with effluent from the treatment train. This result was demonstrated at the American Creosote Works Superfund site, Pensacola, Florida, where system effluent was acceptable for direct discharge off site.

Comments :

For soils, soil texture and structure can significantly influence treatment efficacy. All conventional limitations to biological processes apply (e.g., high metal concentrations, temperature, pH nutrient status, oxygen potential, bioavailability, etc.). However, treatment systems that integrate physical separation technologies (e.g., soil washing and filtration) can be designed to handle organic/inorganic waste streams.

Source of Information : VISITT 3.0

CONTAMINANTS :

☐ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☒ SVOC	☐ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : Biocat (TM)

Application : Ex-situ

Brief Description : The Biocat (TM) process comprises the steps of (1) acid phase anaerobic digestion of biomass to produce volatile acids and a partially stabilized sludge; (2) use of the volatile acids as carbon source and electron donors for biological sulfate reduction for removal of acidity, metals and sulfate from acid mine drainage, and to produce acetate; (3) use of the acetate solution as feed for methane phase anaerobic digestion to produce methane and to reduce the organic content of the effluent of the process; and (4) use of the methane to satisfy the energy requirements of the process.

Company Name/POC: Yellowstone Environmental Science, Inc./Mary M. Hunter

Address : 320 S. Willson Avenue/Bozeman, Montana 59715

Phone Number : 406 586-3905

Fax Number : 406 587-5109

Technology Maturity :

Bench scale testing, only

Performance History : Performance data are available.

Comments : Biocat technology is currently in the research phase. Bench-scale testing has been conducted. The full-scale system may be operated in either batch, continuous, or semicontinuous mode, depending on the particular site requirements. The Biocat technology is designed to operate in environments containing sulfuric acid, in addition to other hazardous materials. If sulfuric acid is not present in adequate concentration, additional acid may be required in order for the process to operate.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides☒ Heavy Metals☒ PCB☒ Explosives/Propellants☒ Petroleum Hydrocarbons☒ Radionuclides☒ SVOC☒ Other Contaminant☒ Nonhalogenated VOC☒ Halogenated VOC☒ N/ATECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : Biocat-II (TM)

Application :

Ex-situ

Brief Description :

The process uses natural microorganisms to remove toxic organic and inorganic waste constituents with recovery of metals, sulfur and energy from mixed hazardous wastes. Applications include bioremediation of industrial wastewater, sludges, slurries and contaminated groundwater.

Company Name/POC: Yellowstone Environmental Science, Inc./Mary M. Hunter

Address : 320 S. Willson Avenue/Bozeman, Montana 59715

Phone Number : 406 586-3905

Fax Number : 406 587-510

Technology Maturity :

Bench scale testing, only

Performance History :

Laboratory studies by Yellowstone Environmental Science, Inc. (YES) and others have confirmed removal of the following constituents during the indicated process steps: (1) denitrification: benzene, toluene, ethylbenzene, o-xylene, m-xylene, p-xylene, phenol, o-cresol, p-cresol, and carbon tetrachloride; (2) sulfate-reduction: phenol, p-cresol, and carbon tetrachloride; (3) methanogenesis: benzene, toluene, ethylbenzene, o-xylene, phenol, p-cresol, 1,1,1-trichloroethane (TCA), tetrachloroethylene (PCE), trichloroethylene (TCE), carbon tetrachloride, chloroform, bromoform, methylene chloride, chlorophenols, and trichlorofluoromethane (FREON II); and (4) aerobic respiration: benzene, toluene, phenol, m-cresol, p-cresol, TCE, and vinyl chloride.

Comments :

The BIOCAT-II (TM) process is applicable to situations wherein the wastes can be exposed to a sequence of treatment environments. This is most easily accomplished in a series of reactors.

Source of Information : VISITT 3.0

CONTAMINANTS :

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

■ Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

■ **Halogenated VOC**

■ N/A

TECHNOLOGY TYPE: *Chemical Reduction/Oxidation*

Technology Name : Wet Oxidation

Application :

On-site

Ex-situ

Off-site

Brief Description : This technology uses wet oxidation to treat radioactive organics and other organics in mixed waste. It converts organics into CO₂ and H₂O.

Company Name/POC: ADTECHS, Inc. (a wholly owned subsidiary of JGC Corp.)/Dennis Wilkie

Address : 2411 Dulles Corner Park/Suite 520/Herndon, Virginia 22071

Phone Number : 703 713-9000

Fax Number : 703 713-9101

Technology Maturity :

Pilot plant testing

Performance History : Process has been fully tested as a pilot plant. ADTECHS is actively seeking a site in the U.S. to construct a commercial system. Full-scale pilot plant is operational overseas.

Comments : No unusual site requirements. Processes use H₂SO₄, H₂O₂, NaOH for process chemicals. Process requires usual support/facilities for a chemical process. Process through-put is determined by the size of the unit and the speed of the chemical process.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Chemical Reduction/Oxidation*

Technology Name : E-Process

Application : On-site Ex-situ

Brief Description : Process injects ozone to oxidize both VOC and metal ions; precipitates and separates these. Final metal ion removal is with metal removal medium (MRM). Ion exchange can be added to the end of the process for water polishing.

Company Name/POC: ADTECHS, Inc. (a wholly owned subsidiary of JGC Corp.)/Lou Reynolds, Dennis Wilkie

Address : 2411 Dulles Corner Park/Suite 520/Herndon, Virginia 22071

Phone Number : 703 713-9000

Fax Number : 703 713-910

Technology Maturity : Bench scale testing, only

Performance History : Performance data are available.

Bench scale phase of EPA SITE Program. Completed field demonstration EPA SITE Program.

Comments : For its applications, the technology has no particular limitations. System can be made in different sizes, depending on floor requirements. No unusual personnel requirements. Uses commercially available process components and equipment.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Chemical Reduction/Oxidation*

Technology Name : Ozo-Detox (TM)

Application : On-site Ex-situ

Brief Description : The Ozo-Detox process is an integrated total treatment system with two key process units: 1) froth flotation and/or flocculation to remove hydrophobic contaminants from water and soil, (or an analogous pretreatment step) and 2) ozonation to degrade residual tars and polyaromatic hydrocarbons (PAH). The conditions created by the ARCTECH pilot-scale Ozo-Detox system lead to a rapid oxidation of soil contaminants and over 90 percent destruction of contaminants with minimal contact time.

Company Name/POC: Arctech, Inc./Dr. Daman Walia

Address : 14100 Park Meadow Drive/Chantilly, Virginia 22021

Phone Number : 703 222-0280

Fax Number : 703 222-0299

Technology Maturity : Pilot plant testing

Performance History : A pilot-scale Ozo-Detox unit has been constructed and is currently being tested with samples from coal gasification sites. The pilot-unit treats 1,000 gallons per day of contaminated materials. In addition, a soil treatment unit with 25-30 percent solids loading is being designed for future testing.

Comments : The Ozo-Detox technology is not applicable to wastes containing only metals, radioactive compounds, and inorganic corrosive materials. The performance of the technology is somewhat limited by the presence of radical scavengers, such as acids.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : Chemical Reduction/Oxidation**Technology Name :** Gas Phase Chemical Reduction**Application :** On-site Ex-situ

Brief Description : The ECO LOGIC Process involves the gas-phase reduction of hazardous organic contaminants. The system is capable of treating any form of organic contamination at any concentration with proven destruction and removal efficiencies (DREs) of at least 99.9999 percent. Contaminants entrained in liquids, soils and bulk solids can be destroyed without the formation of hazardous organic residuals. The system has been verified by various government agencies worldwide including the US EPA through the Superfund Innovative Technology Evaluation program. The ECO LOGIC Process is currently offered as a commercial-scale system for on-site treatment. The closed-loop destruction process ensures that no uncontrolled emissions result while the use of a reducing atmosphere ensures that dioxins and furans are not formed as byproducts. The system is mobile and may be utilized for on-site destruction.

Company Name/POC: ELI Eco Logic International Inc./Jim Nash**Address :** 143 Dennis Street/Rockwood, Ontario, Canada NOB2K0**Phone Number :** 519 856-9591**Fax Number :** 519 856-923**Technology Maturity :** Commercial use experience

Performance History : Development of the technology began in 1986 and proceeded through the bench-scale and laboratory-scale. In 1991, a pilot-scale unit was constructed and tested extensively at Hamilton Harbour, Ontario, Canada. Demonstrations on sediment contaminated with 300,000 ppm PAH and 400 ppm PCBs confirmed DREs of 99.9999 percent. The pilot-scale unit was tested in Bay City, Michigan, the following year for the US EPA and PCB contaminated oil (25 percent PCBs), water and soil. Once again DREs of at least 99.9999 percent were confirmed. Following the Bay City demonstration further modifications were made to the front-end preprocessing units as well as scaling up the technology to a commercial-scale. At the time of this writing, (May 1995) the first commercial-scale unit was operating in Australia on pesticide residuals and PCB contaminated electrical equipment. The second and third commercial-scale units are presently being constructed and will be utilized by General Motors of Canada Ltd. and the steel manufacturing firm Dofasco Inc.

Comments : The ECO LOGIC Process treats only the organic portion of the waste stream. Any inorganic co-contaminants will remain in the treated soil or be separated in the grit and scrubber as metal hydrides, depending on their physical characteristics. Additionally, the radioactive component of a mixed low level waste stream would be captured at various specific locations in the Process. With the ECO LOGIC Process, a mixed waste stream would undergo significant volume reduction and separate the radioactive component into a form that is more amenable to traditional methods of disposal. The ECO LOGIC Process is mobile and mounted on several drop-deck highway trailers. It may be transported to the waste site and set-up within four weeks. Once the on-site waste has been destroyed, the system is simply moved to the next site. The mobility and closed-loop destruction process have garnered significant public acceptance for the technology while being offered at a competitive cost. The ECO LOGIC Process is at an advanced state of development for an alternative remediation technology and is presently offered at a commercial-scale.

Source of Information : International TechCon

CONTAMINANTS:

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

Halogenated VOC

N/A

TECHNOLOGY TYPE : *Chemical Reduction/Oxidation*

Technology Name : E-Process

Application :

On-site

Off-site

Brief Description : Process injects ozone to oxidize both VOC and metal ions. Precipitates and separates these. Final metal ion removal is with a metal removal medium (MRM). Ion exchange can be added to the end of the process for water polishing.

Company Name/POC: H2O, Inc./c/o ADTECHS, Inc./a wholly owned subsidiary of JGC Corp./Lou Reynolds/Dennis Wilkie

Address : 2411 Dulles Corner Park/Suite 520/Herndon, Virginia 22071

Phone Number : 703 713-9000

Fax Number : 703 713-9101

Technology Maturity :

Bench scale testing, only

Performance History : Bench scale phase of EPA SITE Program.

Comments : Requires proof of full scale system. Requires demonstration over a range of VOC and metal ion contamination. The E-Process is presently being evaluated by the EPA. It is next scheduled for a full scale site application. Process has passed exclusive lab scale testing. Process has flexibility for treating wide range of suspended particle sizes and dissolved solids. Processing cost is less than \$5 per thousand gallons.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Chemical Reduction/Oxidation*

Technology Name : Fenton's Chemistry (Fe catalyzed H₂O₂)

Application : On-site Ex-situ

Brief Description : Organic chemicals, i.e., aromatics, chlorohydrocarbons, alcohols, acids, aldehydes and amines react completely with OH to form CO₂ and H₂O. Hydroxyl radical is generated by Fe catalyzed hydrogen peroxide in water at atmospheric pressure and temperature. Reaction is controlled by ORP, pH, time, temperature and concentration.

Company Name/POC: Technotreat Corporation/Richard J. Bigda

Address : 6216 S. Lewis/Suite 106/Tulsa, Oklahoma 74136

Phone Number : 918 445-0966

Fax Number : 918 445-099

Technology Maturity : Commercial use experience

Performance History : Six Technotreat Fenton's Reactors have been put into service for the treatment of paint stripper waste water containing phenol, formic acid, chrome, methylene chloride, benzene and toluene.
References and contacts:

Aero Corporation: 904-752-7911, Joe Bonds

KC Aviation: 214-902-7511, Clyde Phillips

TAP Air Portugal: 011-351-1-841-6022, Abrantes Machado

Comments : Units are skid mounted. 5000 gal/batch capacity system requires about 9' x 20' by 12'h area, requires 12-20 KVA power supply, and compressed air at 69 to 90 psi. Temperatures below 60 degrees Fahrenheit inhibit initiation of reaction. Automated, computer controlled system with proprietary software drives the unit through 55 steps with minimum operator's input or knowledge of chemistry. Various safety shut down devices protect against harm and run-away reactions. Interlocks prevent accidental spills and discharges to environment. Double containment can be incorporated. The system operates at atmospheric pressure and low temp. (100-140 degrees Fahrenheit)

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides☒ Heavy Metals☐ PCB☐ Explosives/Propellants☐ Petroleum Hydrocarbons☒ Radionuclides☐ SVOC☐ Other Contaminant☐ Nonhalogenated VOC☐ Halogenated VOC☐ N/A**TECHNOLOGY TYPE :** *Solidification/Stabilization (Ex Situ)***Technology Name :** Polymerization of Heavy Metal Ions**Application :**

On-site

Ex-situ

Off-site

Brief Description :

Process uses a polymerized sulfide agent to chemically and physically stabilize heavy metal ions. The final waste product meets U.S. EPA leaching criteria. Stabilized product is low in volume and is chemically inert.

Company Name/POC: ADTECHS, Inc. (a wholly owned subsidiary of JGC Corp.)/Ken Sauda**Address :** 2411 Dulles Corner Park/Suite 520/Herndon, Virginia 22071**Phone Number :** 703 713-9000**Fax Number :** 703 713-9101**Technology Maturity :** Commercial use experience

Performance History : This process has been in use for 10 years for chemically binding heavy metals in municipal incinerator effluent streams. It is now also being used for processing electronics and electroplating manufacturing wastes. This process has been used for 10 years in Japan to fix heavy metal ions in process waste streams. It will work with radioactive or non-radioactive metal ions. Full scale, operational systems have been in service for several years.

Comments :

Materials handling and processing equipment are required, depending on the through-put rates and material form. May require soil washing and crushing equipment. Does require tanks for precipitation of waste dissolved water. Heavy metal ions must be wetted or in solution to react with the polymer. The basic challenge is the handling of the contaminated material.

Source of Information : TechCon

PROCESS WATER

CONTAMINANTS : ☐ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Chemical Extraction*

Technology Name : Metals Recovery Process

Application : ☐ On-site ☐ Ex-situ
☐ Off-site

Brief Description : This technology removes metals (arsenic, cadmium, copper, lead, mercury, nickel, and zinc) from soil washing concentrate by using acid pH & polystyrene beads loaded with chelator and Electro-Reduction with water recyclable after treatment.

Company Name/POC: Toronto Harbour Commissioners/Dennis Lang

Address : 60 Harbour St./Toronto, Ontario, Canada M5J 1B7

Phone Number : 416 863-2047

Fax Number :

Technology Maturity : Field demo complete

Performance History : EPA SITE program demonstration was successful for the 4000 ton scale. Toronto Harbor Commission was both contractor & customer. (Soil-washing performed by Bergman USA)

Comments : Very easy to use: off-the-shelf equipment, efficient, reliable. Need supplier of chelator beads. Process converts soil/sludge wash wastewater to recyclable metals & process water. Major cost reduction compared to landfill.

Source of Information : International TechCon

CONTAMINANTS :☒ Pesticides/Herbicides☒ Heavy Metals☐ PCB☐ Explosives/Propellants☒ Petroleum Hydrocarbons☒ Radionuclides☐ SVOC☐ Other Contaminant☒ Nonhalogenated VOC☒ Halogenated VOC☐ N/A**TECHNOLOGY TYPE :** *Electrical Separation***Technology Name :** Direct Membrane Cleaning (DMC)**Application :**

Ex-situ

Brief Description :

Electrochemical method for in-situ cleaning of membrane filters. Avoids the need for chemical reagents, and thus minimizes the volume of secondary waste produced needing controlled disposal. High flux rates maintained with minimal maintenance for all solid-liquid separations.

Company Name/POC: AEA Technology/Dr. Mark Neville**Address :**

Building 429/Harwell Laboratory/Near Didcot/Oxon, OX11 0RA, UK

Phone Number :

44 1235 432252

Fax Number :

44 1235 432278

Technology Maturity :

Field demo complete

Performance History :

Performance data are available.

Comments :

The DMC technology is at the field demonstration stage in its development cycle; therefore, permits have been obtained to operate pilot systems on nuclear sites on a case by case basis.

As with all membrane/filtration technology the goal is to concentrate contaminants into a limited volume. Targets approaching 50 wt percent solids have been obtained. Immobilization of the concentrate is required. The DMC process requires the use of conductive filter media. Traditionally commercially available micro- or ultrafilters, conductive ceramics are used.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Electrical Separation*

Technology Name : Electrochemical Treatment of Inorganics

Application : In-situ (saturated zone) Ex-situ

Brief Description : The electrochemical cell generates a ferrous ion into solution when a direct current is passed across the carbon steel electrodes inside the electrochemical cell. The iron ions will form a solid insoluble matrix that removes other contaminants from solution and maintains them in a tightly bound insoluble form. If contaminants such as hexavalent chromium are present, the ferrous ion will also reduce the chromium to its less hazardous trivalent form.

Company Name/POC: Andco Environmental Processes, Inc./Daryl Zurawski

Address : 595 Commerce Drive/Amherst, NY 14228

Phone Number : 716 691-2100

Fax Number : 716 691-288

Technology Maturity : Commercial use experience

Performance History : The Gleason Works/Rochester, NY/Ken Miller/716-473-1000
Xerox Corporation/Webster, NY/Jim Jakubonis/716-422-1090
Lockheed Corporation/Tucson, AZ/Steve Sexton/602-573-8628
Lockheed Corporation/Charleston, SC/Sonny Moore/803-747-6331
Chrysler Corporation/Huntsville, AL/Steve Smith/205-464-2132
General Motors/St. Therese, Quebec/John Deearie/514-433-4494
Blount Industries/Guelph, Ontario/Jackie Campbell/519-822-6870

Comments : Performance Data are available. List of groundwater installations available.

The technology has been utilized for numerous industrial and groundwater applications. The electrochemical process comes as a user friendly system controlled by a PLC. The process can be automated to the extent that operator attention is only required on an infrequent basis. The operator should have an understanding of mechanical equipment as well as a basic knowledge of chemistry so that accurate sampling procedures can be followed in order to confirm the system's operation. Andco engineers are also available for consultation.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Bioreactors*

Technology Name : GAC Fluid Bed Reactor

Application : On-site Ex-situ

Brief Description : The GAC-Fluid Bed Reactor employs biological treatment and activated carbon adsorption in a single vessel. The bioreactor is utilized to treat a wide variety of toxic organic compounds in water. Removal efficiencies typically exceed 95+ percent, with final effluent concentrations of specific organics in the low ppb range.

Company Name/POC: Envirex, Inc./Michael Doyle, P.E.

Address : 1901 South Prairie Avenue/ Waukesha, Wisconsin 53186

Phone Number : 414 547-0141

Fax Number : 414 547 4120

Technology Maturity : Commercial use experience

Performance History : Performance data are available. Envirex currently has more than 20 full-scale fluidized bed reactor systems in operation or in the design stage throughout the U.S. The full-scale systems range in size from the Model 30 skid-mounted unit (20 degrees dia. reactor) to a 36 MGD denitrification application on municipal wastewater. The largest GAC-FBR installation treats up to 4,000 gpm of gasoline-contaminated groundwater at a decommissioned refinery, and has been operating successfully for over two years. Some typical performance data is on file. While these data focus primarily on BTEX compounds, Envirex has a broad database of other specific organic compounds. Client list: Chevron, BP Oil, Shell Oil, Northville Industries, Celgene, Monsanto, Formosa Plastics, Groundwater Technology, Inc., The Advent Group, E.I. DuPont, Upjohn, Ciba-Geigy, Arco Pipeline, Gulf Power.

Comments : Not applicable for inorganic contaminants such as sulfates, chlorides, radionuclides. Not generally applicable for heavy metals or non-biodegradable organics such as PCBs, dioxin, perchloroethylene, and trichloroethylene (though research on methanotrophic TCE degradation is being conducted). The GAC-FBR has been engineered to provide a high degree of automation with low manpower demand. Manpower requirements range from 1-4 hours/day, typically. Routine maintenance of rotating equipment (pumps and compressors) and electrical powered controls systems is required. Understanding of biological treatment by operating personnel is helpful, but not required as Envirex provides process support. Operator assistance can be provided by Envirex's field personnel through a service contract.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Bioreactors

Technology Name : Bioreactor

Application : On-site Ex-situ

Brief Description : Microbial Environmental Services, Inc. (MES) uses bioremediation technologies to treat industrial effluents containing hazardous organic compounds. The design is based on the introduction of low concentration nutritional cofactors and oxygen to enhance naturally occurring microorganisms. The results of biodegradation of contaminants by naturally occurring microorganisms are carbon dioxide and water.

Company Name/POC: Microbial Environmental Services, Inc./Jack Sheldon

Address : 11270 Aurora Avenue/Des Moines, Iowa 50322

Phone Number : 515 276-3434

Fax Number : 515 276-024

Technology Maturity : Commercial use experience

Performance History : Scientists and engineers at MES, Inc. have applied more than a decade of knowledge and experience in bioreactor design, microbial ecology and environmental microbiology, transport phenomena and waste management to develop and design the biotreatment technologies used by MES, Inc. MES has patents that have been applied for; some patents are still being applied for.

Comments : MES, Inc. bioremediation technologies are not applicable to the treatment of non-biodegradable wastes, wastes containing metals only, inorganic cyanide wastes, inorganic corrosive wastes, and wastes containing radioactive materials. The technologies are also not applicable to the treatment of PCBs and dioxins/furans.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Bioreactors***Technology Name :** BIO-WASH**Application :**

On-site Ex-situ

Brief Description :

W.E.S. Environmental Division has its own R&D group that has tested both vegetative and spore bacteria to break down various types of organic contaminants such as benzene, toluene, xylene, acetone and waste oil. Some tests have been conducted on radioactive nuclei, but are still under testing with W.E.S. The biological approach eliminates the need to dispose of a residue that is hazardous. Normal process allows end-user to dispose of process waste as non-hazardous material after the bacteria has digested the organics.

Company Name/POC: W.E.S. Environmental Division/Anthony DeLoach**Address :** 6389 Tower Lane/Sarasota, Florida 34240**Phone Number :** 941 371-7617**Fax Number :** 941 378-5218**Technology Maturity :** Commercial use experience**Performance History :** Bill DeLoach, DeLoach Industries 813 371-4995 - Acetone treatment

W.D. Howard, Chevron USA 404 984-3085 - hydrocarbon treatment

Comments :

High levels of chlorinated solvents will destroy bacteria growth. Contact time must be insured for proper treatment and acclimation. Once product has been acclimated to organic selection, the use of it is very simple and flexible.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : Filtration**Technology Name :** High Efficiency Filter**Application :** On-site Ex-situ

Brief Description : This technology is a non-precoat, air backwashable, high efficiency filter. Filter media is chemical and radiation resistant. Filter pore size can be <0.1 microns. Replaces precoat and fiber filters that generate greater, overall waste volume. It is air back-washable, thus eliminating back-wash water volume. Filter module can be made in different sizes and flow rates.

Company Name/POC: ADTECHS, Inc. (a wholly owned subsidiary of JGC Corp.)/Ken Sauda, Dennis Wilkie

Address : 2411 Dulles Corner Park/Suite 520/Herndon, Virginia 22071

Phone Number : 703 713-9000

Fax Number : 703 713-910

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Comments : Currently used in fossil power plant water filtration. Used in nuclear power plant liquid radwaste processing systems where low backwash waste volume is important.
 Filter modules are mounted inside a pressure vessel. Upper temperature limit is 185 degrees F. Pore size can vary, but is normally $\approx$ 0.5 μ m. Therefore, filter is applicable as a final filter. Filter modules are mounted in an in-line pressure vessel that can be automatically or manually backwashed.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Filtration***Technology Name :** Uranium removal from groundwater**Application :** On-site Ex-situ

Brief Description : A filter system, known as EXPURRT, was developed for removing uranium and radium from drinking water. The removal methods are based on ion exchange and sorption. The filter system was developed to the commercial stage and tested in a household water supply for a two year period. A larger-scale system was designed and successfully tested for removing U from harbour water. The technology is 90 percent efficient for U removal and 70 percent efficient for Ra removal. This technology is very selective for U and Ra. It is both very inexpensive and very efficient.

Company Name/POC: AECL Research/C. A. McDowall**Address :** Whiteshell Laboratories/Pinawa, Manitoba, R0 E1L0, Canada**Phone Number :** 204 753-2311**Fax Number :** 204 753-2922**Technology Maturity :** Field demo complete

Performance History : There has been one major long term test (tested in a household water supply (well) for a two year period), several short term lab tests, and one commercial pilot scale industrial test for the Low Level Waste Management Office AECL, Ottawa, Ontario; Contact: Dennis Main; Tel: (613) 273-3270.

Comments : Suspended sediment will block the filters and there is a finite chemical capacity for the filters (spent filters must be replaced). There is also a need for the disposal of spent material. This technology is easy to use for small scale operations. Minimal infrastructure is required and the skills requirement is low. Larger scale operations will require some increase in infrastructure and training. There is a possibility for the regeneration and reuse of the uranium filters rather than disposing of them.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Filtration***Technology Name :** Microfiltration**Application :** On-site Ex-situ**Brief Description :** Fine microfiltration of precipitated metals with tight, low-cost Tyvek (R) T-980 filtration media and patented Profix stabilization agent (to pass TCLP) in a fully-automatic Oberlin automatic pressure filter (APF).**Company Name/POC:** DuPont/Dr. Ernest Mayer**Address :** 1007 Market St./Room N6440/Wilmington, Delaware 19898**Phone Number :** 302 774-1000**Fax Number :** 302 774-732**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.

Demonstrations: Industrial partnerships/collaboration potential: participated in USEPA SITE program (w/Oberlin & Enviroguard Mfg. of Profix Stabilization Agent), John Martin, Cincinnati, Ohio; working w/SRS on various wastes; testing other hazardous waste (Oberlin/DuPont/Enviroguard).

Comments : Utilities required for the DuPont/Oberlin microfiltration technology demonstration included water, electricity and telephone service. Flow rates above about 250 gpm require multiple units. Easy to use and implement (6 installations that are operational and functioning well); minimal personnel skill required since simple.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Filtration***Technology Name :** Colloid Filter Method**Application :**

On-site Ex-situ
Off-site

Brief Description :

Secondary wastewater from soil washing; processing to volume minimize heavy metal and radionuclide (excluding tritium) pollutants via: (a) Solids vs. liquid separation; (b) Sorption/filtration concentration of metals and radionuclides; (c) Produce potable effluent for re-use, recycle, or environmental discharge; and (d) Stabilization or recovery of the concentrated metals, radioactive pollutants in a sludge material. The technology is highly efficient for removing metals, U, Sr, Pu, Am, Ce, Co pollutants from wastewater. Replaces ultrafiltration, ion exchange, reverse osmosis methods. The technology efficiently removes colloidal and/or ionic inorganic metallic water pollutants, achieves high volume reduction and concentrates without some of the limitations of filtration, resin bed problems, at a lower cost per 1,000 gallons processed.

Company Name/POC: Filter Flow Technology, Inc./Tod S. Johnson, Ph.D.**Address :** 122 Texas Ave./League City, Texas 77573**Phone Number :** 713 332-3438**Fax Number :** 713 332-3644**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.

Numerous scientific bench tests have demonstrated utility of methodology for inorganic metallic removal from water; field tests (good test results for 8-10 sites, no major problems); demonstrations (EPA/DOE [in progress] contacts can be provided upon request); private industry and government projects are ongoing.

Comments :

Small mobile wastewater processing trailer/skid - 20,000 lbs wt, capacity 50 gpm; large mobile/skid mounted equipment - 250,000 lbs wt or more, capacity 200-250 gpm wastewater processing. The Colloid Filter Method can remove trace metals and non-tritium radioculcide pollutants in primary and secondary wastewater down to ppb, ppt, but cannot process moderate or high TSS water (Requires pre-solids removal). This is a polishing filter method. The Colloid Filter Method has proved useful for removing a wide range of heavy metals, uranium, TRU and NORM radionuclide pollutants from water. The methodology is into commercial applications for industrial metal wastewater; textile industry dye and metals removal for strict compliance standards; environmental remediation projects for metals and radionuclide contaminated water, sludge, solid (secondary wastewater); and EPA, DOE RCRA and Superfund projects. Engineering and design phases for the equipment have been completed; Mobile and in-line equipment has been fabricated and tested. Special sorption/chemical complexing chemicals have been developed and tested; Bulk chemical blending and packaging capability has been established in South Texas. The technology is well into EPA, DOE testing for BAT (Best Available Technology).

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Filtration*

Technology Name : Filtering of Particles

Application : ☐ On-site ☐ Ex-situ
☒ Off-site

Brief Description : Filtering of particles with size greater than 1 micron with ceramic totally inorganic filter. The filter has high capacity to collect all particles in this filtering range, and another feature of the filter allows drying of the filtered mass with underpressure.

Company Name/POC: IVO International Ltd./Jukka Rautakallio

Address : 871 Ethan Allen Hwy., Suite 104/Ridgefield, CT 06877

Phone Number : 203 894-1954

Fax Number : 203 431-029

Technology Maturity : Commercial use experience

Performance History : A filter with height of 640 mm and diameter 168.8 mm has been designed and tested to be used at JAERI in Japan. After pH control, 1.1 g/l of precipitated material will be collected from 275 liters into one filter. Filter will be vacuum dried.

Comments : Inorganic filter suitable for liquids where capillary action can be used; it can be modified almost to any size. The filter can be delivered either as single filter or as multiple filters including pumping systems and needed connections.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☒ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Filtration*

Technology Name : Membrane Filtration of Soil Washing Water

Application : On-site Ex-situ

Brief Description : Filters heavy metals and radionuclides from soil washing water to removal levels in the range of 0.05-.001 ppm. Replaces clarification and sand filtration and ion exchange. Advantages are consistently lower discharge concentrations and lower cost of operation. Works on high concentration feed sources.

Company Name/POC: MEMTEK Corporation/Jayne Caterino

Address : 28 Cook Street, Billerica, Massachusetts 01821

Phone Number : 508 667-2828

Fax Number : 508 667-1731

Technology Maturity : Commercial use experience

Performance History : UMTRA Cleanup projects at Cannonsburg PA; Lakewood OR; Vitro UT; Grand Junction CO; Rifle CO. Contact Erich Tiepel, Research Technology Group, 303 969-8511

Comments : Limited experience with organic removal, other than oil and grease. BOD and COD. Treatability test determines treatment chemistry and filtration rate to size full-scale system. System very flexible to changes in feed-stream composition. Knowledgeable licensed wastewater treatment plant operator needed. This technology has proven itself in UMTRA remediation programs. It is directly applicable to waters produced from soil washing extraction processes.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Filtration***Technology Name :** Radioactive Waste Treatment - Slurry Dewatering**Application :** On-site ☒ Ex-situ ☒
Off-site ☒**Brief Description :** Slurry dewatering technology reduces water content of radioactive waste using cross flow filtration. Solids content is increased from 5 wt percent to typically 25 wt percent (50 wt percent for some waste types). 10-20 cubic meters of waste can be dewatered in one shift (8-10 hrs). Development work has shown that the technology works successfully on a wide range of wastes. The technology has been developed to accept a number of filter membrane. Enables higher waste loadings to be achieved where encapsulation is used for immobilizing radioactive waste. Process reduces quantity of packaged wastes.**Company Name/POC:** Nuclear Electric plc/Dr. R. Clayton**Address :** Littlebroom Manorway/Dartford Kent DA1 5PY, UK**Phone Number :** 44 0 1322 282800**Fax Number :** 44 0 1322 28281**Technology Maturity :** Pilot plant testing**Performance History :** After detailed review of available technology, crossflow filtration was chosen. Nuclear Electric (formerly C.E.G. B.) has carried out successful trials on a wide range of simulants and membranes. The membrane technology has been proven on manufacturer's test rigs and various Nuclear Electric's test rigs including a 1/3 scale test rig. A contract to construct a full size mobile plant will be in place by end of 1995.**Comments :** Technology limited by availability of suitable membranes. Mobile plant has been designed for operation at Power Stations where decommissioning activities have commenced so that minimal site services are required.**Source of Information :** International TechCon

CONTAMINANTS :

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

■ Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

■ Nonhalogenated VOC

Halogenated VOC

N/A

TECHNOLOGY TYPE: Ion Exchange

Technology Name : Radionuclide Separation Process (RASEP)

Application :	On-site	Ex-situ
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Brief Description : This process provides for the selective removal of radioactive metallic ions, only, from liquid waste streams. Process uses filtration, selective adsorption, and electrodeposition fixation followed by cement solidification.

Company Name/POC: ADTECHS, Inc. (a wholly owned subsidiary of JGC Corp.)/Dennis Wilkie

Address : 2411 Dulles Corner Park/Suite 520/Herndon, Virginia 22071

Phone Number : 703 713-9000

Fax Number : 703 713-9101

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

The technology was developed for the selective removal of radioactive nuclides from a nuclear power plant liquid waste stream . Development program was sponsored by five large Japanese utilities with nuclear power plants.

Comments :	Comparable to other ion exchange systems. This technology is used by nuclear power plants in fuel reprocessing. To date, it has been used exclusively in Japan.
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Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Ion Exchange

Technology Name : Uranium Selective Chelate Resin

Application : ☒ On-site ☒ Ex-situ

Brief Description : This ion exchange resin, which is highly selective for removing uranium, is used to treat liquid waste streams.

Company Name/POC: ADTECHS, Inc. (a wholly owned subsidiary of JGC Corp.)/Ken Sauda, Dennis Wilkie

Address : 2411 Dulles Corner Park/Suite 520/Herndon, Virginia 22071

Phone Number : 703 713-9000

Fax Number : 703 713-910

Technology Maturity : Commercial use experience

Performance History : This technology is used in Japan in fuel reprocessing and in combination with other resins in nuclear power plants liquid waste stream processing.

Comments : System is safer to operate than those that use H₂SO₄ and NaOH. Initial resin charge is more expensive than other less selective resins.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Ion Exchange***Technology Name :** Ion Exchange Cs Resin Regeneration**Application :** On-site Ex-situ

Brief Description : Cs is collected by ion exchange onto a selective resin. The Cs is regenerated from this primary column using a volatile regenerant which is boiled off and recovered. The concentrate is loaded onto a secondary column. The process is repeated until the secondary column is full. Using the same regeneration process, the Cs is put onto a small tertiary column of an inorganic absorber.

Company Name/PÓC: Bradtec Limited/George Elder**Address :** University of the West of England/Cold Harbour Lane/Bristol BS 16 1QY, United Kingdom**Phone Number :** 44 117 976 3937**Fax Number :** 44 117 976 3892**Technology Maturity :** Commercial use experience

Performance History : The technology was operated on a Magnox fuel storage pond to remove Cs from 50 microcuries per liter to <1 microcuries per liter. The pond chemistry was 200 ppm NaOH, 100 ppm Na₂CO₃ at pH 11.5. The plant was dismantled when the area was decommissioned.

Comments : None.**Source of Information :** International TechCon

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: Ion Exchange

Technology Name: Cesium Removal with Selective Ion Exchange Material

Application: ☐ On-site ☐ Ex-situ
☒ Off-site

Brief Description: Cesium is selectively removed by inorganic granular (grain size 0.30-0.85 mm) ion exchange material. Typically liquid is purified with DF-1,000-10,000 and VR 1,000-50,000. Material can be used in pH 1-12 and in salt contents up to 400 grams/liter.

Company Name/POC: IVO International Ltd./Jukka Rautakallio

Address: 871 Ethan Allen Hwy., Suite 104/Ridgefield, CT 06877

Phone Number: 203 864-1954 **Fax Number:** 203 431-029

Technology Maturity: Commercial use experience

Performance History: One full scale application in operation in Loviisa NPP. 465 cubic meters purified with 48 liters of ion exchange material in successful operation. One transportable system in operation in Paldiski, Estonia. Over 500 cubic meters purified with 12 liters of material successfully. One system under licensing for Paks NPP in Hungary to treat all liquids containing cesium. One system designed to treat reprocessing liquid in JAERI, Japan.

Comments: pH range 1-12
Salt content tested up to 400 grams/liter
Very easy column operation, flexible to be used in almost any ion exchange process.

Source of Information: International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Ion Exchange***Technology Name :** Water Treatment Process**Application :** On-site Ex-situ

Brief Description : Combined ion exchange and reverse osmosis treatment of uranium containing eluate. Radium removal by a radium selective ion exchange-complexer. Precipitation of arsenic by addition of ferric chloride. Flotation of ferric-arsenic sludge. Immobilization of the contaminated material by solidification with fly ash and additional activities. Deposition of the final residues.

Company Name/POC: URT Umwelttechnik GmbH/Gerd Braun**Address :** 50354 Hurth/Siemensstr. 1/Germany**Phone Number :** 02233 7994 0**Fax Number :** 02233 78199**Technology Maturity :** Commercial use experience**Performance History :** Contact company for performance history.**Comments :** This process targets uranium mill tailings.**Source of Information :** International TechCon

PROCESS WATER

CONTAMINANTS : ☐ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Precipitation*

Technology Name : Potassium Ferrate/TRU Clear

Application : ☐ On-site ☐ Ex-situ

Brief Description : Potassium Ferrate (Iron VI) coagulant. Removes uranium, plutonium, americium, and priority pollutant metals from wastewater; pollutant removal through charge neutralization and precipitation; radionuclide and metals removal levels to below regulatory requirements; generates 2-10 times less dewaterable sludge that requires recovery, transportation, and final EPA restricted disposal.

Company Name/POC: Analytical Development Corporation/Gary Tye

Address : 4405 North Chestnut, Suite D/Colorado Springs, CO 80907

Phone Number : 719 260 1711

Fax Number : 719 260-069

Technology Maturity : Commercial use experience

Performance History : Performance Data are available (below).

West Valley Nuclear Services: Process water, 6.6M gal/yr; reduced sludge 10x--Garret Smith 716/942-4325; Fernald Environmental Restoration Management Corp.: Process water, 8M gal/yr, reduced sludge 2.5x--Lyle Hampshire 513/738-6541; Fernald Environmental Restoration Management Corp.: Process water, 500M+ gal/yr being constructed--Joe Patton, 513/738-6555; Rocky Flats Plant, Bench demo-successful--Chuck Baldwin, 303/966-2919.

Comments : Uses current wastewater treatment equipment; mobile unit utilizes direct filtration or clarification; purple color indicator demonstrates reaction completion, user-friendly; normally no modification of EPA Part B operating permit required; technical service support for bench and plant demonstration; Potassium Ferrate (VI) also oxidizes organic pollutants.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Precipitation*

Technology Name : Autocatalytic Fluid Bed Heavy Metal Removal Plant

Application : On-site Ex-situ

Brief Description : The plant is a fluid bed reactor, capable of removing up to 99 percent of heavy metals and organic matter in water. The process is adsorption-coprecipitation on a granular medium.

Company Name/POC: Kruger A.S./Kurt Ambo Nielsen

Address : 363 Gladsaxevejs/2860 Soeborg, Denmark

Phone Number : 011 45 396 90222

Fax Number : 011 45 31674950

Technology Maturity : Commercial use experience

Performance History : Experience with 5 m(3)/hr plant used for chromate removal from flash leachate over 2.5 years. 95 percent removal.
Pilot plant experiments with arsenic, nickel. 90-95 percent removal.
Bench scale with organics. Up to 99 percent removal.
Batch experiments with Zn, Se, Cd.

Comments : High implementation potential. Easy to construct and operate. Needs little space.

Source of Information : International TechCon

CONTAMINANTS :

- ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Ultraviolet Oxidation*

Technology Name : Titanium Dioxide Photocatalytic Treatment Systems

Application : On-site Ex-situ

Brief Description : Removes and destroys organic pollutants in air and water.
 Fixed TiO₂ semiconductor and UV light generate hydroxyl radicals which readily attack and destroy organic pollutants.
 Typical VOC removal in air is 1200 ppm TCE, PCE, removal at 50-CFM; 7.7 kW system.
 Typical VOC removal in water - BTEX destruction nominally 25 ppm/minute retention time.

Company Name/POC: Matrix Photocatalytic, Inc. (formerly NuTech)/Bob Henderson

Address : 22 Pegler St./London, Ontario, Canada N5W 4C8

Phone Number : 519 660-8669

Fax Number : 519 660-852

Technology Maturity : Field demo complete

Performance History : 23 units produced to date
 Specific customer information is proprietary (contact Matrix Photocatalytic, Inc.)
 Successful pilot test at Savannah River for soil vapor extraction

Comments : Limitations include (1) Flood rates greater than: air 1000 CFM, water 100 GPM;
 (2) certain organic compounds are refractory and take extensive time to break down

Equipment is very simple and easy to install (one man, 4 hours)
 Uses common hand tools
 Maintenance procedure is easy to follow and only required every 5000 hours
 Equipment is very mobile and can easily be moved from site to site
 Equipment is modular in construction, therefore can easily be increased/decreased as flow rates vary over time

Source of Information : TechCon

CONTAMINANTS :

- ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Ultraviolet Oxidation*

Technology Name : Rayox

Application : On-site Ex-situ

Brief Description : Ultraviolet oxidation uses hydrogen peroxide catalyzed by UV light to quickly oxidize and decompose toxic organics in ground or process water with no residual by-products. Replaces carbon or airstripping; destroys contaminants rather than transferring them to other media or concentrate. Contaminates treated include: TCE, PCE, DCE, BTEX, TNT, DNT, vinyl chloride, NDMA, chlorobenzene, 1,4-dioxane, PCP and phenols.

Company Name/POC: Solarchem Environmental Systems/Robert Notarfonzo

Address : 130 Royal Crest Court/Markham, Ontario L3R 0A1/Canada

Phone Number : 905 477 9242

Fax Number : 905 477-4511

Technology Maturity : Commercial use experience

Performance History : Performance Data are available.

Forty full-scale installations world-wide, including: NASA, Kennedy Space Center, Florida; Kelly AFB, Texas; WR Grace Superfund Site, Woburn, Mass. References: Jeff Merriman, Environmental Process Engineer, Uniroyal Chemical, Elmira, Ontario, phone 519/669-1671 (they have several large 270 kW systems treating NDMA [dimethylnitrosamine] and chlorobenzene. Maryellen Johns, Sr. Project Engineer, W.R. Grace & Co., Lexington, MA, phone 617/861-6000, ext. 2359 (supervises the groundwater treatment facility at the WRG Superfund Site at Woburn, which has a 10 kW system treating TCE, PCE, DCE, and VC).

Comments : Limited to organic concentrations <1000 ppm and flow rates of <1000 gpm. Turnkey system, fully automated, operates with minimal supervision and maintenance costs. Relatively high capital costs relative to conventional technologies of activated carbon and air stripping.

Source of Information : TechCon

PROCESS WATER

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Membrane Separation*

Technology Name : AMT Membrane Cartridge System

Application : In-situ (vadose zone) Ex-situ
In-situ (saturated zone)

Brief Description : Membrane Air Stripping Cartridges remove VOCs from water using air stripping across patented, highly permeable membrane fibers. Small, low-cost membrane modules are commercially available to treat low water-flow rates. Modules based on new designs, capable of effectively handling large volumes, should become commercially available in the near future.

Company Name/POC: Applied Membrane Technology, Inc./Stephen Conover

Address : 11558 Encore Circle/Minnetonka, MN 55343

Phone Number : 612 933 5121

Fax Number : 612 933-883

Technology Maturity : Pilot plant testing

Performance History : The current membrane stripping cartridges were recently used in a pilot test for removal of chlorinated and non-chlorinated VOCs from groundwater. Removal rates of 99% were achieved in ~one hour at efficient water and air-flow rates using recirculated water. Scale-up of a complete on-site system, using commercially available modules is planned following State regulatory agency approval. The pilot test on membrane air strippers was conducted for the Crosby Group, Inc., McKissick Products Division, P.O. Box 3128, 2927 Dawson Road, Tulsa, OK 74101. Contact Pat Gordon 918/834-4611. Contaminants treated to date include Trichloroethene (TCE), 1,1,1-Trichloroethane (TCA), 1,2-Dichloroethane (DCA), 1,1-Dichloroethene (DCE), methylene chloride, vinyl chloride, tetrachloroethene, benzene, toluene, xylenes.

Comments : Membrane air stripping cartridges are readily adaptable to small water volumes for either continuous or intermittent treatment regimes. By varying the size and number of cartridges used in series or in parallel, one can engineer processes which optimize the stripping rate of selected or all of the organic water contaminants. Compared to other available air-stripping technology, AMT can treat water contaminated with VOCs by air stripping using small membrane cartridges that are lower in cost to install and operate. The small modules are suitable for situations with intermittent and/or low flow-rate requirements. Larger modules in series and in parallel configurations should be commercially available this year. These modules will provide higher flow-rate treatments and flexibility to deal with variations in flow rates and contaminant concentrations.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Membrane Separation***Technology Name :** Spiral Wound Membrane Technology**Application :** In-situ (saturated zone) Ex-situ

Brief Description : Spiral-wound membrane technology offers a cost-effective, energy-efficient method of making separations using the principles of osmosis. The technology used by Desalination Systems, Inc. allows for the recovery and reuse of waste stream constituents from acids to metals. SWMT needs no additional chemicals, making this technology environmentally friendly. A highly trained operator is unnecessary. There are no additional sludge costs with membrane technology. A membrane system is a small fraction of the cost of installing a Dissolved Air Flotation (DAF) device.

Company Name/POC: Desalination Systems, Inc./Bridgete Owens**Address :** 760 Shadowridge Dr./Vista, California 92083**Phone Number :** 619 598-3334**Fax Number :** 619 598-3335**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available from the company.

Comments : SSWM systems are small compared to other technologies such as DAF. Membrane systems require electricity to run the motor and pump. SWM systems need little support services from an outside operator. These systems can also be located outdoors. A SWM system can be used easily. A technician can be trained in a few hours to take readings, if needed, and watch the system. The membrane system is flexible in that it can be installed inside or outside the facility, so no large infrastructures need to be built. The size of a membrane system is so small that it fits almost anywhere.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Electron Beam*

Technology Name : Electron Beam Hazardous Waste Treatment (E-Beam)

Application : On-site Ex-situ

Brief Description : The process is based on aqueous radiation chemistry and it is non-selective in the destruction of organic chemicals because strongly reducing reactive species, and strongly oxidizing reactive species, are formed at the same time and in approximately the same concentration in solution. The reactive transients initiate thousands of chemical reactions capable of destroying hazardous compounds in aqueous solution, in most cases, mineralizing them to carbon dioxide, water, and salt. High energy electron beam treatment of hazardous waste can be used to replace UV/O₃, UV/H₂O₂, and other advanced oxidation processes (AOPs), and in some cases incineration.

Company Name/POC: High Voltage Environmental Applications, Inc./William J. Cooper, Pres., Mike Nickelsen

Address : 9562 Doral Boulevard/Miami, Florida 33178

Phone Number : 305 593-5330

Fax Number : 305 593-007

Technology Maturity : Commercial use experience

Performance History : In addition to controlled (single solute) feasibility studies, feasibility studies on two multi-source hazardous waste leachates have been conducted which have shown that the process is economical for the ultimate destruction of hazardous waste leachates. HVEA waste treatment systems are part of the US-EPA SITE Program, and are available for use on Superfund sites. HVEA's mobile systems were to be demonstrated on solvent contamination ground water under the SITE program in the fall '93 at Savannah River, South Carolina.

Comments : HVEA's electron beam treatment systems require (1) site location the size of a tractor trailer, (2) a mechanism for delivering the waste to the treatment system, i.e., well pumps, etc., (3) three phase electrical power, (4) 120 VAC electrical power, (5) effluent line and site. Soils, sediments, and sludges must be suspended in an aqueous matrix. The electron beam treatment systems are ineffective in treating heavy metals. HVEA electron beam treatment systems are available in different sizes, to effectively address any size problem. Units are modular in design; therefore, several systems can be interfaced to enhance treatment capability. Systems are completely automated and require only one technician per 8 hr shift. High initial capital cost.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Other*

Technology Name : Wet-Oxidation Process Using Special Autoclave Equipment

Application : ☐ On-site ☐ Ex-situ
☐ Off-site

Brief Description : This technology treats organic and inorganic waste water, sludge, and microdust by means of wet-oxidation processes under air-pressures up to 200 bars and temperatures up to 300 degrees C.

Company Name/POC: ABRA Fluid AG/Markus Frei

Address : Industrie Nollen/Birkenstr. 109/CH-9443 Widnau, Switzerland

Phone Number : 41 71 72 78 72

Fax Number : 41 71 72 78 75

Technology Maturity : Commercial use experience

Performance History : Contact company for performance history..

Comments : None.

Source of Information : International TechCon

PROCESS WATER

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : Other

Technology Name : Catalytic Separation

Application : On-site ☐ Ex-situ ☐
Off-site ☐

Brief Description : This technology/service provides (cradle to grave) understanding of production, health and safety, isotope separation and removal processes. The key elements are the low temperature hydrophobic catalyst separation processes which are patented. The technology can be made available under license of or by direct contract with AECL or its partners. There are many public papers describing the basic processes. The technology has been used in the cooperative projects since 1982 and for 4 major contracts valued at \$3.5 million without any major problems.

Company Name/POC: AECL Research/C. A. McDowall

Address : Whiteshell Laboratories/Pinawa, Manitoba, R0 E1L0, Canada

Phone Number : 204 753-2311

Fax Number : 204 753-292

Technology Maturity : Commercial use experience

Performance History : The technology has been applied for projects at: Brookhaven National Lab - Fermi Labs - Westinghouse Idaho Nuclear Co. - Ontario Hydro. Projects ranged in size from lab scale to industrial scale with no problems experienced.

Comments : This technology is simple to operate for technicians with general operations training. The challenge associated with this technology is to identify/develop more efficient and cheaper catalysts.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☒ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Other*

Technology Name : Prepolishing with Organoclay

Application : Ex-situ

Brief Description : Organically modified clays remove mechanically emulsified and free oil, fats, greases, PCP, PCB from water at 7 times the rate of activated carbon, by partition. This technology will reduce the cost (operations) of carbon changeouts by 50 percent.

Company Name/POC: Biomin, Inc./George Alther

Address : P.O. Box 20028/Ferndale, Michigan 48220

Phone Number : 810 544-2552

Fax Number : 810 544-3733

Technology Maturity : Commercial use experience

Performance History : Hill AFB, Utah - 90,000 lb every 2-3 years (Jeff Watkins 801 777 4924).

Comments : VOCs are not removed effectively with clay. Use organoclay in the same manner as activated carbon.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Other*

Technology Name : Catalytic Oxidation

Application : ☒ On-site ☐ Ex-situ

Brief Description : This process is used to remove organic compounds dissolved in water streams (effective range 0-5,000 ppm COD). The polluted compounds are broken down in situ to CO₂ and H₂O. The process uses O₃ and O₂ in a catalytic reaction. All organic compounds, with few exceptions, are broken down.

Company Name/POC: ECO Purification Systems USA, Inc./John Johns

Address : 8813 Waltham Woods Road, Suite 304/Baltimore, Maryland 21234

Phone Number : 410 882-1566

Fax Number : 410 882-291

Technology Maturity : Commercial use experience

Performance History : One commercial demonstration unit for ground water treatment with a capacity of 20 m³/hr is in use for converting 1,000-5,000 ppb dichlorotrichloroethane to 20 ppb. Plant is situated in Stork/Bronswerk Heat Transfer B.V., Stationsweg 22, Nijerk, the Netherlands.

Comments : The plant can be fully automated and requires minimal attention. Operators require skills and experience in handling state-of-the-art automated process control equipment. Best treatment range is 0-5,000 ppm COD. Maximum reactor diameter so far is 2.5m. Capacity range of 1-1000 m³/hr are available. System can operate over full water temperature range at standard pressure. Catalyst life is at least 3 years and could be much longer. Lab and pilot tests are required; based on the resulting data process design and duty specifications, treatment capability can be predicted with accuracy, using computer model. All materials available in USA. Takes around 9 months to build a complete turnkey installation. Normal infrastructure required: concrete slab, electricity, water and protective building for process control equipment and O₃ generators.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : Other

Technology Name : RECLAIM (TM) In Situ VOCs Partitioning/Extraction

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : "RECLAIM" passive remediation is accomplished by exposing "RECLAIM" porous polymer (proprietary material) to solution-phase and/or vapor-phase volatile organics. This exposure is most often achieved through the placement of stainless mesh containers that hold the spherical beads of "RECLAIM" polymer as a unit ("canister") in monitoring or recovery wells that access VOC-contaminated soil, groundwater, or both. "RECLAIM" is an extremely hydrophobic material, very stable chemically and thermally. It adsorbs and concentrates VOCs based on partial pressures available, achieving concentrations as much as 2,000 times greater on the polymer body than in the atmosphere of the well.

Company Name/POC: Environmental Fuel Systems, Inc./Cal Chapman

Address : P.O. Box 1899/709 Main Street/Bandera, Texas 78003

Phone Number : 210 796-7767

Fax Number : 210 796-7484

Technology Maturity : Commercial use experience

Performance History : The company has performed "RECLAIM" service commercially at eighteen sites with VOC contamination in soil and/or groundwater for periods up to seven months. TPH and BTEX levels have been reduced provided no new contaminants have been introduced. The radius of influence for the RECLAIM canister has been estimated based on weights of fuel residues recovered, and periodic TPH and BTEX measurements through the treatment-time frame. It appears that well grids of 40 feet are sufficient for sandy soil/water clean-up; well grid spacing tightens with lower permeabilities. At sites still dispensing fuel, a number of spills and leaks have been isolated and products often identified through gas chromatographic testing of condensates.

Comments : "RECLAIM" passive remediation is limited by the permeability of geologic structures, concentrations and vapor pressures of contaminants available, and hydraulic gradient. As these decrease, the rate of recovery decreases (as is the case with all clean-up methods). The service is labor- and travel-intensive, as a technician must provide periodic service and support at a site on a periodic basis (as with other approaches). When comparing rates of recovery of the passive "RECLAIM" approach for active methods such as vapor extraction or groundwater pumping and treatment, "RECLAIM" is usually found to be a slower process, but it is much less expensive. "RECLAIM" is only effective with organics.

Source of Information : VISITT 3.0

PROCESS WATER

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Other*

Technology Name : Mobile Cleaning Unit (Biotreatment)

Application : On-site Ex-situ

Brief Description : Technology Type: Biodegradation (Ex-situ). Biodegradation of VOCs and PAHs in water (aerobic degradation). Replaces activated carbon.

Company Name/POC: Hedeselskabet/Mr Thomas Larsen

Address : Ringstedvej 20/DK-4000 Roskilde, Denmark

Phone Number : 45 4630 03 10

Fax Number : 45 4630 031

Technology Maturity : Commercial use experience

Performance History : Technology first used at (Texaco) gas station (~1990)
Approx. 10 units currently employed at gas stations
Water to be treated may reach toxic levels, impairing biodegradation
PAHs require rel. long residence time

Comments : Only applies to substances that are readily biodegradable under aerobic conditions.
Under special conditions, toxic by-products may occur.
Easily relocated, based on standard freight containers.
Easily monitored by modem/cellular phone.
Short mobilization and start-up time.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☒ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Other*

Technology Name : Magnetic Separation

Application : In-situ (vadose zone) Off-site Ex-situ
In-situ (saturated zone)

Brief Description : The MAG SEP process uses specially designed particles to selectively absorb contaminants from water. The particles are composite particles with a magnetite core (to make the particle magnetic), a polymer coating (for durability), and selective absorbers on the surface. Examples are amidoxime, clinoptilolite, zeolites, etc. The selective adsorbers can recover contaminants down to ppb levels without recovering nonhazardous ions. The particles (with contamination) are collected in a magnetic filter. The particles are regenerated for reuse. The regeneration solution can be treated for disposal or recovery of a recycleable material. The alternatives to this technology are precipitation, filtration, ion exchange and reverse osmosis. The advantage of the MAG SEP technology compared to all others is the reduced operating costs due to low pump head costs for magnetic filtration, and reduced waste disposal costs because the process is selective. This can reduce waste volumes by more than an order of magnitude when recovering low ppm or ppb levels of contamination from water containing several hundred ppm total dissolved solids.

Company Name/POC: Rust Remedial Services/John Westcott

Address : Clemson Technical Center, 100 Technology Drive, Clemson Research Park/ Anderson SC 29625

Phone Number : 803 648-2413

Fax Number : 803 646-5311

Technology Maturity : Field demo complete

Performance History : Several successful pilot-scale demonstrations have been completed. Magnetic filters are standard commercial equipment. Currently the process is being demonstrated as part of the in-situ soil treatment demonstration, the in-situ groundwater project, and the Resource Recovery Project.

Comments : The only issue is the ability to selectively adsorb the contaminant of interest which must be determined by a treatability study. Easy to use, takes up minimal space, minimal utility requirements, and will generally require 2 people of moderate technical ability to operate. Equipment and service support is available worldwide.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Other***Technology Name :** Ultrasound Particle Separation (SONOSEP)**Application :**

On-site Ex-situ
 Off-site

Brief Description : Particle separation technology that utilizes ultrasound to coagulate, flocculate and separate particles suspended in a liquid. The technology can separate solid or liquid particles (emulsions) from a liquid. Separation of up to 99 percent of suspended particles may be achieved.

Company Name/POC: Triton Enviromental Consultants/John Poppleton**Address :** 120 - 13511 Commerce Parkway/Richmond, B.C., Canada V6V 2L1**Phone Number :** 604 279-2093**Fax Number :** 604 279-204**Technology Maturity :** Pilot plant testing

Performance History : This technology is at early pilot-scale. Over 6 years of applied research has been performed. Equipment is available for batch and continous-flow testing.

Comments : Particles in suspension with a diameter less than 0.5 microns are difficult to flocculate. Flow through the acoustic treatment chamber must be close to laminar - this limits flow velocity. There is a maximum distance between transducer and reflector. This limits flow rates. The technology achieves flocculation at a higher rate than conventional systems without the use of chemical additives. The equipment is simple and maintenance free since there are no moving parts. The equipment is compact. Primary challenge is scale-up.

Source of Information : International TechCon

Ground Water

Treatment

Ground Water

Treatment

CONTAMINANTS :

- ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Biodegradation (In Situ)***Technology Name :** Biogard method**Application :** In-situ (vadose zone)
In-situ (saturated zone)**Brief Description :** The Biogard Method combines absorption and encapsulation of free hydrocarbons with a catalyzing effect of naturally occurring oil degrading bacteria.

Biogard is a powder product that is mixed into polluted soil or spread over surface water with the above-mentioned effect.

The degradation time will, due to the catalyzing effect, be decreased substantially.

Company Name/POC: AEC/Jan Hyttel, Managing Director**Address :** GI Kongevej 131/DK-1850 Frederiksberg C/Denmark**Phone Number :** 45 31247122**Fax Number :** 45 31247222**Technology Maturity :** Commercial use experience**Performance History :** Invented by a German scientist in the late seventies. Patented in the US (and almost world wide) in 1980/1981.**Comments :** Hundreds of references in Denmark, Europe, and the Middle East.

Biogard is able to treat all sorts of oil pollution on sea and on land.

Easy and flexible to use. No need for special equipment or infrastructure.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Biodegradation (In Situ)***Technology Name :** Bionergies, Biosmose, Biosurf

Application : In-situ (vadose zone) Off-site Ex-situ
 In-situ (saturated zone)

Brief Description : Bioremediation of organic pollutions (in soils, water, effluents) by using: 1. exogenous specific bacterial consortium (non toxic, environment safe, European Federation of Biotechnology class I in order to control a full, complete and non selective biodegradation. 2. Biofixations (mineral natural support). 3. Biosurfactants (produced by selected bacteria) provide an effective, fast and secure alternative to common place bioremediation because Bionergies controls the biodegradation of the pollutant (and metabolites) by using specialized bacteria and feasibility tests (in labs, on the field).

Company Name/POC: Bionergies Laboratories, Biosurf/M. Jacques FAUDIN**Address :** 59/100, rue des 4 termes/B.P. 1009/Z.I. des Paluds/13781 AUBAGNE Cedex, France**Phone Number :** 33 42 84 30 07**Fax Number :** 33 42 84 23 3**Technology Maturity :** Commercial use experience**Performance History :** Contact company for performance data.

Comments : Each case is analyzed in order to optimize the treatment and the on site materials and personnel. Bionergies controls the bacterial action by using exogenous specific bacterial strains, biofixations and biosurfactants. None of the bacteria is genetically engineered. They are classified into class I (one) of the European Federation of Biotechnology, and produced under French and European Community regulations. The company is looking for join-ventures in U.S. in order to cover the environmental and industrial field.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : Bioremediation

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : ChemPete, Inc. has developed and proven an effective, continuous, and timely clean-up method for transforming gasoline, diesel fuel, fuel oil, kerosene, and chlorinated solvents to nonhazardous organic matter, carbon dioxide, and water. ChemPete currently uses bacteria, nutrients, and a catalyst developed by Alpha Environmental Biosystems Inc., which has a worldwide reputation for success.

Company Name/POC: ChemPete, Inc./John Peterson

Address : 405 E. Pierce Street/Elburn, Illinois 60119

Phone Number : 708 365-2007

Fax Number : 708 365-9099

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Comments : By combining Alpha Inc., material with ChemPete's 15-year experience in chemical process design and fermentation, ChemPete Inc., was the first company to close both gasoline and fuel oil sites in situ in accordance with Illinois' rigorous closure guidelines (5 ppb benzene). ChemPete has reduced 140 ppm benzene to nondetectable levels in aboveground sandy piles in as short a time as 40 days. ChemPete has reduced 85 ppm fuel oil (TPH) to 4 ppb in 75 days at a depth of 27 feet.

ChemPete Inc. has the capability of doing ex situ work and treating groundwater, utilizing bioreactors. ChemPete uses trenches, vertical wells, biobarriers and other techniques, depending on the soils' hydraulic conductivities, to set up an effective bioremediation system to conclude the process in a timely manner. The major limitations to the ChemPete system are refractory materials that would not allow the bacteria to exist. Examples of materials that are refractory are strong acids, strong bases, biocides or soils heavily contaminated with solvents.

Source of Information : VISITT 3.0

CONTAMINANTS: ☒ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE: *Biodegradation (In Situ)*

Technology Name: Bioremediation

Application: In-situ (saturated zone)

Brief Description: In situ bioremediation enhances the microbial degradation of contaminants in contaminated groundwater where excavation is not possible. Typically nutrients and oxygen are circulated through the aquifer through a series of injection wells or infiltration trenches coupled with the recovery of the groundwater down gradient for recirculation. For aerobic bioremediation, oxygen is often the rate-limiting parameter for microbial metabolism. Air, pure oxygen or hydrogen peroxide can be injected into the subsurface to increase the available oxygen for the bioremediation. In some cases, adapted microorganisms are added to stimulate the biodegradation process. Anaerobic in situ processes can also be performed.

Company Name/POC: COGNIS, Inc./Dr. K. Mackay

Address: 2331 Circadian Way/Santa Rosa, California 95407

Phone Number: 707 575-7155

Fax Number: 707 575-783

Technology Maturity: Commercial use experience

Performance History: COGNIS has developed anaerobic consortia capable of anaerobically degrading pesticides, particularly the chlorinated pesticides. The majority of the work has been performed with the pesticide 2,4,5-T, a persistent, currently banned pesticide found in groundwater near agricultural operations. A fixed-film upflow anaerobic bioreactor has been developed to degrade 2,4,5-T. Once established, 2,4,5-T was added and recirculated with periodic feeding. Once the needed microbe became resident, a fully functional 2,4,5-T reactor was established. The current bench-scale reactor can eliminate over 95 percent of the pesticide at a rate of 30 mg/l/day. This reactor can easily be scaled up in volume for installation on a ranch site in California or anywhere in the U.S. Additionally, we have developed a reactor for the complete dechlorination and mineralization of monochlorophenols (2,3,4-isomers), PCP and related chlorinated chemicals such as 2,4-D and other pesticides.

Comments: COGNIS offers an enhancement of the in situ process by addition of an above-ground fixed-film bioreactor. Contaminated groundwater is treated by passing it up from the ground and through the bioreactor containing an immobilized support to which preadapted microbes are attached. These microbes are capable of degrading a wide range of contaminants present in the groundwater. Microbes detach from the biofilm at a slow rate and, along with oxygen and/or additional nutrients, are pumped back into the groundwater, allowing more rapid and efficient in situ biodegradation to occur. The bioreactors can operate in either an aerobic mode, an anaerobic mode, or both, depending on the target compounds to be degraded.

Source of Information: VISITT 3.0

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☒ SVOC	☐ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : FyreZyme

Application : In-situ (saturated zone)

Brief Description : FyreZyme is a multifactoral liquid (aqueous) agent, combining a rich source of bacterial growth-enhancing agents, extracellular enzymes, and bioemulsifiers. For in situ treatment, a "front" of FyreZyme-containing aerated water is moved through the groundwater by a combination of infiltration galleries of injection wells upgradient and extraction wells downgradient. Groundwater may be recycled through the bioremediation bed for both maintaining moisture levels for metabolic activity and for cleansing of groundwater. If permitting requires that groundwater extracted be cleansed prior to reinjection or discharge, suitably sized holding tanks with aeration lines to maintain aerobic conditions are utilized as bioremediation reactors.

Company Name/POC: Ecology Technologies International, Inc./Mr. Pete Condy

Address : 1225 So. 48th Street/Suite 2/Tempe, Arizona 85281

Phone Number : 602 985-5524

Fax Number : 602 985-2988

Technology Maturity : Commercial use experience

Performance History : An in-situ field program is in progress with Mobil Oil, using a combination of upgradient vertical and horizontal injection wells and a downgradient extraction well. An in-situ program is currently in progress in Waco, Texas, at a tire manufacturing plant (name withheld at client's request). a second project is underway at a California-Nevada border location, and a third one is undergoing engineering study beneath an intersection in a major metropolitan area.

Comments : FyreZyme is a concentrated aqueous solution, which is diluted to 4, 5, and 6 percent for use as a bioremediation enhancing agent. FyreZyme is stable, with a shelf life of 5 years under "normal" environmental conditions. FyreZyme is effective in accelerating bioremediation of a wide range of organic contaminants in an environmentally friendly, scientifically sound, and cost-effective manner. FyreZyme may be used as a stand-alone technology or incorporated into other technologies, such as bioventing, soil venting, sparging, slurry phase treatment, sediment treatment, pump-&-treat, etc.

Source of Information : VISITT 3.0

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Biodegradation (In Situ)***Technology Name :** Electro-Klean

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : The electrokinetic bioremediation (or bio-electrokinetic remediation) technology for continuous treatment of in situ groundwater or soil utilizes either electro-osmosis or electrochemical migration (ion migration) to initiate or enhance in-situ bioremediation.

Company Name/POC: Electrokinetics, Inc./Robert Marks/Yalcin Acar/Robert Gale

Address : LA Business and Technology Center/Suite 155/South Stadium Drive/Baton Rouge, Louisiana
70803-6100

Phone Number : 504 388-3992**Fax Number :** 504 388-397**Technology Maturity :**

Bench scale testing, only

Performance History : Electrokinetics, Inc. has developed a strong research and development plan. One of their first pilot tests for the electrokinetic bioremediation program will be to compare removal of jet fuel from contaminated sites with other conventional remediation processes.

Comments : None.

Source of Information : VISITT 3.0

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Biodegradation (In Situ)***Technology Name :** Anaerobic Biotransformation**Application :** In-situ (saturated zone)

Brief Description : ENSR has designed and implemented a full-scale system combining several remediation technologies to treat soil and groundwater contaminated with chlorinated solvents. The system combines bioremediation, steam injection, soil vapor extraction, groundwater extraction, and air-stripping. The remediation approach for this technology combines the use of steam injection for the removal of dense nonaqueous phase liquids (DNAPL), coupled with the application of nutrients to groundwater to promote biotransformation of TCE and 1,1,1-TCA to compounds which are more easily removed from the subsurface. DNAPLs which are volatilized by close contact with injected steam are removed in the vapor phase by a network of vapor extraction wells.

Company Name/POC: ENSR Consulting and Engineering/D. J. Poehls**Address :** 1220 Avenida Acaso/Camarillo, California 93012**Phone Number :** 805 388-3775**Fax Number :** 805 388-3577**Technology Maturity :** Commercial use experience

Performance History : ENSR has been operating a full scale remediation system based on biotransformation combined with steam injection for approximately two years. A design for remediation of a second site impacted by chlorinated solvents present as DNAPLs using a similar approach was completed in mid-1993. System installation and start-up is scheduled for 1994. Both sites where this technology is being applied are being remediated under privately funded voluntary cleanups.

Comments : This type of in-situ remediation process is limited to the treatment of chlorinated solvents. Implementation of this technology requires bench- or pilot-scale testing to aid in design of a full-scale system. Injection of substrate and nutrients into groundwater will likely require a permit in most states.

Source of Information : VISITT 3.0

CONTAMINANTS:

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE: *Biodegradation (In Situ)***Technology Name :** In Situ Groundwater Bioremediation**Application :** In-situ (saturated zone)

Brief Description : In situ bioremediation of groundwater and saturated soil is achieved by developing a system of extraction and injection wells that deliver nutrients and oxygen and contain the plume of contaminants. The process enhances the subsurface environment such that microbial degradation of organic contamination is stimulated. The system is enhanced by polishing the recovered water, supplementing it with Restore brand central products, and reinjecting it into the subsurface.

Company Name/POC: IT Corporation/Tom Geisler**Address :** 312 Directors Drive/Knoxville, Tennessee 37923**Phone Number :** 615 690-3211**Fax Number :** 615 690-362**Technology Maturity :** Commercial use experience

Performance History : IT Corporation has successfully used this technology to obtain closure on more than six sites. IT Corp. is prepared to provide all services and equipment required to conduct in situ groundwater bioremediation.

Comments : The major limitation this technology has is the transport of nutrients and oxygen in the subsurface. This technology is also limited to treating contaminants in the aqueous phase. For this reason, it is usually less cost-effective than other remedies for treating free-phase product.

Source of Information : VISITT 3.0

CONTAMINANTS :

- ☒ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : In Situ Groundwater Bioremediation

Application : In-situ (saturated zone)

Brief Description : A system of infiltration and recovery galleries is installed and connected to a bioreactor and an aeration system. The system is installed as a stack of vertical trenches alternating between infiltration and recovery trenches. Natural groundwater is recirculated in a closed-loop system, starting from the infiltration galleries, through the contaminated soils, into the recovery galleries, and then through the aerator and bioreactor. The bioreactor is used to add nutrients and other chemicals as needed for the remediation process. The natural microbial community in the contaminated soils is thus stimulated to degrade the contaminants.

Company Name/POC: Kemron Environmental Services, Inc./James A. Novitsky

Address : 2987 Clairmont Road/Suite 150/Atlanta, Georgia 30329

Phone Number : 404 636-0928

Fax Number : 404 636-7162

Technology Maturity : Commercial use experience

Performance History : Full-scale application of the system resulted in the reduction of soil petroleum hydrocarbons by over 98 percent. The system was reviewed and approved by the Virginia Water Control Board.

Comments : This system is not applicable for contaminants that are not readily biodegradable such as chlorinated solvents, pesticides and herbicides, PCBs, metals, and certain inorganics. The cleanup times can be long, on the order of several months, depending on the type of contaminant and initial and target concentrations.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Biodegradation (In Situ)***Technology Name :** In Situ Groundwater Bioremediation**Application :** On-site

Brief Description : Microbial Environmental Services, Inc. (MES) uses bioremediation technologies to treat groundwater aquifers contaminated with petroleum. The design is based on the introduction of low concentration nutritional cofactors and oxygen into the subsurface via infiltration galleries and extraction through a recovery well to enhance naturally occurring microorganisms. The system is a closed-loop biodegradation system designed to prevent migration of the contaminants and nutritional cofactors off the treatment site. The results of biodegradation of contaminant by naturally occurring microorganisms are carbon dioxide and water.

Company Name/POC: Microbial Environmental Services, Inc./Jack Sheldon**Address :** 11270 Aurora Avenue/Des Moines, Iowa 50322**Phone Number :** 515 276-3434**Fax Number :** 515 276-024**Technology Maturity :** Commercial use experience

Performance History : Scientists and engineers at MES, Inc. have applied more than a decade of knowledge and experience in bioreactor design, microbial ecology and environmental microbiology, transport phenomena and waste management to develop and design the biotreatment technologies used by MES, Inc. MES has patents that have been applied for; some patents are still being applied for.

Comments : MES, Inc. bioremediation technologies are not applicable to the treatment of non-biodegradable wastes, wastes containing metals only, inorganic cyanide wastes, inorganic corrosive wastes, and wastes containing radioactive materials. The technologies are also not applicable to the treatment of PCBs and dioxins/furans.

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : In Situ Bioremediation

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : NGI provide: Site characterization, treatability studies, pilot scale tests, full scale remediation (including: design, implementation and monitoring).

Company Name/POC: Norwegian Geotechnical Institute/Tor Loken

Address : PO Box 3930, Ullevaal Hageby/N 0806 Oslo, Norway

Phone Number : 47 22023000

Fax Number : 47 22230448

Technology Maturity : Commercial use experience

Performance History : Used on 20m3 spill of fuel oil contaminating 2000m3 of sandy and gravelly soil above ground water (in Norway). 70% reduction of contaminate was achieved with no ground water contamination occurring. Pilot tests on PAH contaminated soil from creosote and gas work plants have been performed.

Comments : None

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☐ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : Phytostabilized Bioremediation

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Uses enhanced biotechnology to degrade organics - e.g., phenol, PCB, dioxin and inorganics - nitrate, ammonia etc. The technology can be used in a soil matrix to treat flowing groundwater/effluent or by direct planting into soil. Non-stabilized bioremediated and many types of conventional water treatment. Microorganisms (fungi and bacteria) which develop in the planted soil are responsible for most of the treatment. The root and rhizone systems of the reeds bring air into the soil surrounding them while further away the environment is anaerobic creating a unique mosaic of treatment spheres which facilitates the impressive ability of reed beds to remove complex and previously intractable pollutants. The majority of treatment is by soil microbes but certain contaminants (such as heavy metals, sulphur and phosphorous) are removed via soil processes.

Company Name/POC: OEEL Ltd/ESU Ltd/ Lucian S. Gill

Address : 4 Cumberland House/Greenide Land/Lidget Green/Bradford W. Yorkshire BD89TF England

Phone Number : 1274 480033

Fax Number : 1274 48300

Technology Maturity : Commercial use experience

Performance History : Over 500 applications worldwide including PCB, Pesticide, Dioxins, Organics - including solvents, phenolics, PAH's, ammonia, nitrates, cyanide etc., sewage, farm slurries, metal entrapment/extraction.

Comments : Requires adaptation and monitoring over the first 3 years to maturity but then continues in some cases with little or no attention. Requires larger land areas than conventional "packaged" systems. Requires three years adaption period. Once adapted is extremely flexible and will readapt to changes in input. The technique involves genetics selection of plant types to withstand toxic material. The plant/soil/bacterial matrix is then adapted to the site conditions and once stabilized - continues to treat the toxic material indefinitely. Effluent/groundwater is fed into a basin containing the PL/SO/BAC matrix. Plants are allowed to develop and penetrate their rhizomes into the toxic soil. Because each site has a unique problem, no hard rule for system costs can be given. Smallest system - 10 sq. meters, largest 20 hectares; volume 1 m(cubed) per day to 5000 m(cubed) per day.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☒ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Biodegradation (In Situ)***Technology Name :** Bioremediation**Application :**
In-situ (vadose zone)
In-situ (saturated zone)**Brief Description :** SBP Technologies, Inc. (SBP) has compiled a unique collection of patented microorganisms for use in bioremediation applications. The integrated use of these microorganisms together with in situ bioreactor technologies promise to yield an effective and cost-efficient remedial solution for soil, sediment and groundwater contaminated by a great number of organic compounds. The in situ bioreactor is an encapsulated cell designed to be inserted into a well. The bioreactor can be inserted to treat the vadose zone or groundwater.**Company Name/POC:** SBP Technologies, Inc./Dr. James Mueller, Ph.D.**Address :** One Sabine Island Drive/Gulf Breeze, Florida 32561-3999**Phone Number :** 904 934-9282**Fax Number :** 904 934-9201**Technology Maturity :** Pilot plant testing**Performance History :** Specially selected microorganisms have been patented for the treatment of soil (and water) containing organic wood preservatives, namely creosote and PCP, and chlorinated solvents, especially TCE. Application strategies using in situ bioreactors and encapsulated cells are designed on a site-specific basis.**Comments :** Time constraints often limit in situ applications. All conventional limitations to biological processes apply (e.g., high metal concentrations, temperature, pH, nutrient status, oxygen potential, bioavailability, etc.). Physical/hydrogeological constraints are also relevant.**Source of Information :** VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : Biocat-II (TM)

Application : In-situ (saturated zone)

Brief Description : The BIOCAT-II (TM) process for bioremediation - in-situ ground water treats a variety of wastes including aromatic hydrocarbons and halogenated hydrocarbons. The process entails such means as control of oxidation-reduction potential, pH, salinity, temperatures, and addition of electron donor(s) and/or electron acceptor(s) to sequentially enrich in-situ cultures of microorganisms capable of accomplishing the required biotransformations.

Company Name/POC: Yellowstone Environmental Science, Inc./Mary M. Hunter

Address : 320 S. Willson Avenue/Bozeman, Montana 59715

Phone Number : 406 586-3905

Fax Number : 406 587-510

Technology Maturity : Bench scale testing, only

Performance History : Laboratory studies by Yellowstone Environmental Science, Inc. (YES) and others have confirmed removal of the following constituents during the process steps: (1) denitrification: benzene, toluene, ethylbenzene, o-xylene, m-xylene, p-xylene, phenol, o-cresol, p-cresol, and carbon tetrachloride; (2) sulfate-reduction: phenol, p-cresol, and carbon tetrachloride; (3) methanogenesis: benzene, toluene, ethylbenzene, o-xylene, phenol, p-cresol, 1,1,1-trichloroethane (TCA), tetrachloroethylene (PCE), trichloroethylene (TCE), carbon tetrachloride, chloroform, bromoform, methylene chloride, chlorophenols, and trichlorofluoromethane (FREON II); and (4) aerobic respiration: benzene, toluene, phenol, m-cresol, p-cresol, TCE, and vinyl chloride.

Comments : The BIOCAT-II (TM) process is applicable to situations wherein the wastes can be exposed to a sequence of treatment environments. This is most easily accomplished in a series of reactors.

Source of Information : VISITT 3.0

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Bioventing*

Technology Name : Bioventing by Global Environmental Inc.

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Anoxic air is injected through well points into the vadose zone. The resulting air flow through the contaminated soils accelerates the volatilization of high vapor pressure halocarbons. The vaporized halocarbons migrate toward the ground surface. As the vapors move upward, they are biodegraded through a co-metabolic process using a supplemental substrate and nutrients to enhance bioactivity. Aliphatic hydrocarbons or acetate are the usual substrates.

Company Name/POC: Global Environmental Engineering/Robert H. Douglas

Address : 2640 Aero Park Dr./Traverse City, MI 49686

Phone Number : 616 947-1000

Fax Number : 619 947-1044

Technology Maturity :

Performance History : Bioventing has been used successfully for remediating hydrocarbon-contaminated vadose and capillary fringe soils at the USCG Air Station in Traverse City, MI. Contaminant concentrations were reduced to below regulatory cleanup standards. Halocarbon treatment by use of an introduced co-metabolic substrate has been successfully used for groundwater remediation at Moffit Naval Air Station in California and at a site in St. Joseph, MI.

Comments : Bioventing can be applied to a wide variety of physical locations, but generally requires an open area with at least 6-12" of loamy top soil and minimal infrastructure which may inhibit or redirect air flow from below and infiltration from the surface. General labor can be used for most construction activities such as trenching and piping with on-site technical supervision. Electrical hook-up requires skilled labor. Construction requires 2-4 weeks. A bioventing project will consist of a field technician to monitor, maintain, and sample the system, a project engineer to evaluate system performance, and a project manager to assure compliance and coordinate all associated activities such as contractors, regulatory reporting, health and safety measures, etc. Global provides a whole range of soil and groundwater environmental services.

Source of Information : TechCon

GROUND WATER

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Bioventing*

Technology Name : Bioaugmented Soil Vapor Extraction (BSVE)

Application : In-situ (vadose zone) Ex-situ

Brief Description : Bioaugmented soil vapor extraction (BSVE) is the removal of volatile organic compounds from unsaturated soils by aeration forces and nutrient augmentation. The technology results in the physical removal of VOCs through enhanced volatilization and in the biodegradation of organic compounds through the acceleration of indigenous microbial processes. The key to the process is the effective contact of contaminated soil with an induced air stream. The partitioning of the process between physical removal and biodegradation is a function of the rate of aeration and the relative biodegradability of the material being used. Combining physical removal with biodegradation accelerates remediation and allows for the achievement of lower closure levels. The system can be applied both in situ and ex situ. Bioaugmented soil vapor extraction extends the range of contaminants that can be effectively treated through vapor extraction. It has been demonstrated effective in treating chlorinated hydrocarbons. BSVE is effective in treating chlorinated organics and is faster than conventional technologies because it combines two remedial technologies: volatilization and biodegradation.

Company Name/POC: Groundwater Technology, Inc./Richard Brown

Address : 310 Horizon Center Dr./Trenton, NJ 08691

Phone Number : 609 587-0300

Fax Number : 609 587-790

Technology Maturity : Commercial use experience

Performance History : BSVE has been successfully applied on a commercial scale to treat petroleum hydrocarbons, (e.g. gasoline and diesel), organic chemicals (e.g., chlorobenzene) and numerous chlorinated solvents ex situ. BSVE has been used to treat sites ranging in size from <1 acre to >50 acres. Harry Mösley, Public Service of Colorado, Denver CO. 303 294-2815.

Comments : Ex-situ system consists of an aeration bed-gravel layer with aeration pipe that is placed in a soil pile. The pile is constructed around vacuum piping which is on 3-ft centers and connected to a vacuum pump. Nutrient infiltration is accomplished through an infiltration pipe. In-situ system consists of air nutrient injection wells and separate vapor extraction wells. The two limitations to the technology are the ability to aerate the soil/solid matrix and the properties of the contaminant. If the permeability is too low, or if the contaminant is both nondegradable and nonvolatile, BSVE will not be effective. Systems are relatively easy to design and implement. Bench-scale studies, which consist of loading columns with soil, adding nutrients and measuring rates of removal due to volatilization or biodegradation during aeration, are required. Air permeability must be measured in the field for in-situ systems; air permeability for ex-situ systems can be measured by pressure drop and flow-through columns.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Bioventing*

Technology Name : Biosparge System

Application : In-situ (saturated zone)

Brief Description : The BioSparge System is a patented closed-loop system of in situ remediation. It utilizes a designed system of gas injection wells combined with surrounding vapor extraction wells and a mobile surface treatment system to provide injection, capture and cleaning without gas venting and emissions. However, on a site-specific basis the in situ treatment of soil and groundwater can be combined with ex situ treatment for a more efficient removal of contaminants. For sites with chlorinated contaminants such as solvents or phenols (TCE, TCA, PCP), the BioSparge system is modified to include an ozone generator.

Company Name/POC: Hayward Baker Environmental, Inc./George K. Burke, P.E.

Address : 1130 Annapolis Road/Odenton, Maryland 21113

Phone Number : 410 551-1995

Fax Number : 410 551-1900

Technology Maturity : Commercial use experience

Performance History : The first full scale BioSparge remediation project was initiated in 1990 and since then four (4) sites have been completed. Two additional projects were recently initiated with one site using an Ozone Amended BioSparge unit to remediate pentachlorophenol (PCP). Sites have ranged from gasoline fuel stations and truck terminals to fuel distribution facilities.

Comments : The primary function of the BioSparge system is to create and maintain an environment in the subsurface which induces in situ biodegradation. Approximately 75 percent of the contaminants are degraded in situ with the remaining constituents being treated above ground in the treatment unit. The economy of the system is that the nonvolatile components are degraded in situ which reduces the remediation time to between 6 and 24 months for most sites.

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Bioventing

Technology Name : Biological Vapor Extraction

Application : In-situ (vadose zone)
 In-situ (saturated zone)

Brief Description : Vapor extraction-enhanced bioremediation is an effective method for remediation of soils in the vadose and saturated zones which are contaminated with volatile or semi-volatile compounds. This technology supplements the capabilities of the vapor extraction process when compounds are present which have large non-volatile fractions. With this technology, the vapor extraction removes the volatile portions of the contaminant while the in-situ bioremediation degrades the non-volatile portion of the contaminant. Vapor extraction wells are installed into the area of contamination and well screens are installed such that the vadose zone and the saturated zone are subject to the vacuum influence. Experimentation is performed on the indigenous organisms at the site to determine what nutrients are required to maximize chemical breakdown of the non-volatile portions of the contaminant. In most cases, these aerobic bacteria are limited by a lack of oxygen, which will be provided in sufficient quantities by the vapor extraction process. In some instances, other nutrients, such as nitrogen or phosphorus, may be necessary to maximize bioremediation rates. During the remediation process, bioactivity is monitored by measuring the production of carbon dioxide in the exiting vapor stream and comparing it to a known baseline value. The vapor extraction wells are connected via a manifold of piping to a gas-liquid separator, a blower capable of inducing a vacuum in the system of vapor extraction wells and the surrounding soils, and finally to an airstream treatment device. Any water removed in the gas-liquid separator is treated separately from the air stream using a conventional treatment method.

Company Name/POC: Terra Vac/James Malot/Bruce Bosshard

Address : 356 Fortaleza St., P.O. Box 1591/San Juan, P.R. 00902-1591

Phone Number : 809-723-9171

Fax Number :

Technology Maturity : Commercial use experience

Performance History : Contact company representatives for performance summary and client list. Job size has ranged from small gas station projects to major superfund sites. Contaminants that have been recovered by this technology include: Benzene, toluene, xylenes, ethylbenzene, hexane, chloroform, methylene chloride, tetrachloroethylene, trichloroethylene, dichloroethylene, ethyl acetate, cyclohexane, methyl ethyl ketone, methyl isobutyl ketone, methanol, acetone, pyridine, tetrahydrofuran, dimethylfuran, carbon tetrachloride, trichloroethane, methyl methacrylate, decane, chlorobenzene, dichlorobenzene, trichloropropane, gasoline, jet fuel, Stoddard Solvent, diesel, kerosene, and heavy naphthas.

Comments : Conditions in the soil to be remediated must not create a toxic environment for microorganisms or bioremediation will not take place. The rate at which bioremediation takes place is much slower than the rate of volatile contaminant removal achieved by vapor extraction because the process of bioremediation is affected by many factors. Therefore, the system will have to be operated for a period of time after the volatile portion of the contaminant has been removed in order to assure degradation of the non-volatile portion of the contaminant. In some cases, naturally-occurring organisms do not exist to break down synthetically produced compounds. Genetically engineered organisms or accelerated evolution would have to be utilized to overcome this obstacle. After installation of the system, additional analysis will be required during system operation to maximize the rate of bioremediation. This may involve bacterial culture observation and additional chemical analysis. The most difficult part of this technology is the proper selection of well screening intervals and the correct maintenance of the microorganism's environment. The airflow path must be well known to ensure that the nutrients and oxygen are being supplied in sufficient quantities to the microorganisms. The presence of suitable nutrients must be verified during the site investigations process.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Bioventing***Technology Name :** In Situ Venting of Soil and Groundwater**Application :** In-situ (vadose zone)
In-situ (saturated zone)**Brief Description :** The technology aims at providing the subsurface layers, including the groundwater aquifer, with air and/or oxygen either for stimulating the aerobic biodegradation of the organic compounds or by stripping volatile compounds from the soil layers. The air or oxygen is supplied through horizontal injection wells, ensures vertical aeration of the soil or the aquifer. The performance is dependent on the geology of the site, since very inhomogeneous soils and aquifers might interfere with proliferation of the air and thereby also the extent of contact between air and/or oxygen and the contaminants.**Company Name/POC:** VKI Water Quality Institute/Bjorn Jensen**Address :** VKI/Agern Alle 11/DK - 2970 Hoersholm, Denmark**Phone Number :** 45 42 86 52 11**Fax Number :** 45 42 86 72 73**Technology Maturity :** Field demo complete**Performance History :** Full-scale soil venting or bioventing using vertical injection and extraction wells have been applied in a number of cases in Denmark and abroad. Currently have an application of about \$2 million (US) submitted to the Danish Ministry of Business and Industry for development of venting techniques for further applications (clayish soils and aquifers).**Comments :** If the compounds are stripped off the soil or groundwater, the gases must be trapped or treated on th ground. The technology cannot be used for non-volatile, persistent compounds like the heavy metals. It cannot be applied in cases with low permeability of the soil, and it is not clear at the moment whether it can be applied in fractured clay.**Source of Information :** International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☐ SVOC	☐ Other Contaminant
☒ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Solidification/Stabilization (In Situ)*

Technology Name : Treatment Agents for In-Situ Infiltration

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : This technology uses modified natural clays (MNCs) to immobilize target contaminants such as heavy metals, radionuclides, and organics. The MNCs can be directly mixed into the material containing the contaminants or can be molded or injected to form in-situ barriers, preventing contaminant migration. MNCs drastically reduce contaminant migration by restricting hydraulic conductivity through a barrier constructed of MNCs and by providing reactive surfaces for contaminant adsorption and immobilization. MNCs, especially combined with binding agents, will impede the flow of contaminated-laden soil moisture and groundwater.

Company Name/POC: Fluid Tech, Inc./Dean Rowsell

Address : 4335 West Tropicana Avenue/Suite 3/Las Vegas, NV 89103

Phone Number : 702 871 1884

Fax Number : 702 871-362

Technology Maturity : Pilot plant testing

Performance History : In-situ immobilization currently under R&D.

Comments : Treatability testing is required to formulate reagent for waste streams of peculiar characteristics (high salt concentrations, high level of chelating or complexing agents). Acidic, basic, reductive, and oxidative waste streams may require pretreatment. Slurried clay is easy to work with, requires less infrastructure than grout, and can be applied in many environments and remains stable (clays form in soils). The greatest challenge to this technology is bringing an awareness of the use of the technology to potential users. Matching MNC to the need in very complex environments requires bench testing. Finally, finding reliable data is difficult for comparison of critical factors such as volume expansion, thermodynamic stability in soils, susceptibility to freeze/thaw cycle stresses, stability to heat or radioactive decay, and energy usage, product cost, and final waste form disposal charges.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Solidification/Stabilization (In Situ)*

Technology Name : In-situ Fixation (FIX) of Radionuclides and Heavy Metals

Application : In-situ (saturated zone)

Brief Description : Achieves in-situ remediation of uranium and chromium by reducing mobile anions of elements to the low-mobility cation. Required pumpage is commonly 10 to 25 percent of pumpage for a "pump and treat" system, with associated operational cost reduction and reduction of solid/hazardous sludge for disposal.

The treatment process removes chromium from contaminated groundwater using a variation on traditional pump and treat methods. As part of the approach, contaminated groundwater is brought to the surface and treated using conventional treatment systems. Next a reductant is added to the treated water, which is reinjected around the plume margin. Here it reacts with and reduces residual levels of chromium, forming a precipitate. Such reinjection achieves better hydrodynamic control by building a "barrier" of elevated water levels around the plume, thereby enhancing the gradient and associated hydraulic control. The reinjection also allows for in situ reduction and subsequent fixation of residual chromium.

Company Name/POC: Groundwater Technology - FIX/Jim V. Rouse

Address : 6436 S. Racine Circle/Suite 200/Englewood, Colorado 80111

Phone Number : 303 799-4241

Fax Number : 303 799-4274

Technology Maturity : Pilot plant testing

Performance History : The in-situ approach was initially developed and used by a number of in-situ uranium leaching mines in South Texas in the 1970s, and has been adapted for environmental applications. The technology has been accepted into the EPA SITE program for application at 2 sites.

Comments : Feed rate can vary widely, since the treatment equipment consists of modules of "off-the-shelf" treatment equipment. Capital equipment will be essentially the same as a conventional pump and treat system, but O&M costs commonly are 10 percent to 25 percent of those associated with such a system. This results from elimination of "tailing" and the need to treat large volumes of low-concentration water. The waste generated is the same as that generated by a conventional pump and treat system, except that the use of in-situ fixation significantly reduces the volume of residual for disposal. Options include recycling generated material back to facility for use, sending to a secondary recovery system, or off-site disposal. Operation of the in-situ technique requires reinjection of the treated effluent, with additional reagent, back into the contaminated aquifer. This, in turn, requires a Class V Underground Injection Control (UIC) permit, which consists of a notification to EPA and/or involved states.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Solid Phase Biological Treatment*

Technology Name : Bioaugmented Soil Vapor Extraction (BSVE)

Application : In-situ (vadose zone) Ex-situ

Brief Description : Bioaugmented soil vapor extraction (BSVE) is the removal of volatile organic compounds from unsaturated soils by aeration forces and nutrient augmentation. The technology results in the physical removal of VOCs through enhanced volatilization and in the biodegradation of organic compounds through the acceleration of indigenous microbial processes. The key to the process is the effective contact of contaminated soil with an induced air stream. The partitioning of the process between physical removal and biodegradation is a function of the rate of aeration and the relative biodegradability of the material being used. Combining physical removal with biodegradation accelerates remediation and allows for the achievement of lower closure levels. The system can be applied both in situ and ex situ. Bioaugmented soil vapor extraction extends the range of contaminants that can be effectively treated through vapor extraction. It has been demonstrated effective in treating chlorinated hydrocarbons. BSVE is effective in treating chlorinated organics and is faster than conventional technologies because it combines two remedial technologies: volatilization and biodegradation.

Company Name/POC: Groundwater Technology, Inc./Richard Brown

Address : 310 Horizon Center Dr./Trenton, NJ 08691

Phone Number : 609 587-0300

Fax Number : 609 587-790

Technology Maturity : Commercial use experience

Performance History : BSVE has been successfully applied on a commercial scale to treat petroleum hydrocarbons, (e.g. gasoline and diesel), organic chemicals (e.g., chlorobenzene) and numerous chlorinated solvents ex situ. BSVE has been used to treat sites ranging in size from <1 acre to >50 acres. Harry Mosley, Public Service of Colorado, Denver CO. 303 294-2815.

Comments : Ex-situ system consists of an aeration bed-gravel layer with aeration pipe that is placed in a soil pile. The pile is constructed around vacuum piping which is on 3-ft centers and connected to a vacuum pump. Nutrient infiltration is accomplished through an infiltration pipe. In-situ system consists of air nutrient injection wells and separate vapor extraction wells. The two limitations to the technology are the ability to aerate the soil/solid matrix and the properties of the contaminant. If the permeability is too low, or if the contaminant is both nondegradable and nonvolatile, BSVE will not be effective. Systems are relatively easy to design and implement. Bench-scale studies, which consist of loading columns with soil, adding nutrients and measuring rates of removal due to volatilization or biodegradation during aeration, are required. Air permeability must be measured in the field for in-situ systems; air permeability for ex-situ systems can be measured by pressure drop and flow-through columns.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment***Technology Name :** Bionergies, Biosmose, Biosurf

Application : In-situ (vadose zone) Off-site Ex-situ
 In-situ (saturated zone)

Brief Description : Bioremediation of organic pollutions (in soils, water, effluents) by using: 1. exogenous specific bacterial consortium (non toxic, environment safe, European Federation of Biotechnology class I in order to control a full, complete and non selective biodegradation. 2. Biofixations (mineral natural support). 3. Biosurfactants (produced by selected bacteria) provide an effective, fast and secure alternative to common place bioremediation because Bionergies controls the biodegradation of the pollutant (and metabolites) by using specialized bacteria and feasibility tests (in labs, on the field).

Company Name/POC: Bionergies Laboratories, Biosurf/M. Jacques FAUDIN**Address :** 59/100, rue des 4 termes/B.P. 1009/Z.I. des Paluds/13781 AUBAGNE Cedex, France**Phone Number :** 33 42 84 30 07**Fax Number :** 33 42 84 23 33**Technology Maturity :** Commercial use experience**Performance History :** Contact company for performance data.

Comments : Each case is analyzed in order to optimize the treatment and the on site materials and personnel. Bioenergies controls the bacterial action by using exogenous specific bacterial strains, biofixations and biosurfactants. None of the bacteria is genetically engineered. They are classified into class I (one) of the European Federation of Biotechnology, and produced under French and European Community regulations. The company is looking for join-ventures in U.S. in order to cover the environmental and industrial field.

Source of Information : International TechCon

GROUND WATER

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Slurry Phase Biological Treatment*

Technology Name: Biodegradation of VOCs

Application: ☒ On-site ☐ Ex-situ

Brief Description: Reactor system to biologically degrade trichloroethylene, vinyl chloride, dichloroethylene and related compounds in the vapor phase. The system has been proven to destroy >90 percent of the VOCs while maintaining biocatalytic life over extended periods.

Company Name/POC: Envirogen, Inc./William J. Guarini

Address: 4100 Quakerbridge Rd./Lawrenceville, New Jersey 08648

Phone Number: 609 936-9300

Fax Number: 609 936-922

Technology Maturity:

Field demo complete

Performance History: Technology based on successful pilot results in DOE-OTD Argonne National Lab funded project. Currently being field tested at a commercial site in New York State.

Comments: Full-scale operating parameters to be determined. Simple operation, minimal operator attention.

Source of Information: TechCon

CONTAMINANTS:

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

■ Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

■ Halogenated VOC

■ N/A

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : Biological Sulfate and Metal Removal

Application :	On-site	Ex-situ
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Brief Description : Biologically reduce sulfate to sulfide. Remove metals as insoluble metal sulfide, remove excess sulfide as elemental sulfide. Metal removals >99.1%; Sulfate removals >90.1%.

Company Name/POC: Paques, Inc./Andre de Voogt

Company Name/POC: Paques, Inc./Andre de Vegt

Address : 486 Thomas Jones Way/Suite 100/Exton, PA 19341 USA

Phone Number : 610 363-9564

Fax Number : 610 363-9554

Technology Maturity : Commercial use experience

Performance History : One full scale plant in operation at Zinc Production Facility in the Netherlands. Good operation since start-up in May 1992

Comments : Electron donor required for sulfate reducing bacteria (can be ethanol, hydrogen gas, organic wastes).
Highly automated operation possible. Parent company is located in town of Balk, Netherlands.

Source of Information : International TechCon

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE: *Chemical Reduction/Oxidation***Technology Name:** E-Process**Application:** On-site Ex-situ

Brief Description: Process injects ozone to oxidize both VOC and metal ions; precipitates and separates these. Final metal ion removal is with metal removal medium (MRM). Ion exchange can be added to the end of the process for water polishing.

Company Name/POC: ADTECHS, Inc. (a wholly owned subsidiary of JGC Corp.)/Lou Reynolds, Dennis Wilkie

Address: 2411 Dulles Corner Park/Suite 520/Herndon, Virginia 22071

Phone Number: 703 713-9000

Fax Number: 703 713-910

Technology Maturity: Bench scale testing, only

Performance History: Performance data are available.

Bench scale phase of EPA SITE Program. Completed field demonstration EPA SITE Program.

Comments: For its applications, the technology has no particular limitations. System can be made in different sizes, depending on floor requirements. No unusual personnel requirements. Uses commercially available process components and equipment.

Source of Information: TechCon

CONTAMINANTS :

- ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Chemical Reduction/Oxidation*

Technology Name : Gas Phase Chemical Reduction

Application : On-site Ex-situ

Brief Description : The ECO LOGIC Process involves the gas-phase reduction of hazardous organic contaminants. The system is capable of treating any form of organic contamination at any concentration with proven destruction and removal efficiencies (DREs) of at least 99.9999 percent. Contaminants entrained in liquids, soils and bulk solids can be destroyed without the formation of hazardous organic residuals. The system has been verified by various government agencies worldwide including the US EPA through the Superfund Innovative Technology Evaluation program. The ECO LOGIC Process is currently offered as a commercial-scale system for on-site treatment. The closed-loop destruction process ensures that no uncontrolled emissions result while the use of a reducing atmosphere ensures that dioxins and furans are not formed as byproducts. The system is mobile and may be utilized for on-site destruction.

Company Name/POC: ELI Eco Logic International Inc./Jim Nash

Address : 143 Dennis Street/Rockwood, Ontario, Canada NOB2KO

Phone Number : 519 856-9591

Fax Number : 519 856-9235

Technology Maturity : Commercial use experience

Performance History : Development of the technology began in 1986 and proceeded through the bench-scale and laboratory-scale. In 1991, a pilot-scale unit was constructed and tested extensively at Hamilton Harbour, Ontario, Canada. Demonstrations on sediment contaminated with 300,000 ppm PAH and 400 ppm PCBs confirmed DREs of 99.9999 percent. The pilot-scale unit was tested in Bay City, Michigan, the following year for the US EPA and PCB contaminated oil (25 percent PCBs), water and soil. Once again DREs of at least 99.9999 percent were confirmed. Following the Bay City demonstration further modifications were made to the front-end preprocessing units as well as scaling up the technology to a commercial-scale. At the time of this writing, (May 1995) the first commercial-scale unit was operating in Australia on pesticide residuals and PCB contaminated electrical equipment. The second and third commercial-scale units are presently being constructed and will be utilized by General Motors of Canada Ltd. and the steel manufacturing firm Dofasco Inc.

Comments : The ECO LOGIC Process treats only the organic portion of the waste stream. Any inorganic co-contaminants will remain in the treated soil or be separated in the grit and scrubber as metal hydrides, depending on their physical characteristics. Additionally, the radioactive component of a mixed low level waste stream would be captured at various specific locations in the Process. With the ECO LOGIC Process, a mixed waste stream would undergo significant volume reduction and separate the radioactive component into a form that is more amenable to traditional methods of disposal. The ECO LOGIC Process is mobile and mounted on several drop-deck highway trailers. It may be transported to the waste site and set-up within four weeks. Once the on-site waste has been destroyed, the system is simply moved to the next site. The mobility and closed-loop destruction process have garnered significant public acceptance for the technology while being offered at a competitive cost. The ECO LOGIC Process is at an advanced state of development for an alternative remediation technology and is presently offered at a commercial-scale.

Source of Information : International TechCon

GROUND WATER

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Chemical Reduction/Oxidation

Technology Name : In Situ Ozonation

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : In situ chemical oxidation of organic contaminants includes ozone injection into contaminated aquifers and/or contaminated unsaturated zones. Combines knowledge of ozone oxidation chemistry and gaseous transport through saturated and unsaturated sediments.

Can replace or complement traditional in-situ remediation methods such as pump-and-treat, soil venting, air sparging and in-situ bioremediation. Particularly appropriate for recalcitrant contaminants with limited treatment options such as PAHs, TCE and PCP. Can minimize or eliminate off-gas treatment of VOCs.

Company Name/POC: Groundwater Technology, Inc./Christopher Nelson

Address : 6436 S. Racine Circle/Suite 200/Englewood, Colorado 80111

Phone Number : 303 799-4241

Fax Number : 303 799-427

Technology Maturity :

Field demo complete

Performance History : Not available.

Comments :

Equipment includes air compressor, oxygen generator, ozone generators, injection wells, piping, etc. Feasibility and pilot testing required to determine oxidation effectiveness and injection transport limitations. Can also be implemented in combination with in situ reduction technologies such as the utilization of zero-valent iron.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Chemical Reduction/Oxidation***Technology Name :** E-Process**Application :**

On-site

Off-site

Brief Description : Process injects ozone to oxidize both VOC and metal ions. Precipitates and separates these. Final metal ion removal is with a metal removal medium (MRM). Ion exchange can be added to the end of the process for water polishing.

Company Name/POC: H2O, Inc./c/o ADTECHS, Inc./a wholly owned subsidiary of JGC Corp./Lou Reynolds/Dennis Wilkie

Address : 2411 Dulles Corner Park/Suite 520/Herndon, Virginia 22071

Phone Number : 703 713-9000

Fax Number : 703 713-9101

Technology Maturity :

Bench scale testing, only

Performance History : Bench scale phase of EPA SITE Program.

Comments : Requires proof of full scale system. Requires demonstration over a range of VOC and metal ion contamination. The E-Process is presently being evaluated by the EPA. It is next scheduled for a full scale site application. Process has passed exclusive lab scale testing. Process has flexibility for treating wide range of suspended particle sizes and dissolved solids. Processing cost is less than \$5 per thousand gallons.

Source of Information : TechCon

GROUND WATER

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Chemical Reduction/Oxidation*

Technology Name : In-Situ Oxidation of Organic Contamination in Groundwater

Application : In-situ (saturated zone)

Brief Description : CleanOX is a new patent-pending process for the in-situ treatment and remediation of hydrocarbon and/or halocarbon-contaminated groundwater. The process utilizes injection of hydrogen peroxide under controlled conditions to oxidize the contaminant, leaving water and carbon dioxide as byproducts of reaction. Similar chemistry is used in water treatment, aseptic packaging, and other systems worldwide. Solutions of hydrogen peroxide are safe, effective, and easily applied. CleanOX uses the classical Fenton reaction to generate the hydroxyl free radical, one of the most powerful oxidizing agents known. It is this agent which attacks and destroys the carbon bonding of the organic contaminant. The CleanOX system is self-contained in a mobile vehicle.

Company Name/POC: Radiation Science/Thomas P. Bracke

Address : P.O. Box 3299/Princeton, NJ 08543

Phone Number : 609 799 0014

Fax Number : 609 799-031

Technology Maturity : Commercial use experience

Performance History : The Arrow Tire project, spring 1993, was the first commercial pilot scale application of the CleanOX process. The site, approximately one acre, located in the town of Butler, NJ., had been utilized as a gasoline station for a period of 60 years. The tank field and pump island had been previously excavated. A Discharge Investigation Report filed in the spring of 1989 indicated high levels of gasoline contamination in the site groundwater (BTEX in excess of 10,000 ppb). CleanOX was applied. Subsequent testing a month later demonstrated that BTEX contamination in all site monitoring wells had been reduced to below EPA acceptance levels (<10 ppm). The Phillips Lighting project in Lynn, MA, was the second pilot scale application of the CleanOX technology.

Comments :

The CleanOX process utilizes a powerful oxidant to cleave the carbon/carbon bonds of organic material, leaving behind carbon dioxide and water. As such, CleanOX is effective in elimination of gasoline, fuel oil, coal tar, pesticides, PCBs, and aromatics and chlorinated solvents. CleanOX is not effective in organic contamination. Based on the geology and dispersion of the contamination, CleanOX may be used in connection with other pretreatment technologies (such as pump-and-treat) to achieve a more effective remedial effort. Iron is used in small quantities in the CleanOX process.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Solidification/Stabilization (Ex Situ)*

Technology Name : Polymerization of Heavy Metal Ions

Application : On-site Ex-situ
 Off-site

Brief Description : Process uses a polymerized sulfide agent to chemically and physically stabilize heavy metal ions. The final waste product meets U.S. EPA leaching criteria. Stabilized product is low in volume and is chemically inert.

Company Name/POC: ADTECHS, Inc. (a wholly owned subsidiary of JGC Corp.)/Ken Sauda

Address : 2411 Dulles Corner Park/Suite 520/Herndon, Virginia 22071

Phone Number : 703 713-9000

Fax Number : 703 713-9101

Technology Maturity : Commercial use experience

Performance History : This process has been in use for 10 years for chemically binding heavy metals in municipal incinerator effluent streams. It is now also being used for processing electronics and electroplating manufacturing wastes. This process has been used for 10 years in Japan to fix heavy metal ions in process waste streams. It will work with radioactive or non-radioactive metal ions. Full scale, operational systems have been in service for several years.

Comments : Materials handling and processing equipment are required, depending on the through-put rates and material form. May require soil washing and crushing equipment. Does require tanks for precipitation of waste dissolved water. Heavy metal ions must be wetted or in solution to react with the polymer. The basic challenge is the handling of the contaminated material,

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Co-Metabolic Processes*

Technology Name : Bioventing by Global Environmental Inc.

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Anoxic air is injected through well points into the vadose zone. The resulting air flow through the contaminated soils accelerates the volatilization of high vapor pressure halocarbons. The vaporized halocarbons migrate toward the ground surface. As the vapors move upward, they are biodegraded through a co-metabolic process using a supplemental substrate and nutrients to enhance bioactivity. Aliphatic hydrocarbons or acetate are the usual substrates.

Company Name/POC: Global Environmental Engineering/Robert H. Douglas

Address : 2640 Aero Park Dr./Traverse City, MI 49686

Phone Number : 616 947-1000

Fax Number : 616 947-104

Technology Maturity :

Performance History : Bioventing has been used successfully for remediating hydrocarbon-contaminated vadose and capillary fringe soils at the USCG Air Station in Traverse City, MI. Contaminant concentrations were reduced to below regulatory cleanup standards. Halocarbon treatment by use of an introduced co-metabolic substrate has been successfully used for groundwater remediation at Moffit Naval Air Station in California and at a site in St. Joseph, MI.

Comments : Bioventing can be applied to a wide variety of physical locations, but generally requires an open area with at least 6-12" of loamy top soil and minimal infrastructure which may inhibit or redirect air flow from below and infiltration from the surface. General labor can be used for most construction activities such as trenching and piping with on-site technical supervision. Electrical hook-up requires skilled labor. Construction requires 2-4 weeks. A bioventing project will consist of a field technician to monitor, maintain, and sample the system, a project engineer to evaluate system performance, and a project manager to assure compliance and coordinate all associated activities such as contractors, regulatory reporting, health and safety measures, etc. Global provides a whole range of soil and groundwater environmental services.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Co-Metabolic Processes*

Technology Name : Biological Treatment of Chlorinated Solvents

Application : In-situ (saturated zone)

Brief Description : Biodegradation of chlorinated solvents in groundwater or soil matrix is achieved with this technology via cometabolic mechanism. The process is able to achieve >99 percent reduction from concentrations up to 2000 ppb.

Company Name/POC: Walsh & Associates/Dr. Bill Mahaffey

Address : 4888 Pearl East Circle/Suite 108/Boulder, CO 80301-2975

Phone Number : 303 670-2875

Fax Number : 303 443-0367

Technology Maturity :

Field demo complete

Performance History : Performance data are Available.

Comments :

The process is easily implementable by a field technician and/or operators. Technical support by a staff microbiologist (Clay Walton) is also required. Mobilization/demobilization and system startup time is minimal, with the exception of establishment of viable, specific biological populations.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Electrical Separation*

Technology Name : Electrochemical Treatment of Inorganics

Application : In-situ (saturated zone) Ex-situ

Brief Description : The electrochemical cell generates a ferrous ion into solution when a direct current is passed across the carbon steel electrodes inside the electrochemical cell. The iron ions will form a solid insoluble matrix that removes other contaminants from solution and maintains them in a tightly bound insoluble form. If contaminants such as hexavalent chromium are present, the ferrous ion will also reduce the chromium to its less hazardous trivalent form.

Company Name/POC: Andco Environmental Processes, Inc./Daryl Zurawski

Address : 595 Commerce Drive/Amherst, NY 14228

Phone Number : 716 691-2100

Fax Number : 716 691-288

Technology Maturity : Commercial use experience

Performance History : The Gleason Works/Rochester, NY/Ken Miller/716-473-1000
 Xerox Corporation/Webster, NY/Jim Jakubonis/716-422-1090
 Lockheed Corporation/Tucson, AZ/Steve Sexton/602-573-8628
 Lockheed Corporation/Charleston, SC/Sonny Moore/803-747-6331
 Chrysler Corporation/Huntsville, AL/Steve Smith/205-464-2132
 General Motors/St. Therese, Quebec/John Deearie/514-433-4494
 Blount Industries/Guelph, Ontario/Jackie Campbell/519-822-6870

Comments : Performance Data are available. List of groundwater installations available.

The technology has been utilized for numerous industrial and groundwater applications. The electrochemical process comes as a user friendly system controlled by a PLC. The process can be automated to the extent that operator attention is only required on an infrequent basis. The operator should have an understanding of mechanical equipment as well as a basic knowledge of chemistry so that accurate sampling procedures can be followed in order to confirm the system's operation. Andco engineers are also available for consultation.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides☒ Heavy Metals☐ PCB☐ Explosives/Propellants☒ Petroleum Hydrocarbons☒ Radionuclides☐ SVOC☐ Other Contaminant☒ Nonhalogenated VOC☒ Halogenated VOC☐ N/A**TECHNOLOGY TYPE :** *Electrical Separation***Technology Name :** Electrokinetics**Application :**
In-situ (vadose zone)
In-situ (saturated zone)**Brief Description :** When direct current is passed through a low permeability soil, the aqueous phase is observed to move from the positive electrode to the negative electrode. This is commonly referred to as electroosmosis. Soil contaminants such as heavy metals (Cs, Sr, Zn, Cd, U, etc.) and organic materials (gasoline, TCE, benzene, etc.) may be removed along with the aqueous phase as it is "pumped" through the soil. Electrokinetic permeabilities for aqueous systems in clays have been demonstrated to be up to one thousand times over normal hydraulic permeabilities.**Company Name/POC:** Electro-Petroleum, Inc./Dr. J. Kenneth Wittle**Address :** 996 Old Eagle School Road/Suite 1118/Wayne, Pennsylvania 19087**Phone Number :** 610 687-9070**Fax Number :** 610 964-8570**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.**Comments :** Field experience in oil field application for oil recovery, mud pit dewatering.
Applicable to contaminated soils and usable to depths of several hundred feet. Works best in soil with >10 percent clay.**Source of Information :** TechCon

GROUND WATER

CONTAMINANTS: ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE: *Oxygen Enhancement with Air Sparging*

Technology Name: Subsurface Volatilization and Ventilation System

Application: In-situ (vadose zone)
In-situ (saturated zone)

Brief Description: SVVS (Trademark) provides in situ aeration and bioremediation of contaminated soils and groundwater. The heart of the process is sparging (saturated zone air injection) and vacuum extraction. This volatilizes contaminants and increases dissolved oxygen in groundwater and soil moisture, stimulating bioremediation.

Company Name/POC: Brown & Root Environmental (previously known as Halliburton NUS Env. Corp.)/Mark Spencer

Address: 4100 Clinton Drive/Houston, Texas 77020

Phone Number: 713 676-3011

Fax Number: 713 676-410

Technology Maturity: Commercial use experience

Performance History: Over 40 installations have demonstrated success at rapid soil and groundwater remediation. Performance contaminant removal rates achieved in all cases. Difficulties in building up dissolved oxygen on some areas of some sites. Problem rectified by redirecting air to reticent areas and/or additional sampling wells. References from Sharon Russell, B&R, 10200 Bellaire Blvd., Houston, TX 77072, phone 713/575-3361 (fax: 575-4691); Conoco Remediation, Laurel Hendricks, 713/293-5513; Conoco Convenience Store, Escambia County, Pensacola, FL, Gordon Richmond, no phone number given; Conoco, Pinellas Park, Clearwater, FL, Keith Coffman, phone 713/293-3593.

Comments: System tends to be installation-intensive in that many wells may have to be installed if the site is large. System is flexible in operation. Biggest challenge is expanding the technology into non-petroleum hydrocarbon contaminants, especially chlorinated hydrocarbons. Several projects involving chlorinates are on-line, including a demonstration under the EPA "SITE" program.

Source of Information: TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Air Sparging***Technology Name :** In Situ Soil Ventilation and Heating**Application :** In-situ (vadose zone)
In-situ (saturated zone)**Brief Description :** The technology heats and air sparges the saturated and unsaturated zone causing evaporation and biodegradation of hazardous organics. Furthermore, the method causes fluidization of low viscosity hazardous contaminants. The method has been proven to "remove" 90 percent of the total content of hazardous components.**Company Name/POC:** Carl Bro Energy & Environment/Nils Bull/Torsten Toksvad**Address :** Granskoven 8/DK-2600 Glostrup, Denmark**Phone Number :** 45 43 48 66 11**Fax Number :** 45 43 96 44 14**Technology Maturity :** Commercial use experience**Performance History :** Contact company for performance history.**Comments :** None.**Source of Information :** International TechCon

GROUND WATER

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Air Sparging

Technology Name : Air Sparging

Application : In-situ (saturated zone)

Brief Description : Air sparging essentially creates a crude air stripper in the subsurface zone, with the saturated soil column acting as the packing. Injected air flows through the water columns over the packing, and air bubbles contacting dissolved/adsorbed-phase contaminants cause the VOCs to volatilize. The entrained organics are then carried by the air bubbles into the vadose zone where they can be captured by a vapor extraction system, or, if possible, allowed to escape through the ground surface. As a bonus, the sparged air maintains high dissolved oxygen, which enhances natural biodegradation.

Company Name/POC: Groundwater Technology, Inc./Richard Brown

Address : 310 Horizon Center Dr./Trenton, NJ 08691

Phone Number : 609 587 0300

Fax Number : 609 587-790

Technology Maturity : Commercial use experience

Performance History : Contact Groundwater Technology, Inc. for performance data.

Comments : The main limitation to the technology is the lack of or the blocking of effective air dispersion in the subsurface. If soil permeability is too low or the soils are highly layered, air sparging may not be effective due to the hindering of vertical (escape) air travel. The best sparge system design requires a field test that includes monitoring the following parameters: (1) Pressure vs. distance (this indicates radius); (2) VOC concentrations in groundwater (these indicate what is being removed and areas being affected and should be done before, during [with and without the system running], and after test) (3) CO₂ and O₂ levels in soil vapor (these indicate biological activity and should be done before, during, and after test for petroleum contamination sites, under static as well as pumping conditions) (4) Dissolved oxygen levels in water (these indicate effect and may be slower to see than air flow) (5) Water levels before and during test (air flow will cause some mounding). The ease and affordability of installing small-diameter air injection points allows considerable flexibility in the design and construction of a remediation system. The ability to install a dense grid of injection points without major site disruption or expense means that many of the problems associated with stagnation zones in wellfields may be avoided simply by completely covering the contaminated zone with injection points. Construction of the air injection points also allows fairly precise targeting of the aeration effect. The screened zone for these points is typically very short, providing a single point of aeration. If site investigation activities have identified zones or layers of either high contamination or aquifer heterogeneity, injection points may be dedicated to concentrate remediation activities on a specific zone.

Source of Information : TechCon

CONTAMINANTS :

- ☒ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Air Sparging***Technology Name :** Biosparge System**Application :** In-situ (saturated zone)

Brief Description : The BioSparge System is a patented closed-loop system of in situ remediation. It utilizes a designed system of gas injection wells combined with surrounding vapor extraction wells and a mobile surface treatment system to provide injection, capture and cleaning without gas venting and emissions. However, on a site-specific basis the in situ treatment of soil and groundwater can be combined with ex situ treatment for a more efficient removal of contaminants. For sites with chlorinated contaminants such as solvents or phenols (TCE, TCA, PCP), the BioSparge system is modified to include an ozone generator.

Company Name/POC: Hayward Baker Environmental, Inc./George K. Burke, P.E.**Address :** 1130 Annapolis Road/Odenton, Maryland 21113**Phone Number :** 410 551-1995**Fax Number :** 410 551-1900**Technology Maturity :** Commercial use experience

Performance History : The first full scale BioSparge remediation project was initiated in 1990 and since then four (4) sites have been completed. Two additional projects were recently initiated with one site using an Ozone Amended BioSparge unit to remediate pentachlorophenol (PCP). Sites have ranged from gasoline fuel stations and truck terminals to fuel distribution facilities.

Comments : The primary function of the BioSparge system is to create and maintain an environment in the subsurface which induces in situ biodegradation. Approximately 75 percent of the contaminants are degraded in situ with the remaining constituents being treated above ground in the treatment unit. The economy of the system is that the nonvolatile components are degraded in situ which reduces the remediation time to between 6 and 24 months for most sites.

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Air Sparging*

Technology Name : Vacuum-Vaporizer Well (UVB)

Application : In-situ (saturated zone)

Brief Description : The groundwater well has two separate screen segments, one at the aquifer bottom and one at the groundwater surface or below an aquitard in a confined aquifer. The water level rises inside the well due to negative pressure generated by a ventilator situated at the top of the well. Through a pipe connected to the vacuum reactor, fresh air is led through the raised water level under negative pressure conditions and stripping takes place. Rising air bubbles enhance the suction effect at the well bottom (air-lift effect). The groundwater entering the well through the lower screened segment is drawn upward through the well shaft, stripped of volatile contaminants, enriched with dissolved oxygen, and returns to the aquifer through the upper screened segment.

Company Name/POC: IEG Technologies Corp./Eric J. Klingel, Ph.D.

Address : 5015-D West W.T. Harris Blvd./Charlotte, North Carolina 28269

Phone Number : 704 599-4818

Fax Number : 704 509-481

Technology Maturity : Commercial use experience

Performance History : The UVB technology has been successfully demonstrated at bench scale, pilot scale, and full scale. Over 100 UVBs have been implemented over the last seven years in Germany and 13 in the U.S., mostly decontaminating aquifers polluted with volatile and semivolatile hydrocarbons and heavy metals. In addition, the UVB technology has been successful in bioremediating sites contaminated with pesticides. To date, five sites in Germany are considered completed, meaning the groundwater is remediated.

Comments : Metals are precipitated inside the well and removed via a sludge pump. A cation exchange column can be inserted into the well to remove ionic species. If the saturated zone is ten feet or less, the cost of application of this technology becomes prohibitive.

Source of Information : VISITT 3.0

CONTAMINANTS :☐ Pesticides/Herbicides☐ Heavy Metals☐ PCB☐ Explosives/Propellants☒ Petroleum Hydrocarbons☐ Radionuclides☐ SVOC☐ Other Contaminant☒ Nonhalogenated VOC☒ Halogenated VOC☐ N/A**TECHNOLOGY TYPE :** *Air Sparging***Technology Name :** In Situ Air Sparging (IAS)**Application :** In-situ (saturated zone)**Brief Description :**

A typical air sparging system will use a network of air sparging well-points. These are usually constructed of 2 inch PVC well pipe and are spaced close enough to have overlapping zone of influence for the air sparging. The well points are drilled to below the zone of groundwater contamination. A two to three foot pipe is extended to the surface. In operation, the air blown into the well points exits in the upper part of the well screen and then moves outward and upward through the groundwater. Air is usually injected at 2 to 3 psi over the hydrostatic pressure. The radius of the zone of influence of sparging around a well point is approximately 1 to 1.5 times the submerged depth of the well screen. The main applications for this approach are as a stand alone method for site remediation or to help accelerate and/or complete a standard pump and treat remediation project.

Company Name/POC: IT Corporation/John G. Morse**Address :** 312 Directors Drive/Knoxville, Tennessee 37923**Phone Number :** 615 690-3211**Fax Number :** 615 690-3626**Technology Maturity :** Commercial use experience

Performance History : IT is successfully implementing in-situ air sparging and biosparging at remediation sites throughout the United States. IT conducts the field pilot tests, biotreatability tests, manufactures the remediation equipment and designs, installs, and operates in-situ air sparging systems.

Comments :

Most applications of this remediation technique use soil vapor extraction along with the air sparging to remove the soil vapors that have stripped the volatile contaminants from the groundwater. In-situ air sparging is sometimes used without soil vapor extraction in a "biosparging" mode of operation. In biosparging, the primary mode of site remediation is through the introduction of oxygen and the resulting biodegradation of the contaminants.

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Air Sparging*

Technology Name : SparTech

Application : In-situ (vadose zone)
 In-situ (saturated zone)

Brief Description : Introduces air bubbling streams into groundwater through injection wells. Causes reduction in concentration of VOCs in aquifer and capillary fringe. Gases other than atmospheric air (N₂, CO₂, etc.) can be used to enhance or retard biological, chemical, or physical processes in groundwater or capillary fringe. Replaces or enhances groundwater pumping for aquifer restoration. Enhances soil vapor extraction for capillary fringe treatment.

Company Name/POC: MWR, Inc., Division of ETG Environmental, Inc./Frederick C. Payne, PhD

Address : 7707 Rickle Road/Lansing, Michigan 48917

Phone Number : 517 322-9311

Fax Number : 517 322-293

Technology Maturity : Commercial use experience

Performance History : 10 projects (2 complete, 5 in-progress, 3 installation phase).
 Groundwater concentrations have been reduced to health-based closure levels.
 Call F. Payne for confidential client contact information.

Comments : This is a small-footprint, field-mobile unit. Surface area requirement approximately 100 square feet. Power required (100 Amp, 220-volt, single-phase). Air discharge source control may be required. Capable of closed-loop operation. Aquifer sparging requires moderate to high pneumatic conductivity, without significant contrasting permeability stratification in the treatment zone. The design, installation and operation of aquifer sparging systems requires experience. Critical factors include depth in aquifer and length of air release points, air release rate, and air point field configuration. The technology is not applicable to heavy clays or in sites where injected air can escape laterally from recovery wells. Contaminants with high water solubility may be difficult to remove.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Air Sparging***Technology Name :** Air Sparging**Application :** In-situ (saturated zone)

Brief Description : Quaternary Investigations, Inc. (QI) has developed a groundwater air sparging system that provides in situ enhancement of air (oxygen) levels in groundwaters and volatilization of readily volatile compounds. The system is installed using QI's hydraulic installation unit and sealed below the groundwater surface level, providing maximum sparging efficiency. The air sparging system was designed to provide oxygen to groundwater thereby enhancing the naturally occurring hydrocarbon biodegrading microorganism population and increasing in situ bioremediation of contaminants. No emissions result from this system.

Company Name/POC: Quaternary Investigations, Inc. (QI)/Tony Morgan**Address :** 300 W. Olive St./Suite A/Colton, CA 92324**Phone Number :** 909 423-0740**Fax Number :** 909 423-0743**Technology Maturity :** Commercial use experience

Performance History : This system has been demonstrated successfully at the pilot scale. The system has been used to treat fuel related compounds and some chlorinated compounds. A pilot unit and a full-scale system have been constructed. Depending on the compounds, the system can achieve drinking water standards for many contaminants.

Comments : The system has provided the best results with readily biodegradable contaminants or volatile organic compounds that are removed following volatilization from the groundwater. The system is not applicable to metals or other inorganic wastes.

Source of Information : VISITT 3.0

GROUND WATER

CONTAMINANTS:

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : Air Sparging

Technology Name : Air-Sparging Vapor Extraction

Application : In-situ (vadose zone)

Brief Description : Sparge Vac is an effective method for remediation of vadose-zone soils and groundwater containing volatile and semi-volatile compounds. This method is more effective than the pump and treat technology because the volatile and semi-volatile components desorb much more readily into the gas phase than they do to the surrounding groundwater. This technology is particularly effective where large quantities of groundwater must be treated. Vapor extraction wells are installed into the vadose zone of the area of contamination with special care taken in the selection of well screening depths.

GROUND WATER

CONTAMINANTS:

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : Dual Phase Extraction

Technology Name : Vacuum Vaporizer Well

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : The Unterdruck-Verdampfer Brunnen (UVB) is an in situ system and uses a combination of chemical, physical and biologic processes. A UVB system consists of a specially adapted groundwater well, a negative pressure stripping reactor, an aboveground mounted blower, and a waste air decontamination system such as disposable granular activated carbon filters.

Company Name/POC: IEG - Industrie Eng./Marc R. Sick

Address : Lilienthalstr.6/D72770 Reutlingen, Germany

Phone Number : 49 7121 506665

Fax Number : 49 7121 57923

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

~12 cases in Germany; 10 reached closure within 7 years of operation.
~30 cases up and running in the U.S. since 1992.

Comments : This technology was accepted into the SITE Demonstration Program in 1993. The 6-month demonstration at March Air Force Base, California was to be completed in November 1993. Final report due in June 1995.

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Dual Phase Extraction***Technology Name :** Vacuum Enhanced Pumping (VEP)

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : The use of vacuum dewatering or vacuum enhanced pumping techniques is particularly beneficial in moderate to low permeability sediments consisting of silt and clayey material. Vacuum enhanced pumping also induces the volatilization of contaminants from the soils and aquifer material by vapor flow from the vadose zone and dewatered sediments. Vacuum Enhanced Pumping (VEP) uses a modification of vacuum dewatering techniques to extract groundwater, soil vapors and nonaqueous phase liquids from the subsurface. The IT VEP system uses passive airlift techniques and either a vacuum blower or pump to extract the fluids from the subsurface. This approach eliminates the need for electrical or pneumatic pumps in the wells, greatly increases the flow rate of fluids into the well and accelerates the remediation process.

Company Name/POC: IT Corporation/Mike Capps**Address :** 312 Directors Drive/Knoxville, Tennessee 37923**Phone Number :** 615 690-3211**Fax Number :** 615 690-3626**Technology Maturity :** Commercial use experience

Performance History : Vacuum Enhanced Pumping or vacuum dewatering techniques are being applied by numerous remediation contractors. IT has completed or is implementing VEP systems at over 30 sites during the last two years. IT has several pilot test systems that are used at locations throughout the United States. The VEP approach is particularly advantageous at sites with free phase gasoline or with relatively low permeability soils. VEP's performance is far superior to conventional gravity pumping systems with low fluid yields and significant mechanical problems.

Comments : The only limitation to this approach is the local regulatory requirements for air and water discharges. If the air discharging from the vacuum system has high concentrations of hydrocarbons or other VOCs, then either vapor phase carbon, thermal or photocatalytic oxidation treatment may be required. Groundwater can be discharged directly if an NPDES permit is obtained or to a POTW. Groundwater can also be reinfiltrated on site if conditions and regulations permit. Treatment of groundwater is usually with low profile tray aeration and carbon polishing if needed.

Source of Information : VISITT 3.0

GROUND WATER

CONTAMINANTS : ☒ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Hot Water or Steam Flushing/Stripping*

Technology Name : AQUADETOX/SVE Integrated System

Application : In-situ (vadose zone) Ex-situ
In-situ (saturated zone)

Brief Description : A low-pressure steam-stripping technology for the removal of volatile organic compounds (VOCs) from the groundwater, and a soil vapor extraction (SVE) system that treats VOCs from the soil. This system is capable of simultaneously cleaning soil and groundwater without emitting pollutants into the air. The advantages include a closed-loop system with no air emissions (reduced cost) and a removal efficiency in excess of 99.9 percent for groundwater and >99 percent for soil vapor treatment.

Company Name/POC: DOW Environmental/C.J. Davenport

Address : 15204 Omega Drive/Suite 200/Rockville, Maryland 02850

Phone Number : 713 978-3107

Fax Number : 713 978-295

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Approximately 45 to 50 units are in operation as of September 1993 ranging in size from 5 to 3,000 gpm with the average unit at 300 gpm. Unit experiences typical facility start-up problems which have been routinely resolved. More persistent problems which require pretreatment have been caused by high alkalinity of groundwater, biofouling, and high iron content, and scaling in the unit. Reference: Lockheed Aeronautical Systems Co., David Jensen (818) 847-0792; Exxon, Gary Hope (713) 425-5793.

Comments : SVE portion of unit requires fairly porous soils. The AQUADETOX system is completely computer controlled and after installed and tested requires only one trained operator. The operator will receive training from AWD along with detailed manuals of operation. The training is minimal and no unusual personnel skills are required.

Source of Information : TechCon

CONTAMINANTS :

- ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Hot Water or Steam Flushing/Stripping*

Technology Name : Integrated Steam Stripping/Condensation

Application : On-site Ex-situ

Brief Description : Integrated treatment system would reinject treated off-gases to increase subsurface gradients and augment removal. Condensation produces concentrated liquid organic phase.

Company Name/POC: Radian Corporation/Joe Milanowski

Address : 10150 West National Ave./Milwaukee, Wisconsin 53227

Phone Number : 414 327-9955

Fax Number : 414 327-2129

Technology Maturity : Pilot plant testing

Performance History : Hill AFB, Utah

Comments : Energy required to produce the steam off-gases. Aqueous-phase organics require additional treatment.

Presence of residual contaminants (i.e., nonvolatiles and metals) are better removed by other processes.

Source of Information : TechCon

GROUND WATER

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Hot Water or Steam Flushing/Stripping*

Technology Name : Contained Recovery of Oily Wastes (CROW)

Application : In-situ (saturated zone)

Brief Description : The process is in the in-situ recovery of oily wastes from the saturated zone by the injection of hot water and/or low-quality steam with or without chemicals to displace the contamination to production wells. The surrounding area is isolated laterally by the hydraulic gradients produced by the production and injection wells. Vertical containment of potential vapor emission is accomplished by a cold-water cap. Removal rates vary with waste characteristics and can be as high as the mid 90% range.

Company Name/POC: Western Research Institute/Lyle Johnson Jr.

Address : 365 N. 9th/Laramie, WY 82070

Phone Number : 307 721-2281

Fax Number : 307 721-223

Technology Maturity : Field demo complete

Performance History : 1. Treatability studies with wood treatment and MPG plant contaminants, 70-95% removal.
2. Pilot tests at a wood treatment facility, 80-85% removal, going to full scale.
3. Full-scale remediation of MPG site; 75% removal without chemical, 90%+ removal with chemical from treatability study; work in progress.

Comments : Limited access required for well placement; need hot water or steam generation facility; electricity/gas; and water treatment for produced effluent. For the technology to be functional, the ability to inject fluid into and produce effluent from the contaminated area at a rate sufficient to heat the contaminants is required. This injection/production ability is the only limiting factor. The technology is easy to apply and readily adaptable to varying in-situ conditions. Skills required are well design, drilling and completion, knowledge of two-phase flow, hot water/steam generation and water treatment. WRI has the infrastructure available for this technology and can assist any competent environmental contractor with its implementation.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Passive Treatment Walls*

Technology Name : Metal-Enhanced Abiotic Degradation of Chlorinated Organic Compounds

Application : In-situ (saturated zone) Ex-situ

Brief Description : The EnviroMetal process enhances the abiotic degradation of groundwater containing dissolved halogenated methanes, ethanes and ethenes by using a metal (usually iron) to cause the rapid substitution of chlorine atoms by hydrogen atoms. The contaminant concentration can reach non-detect given sufficient residence times. A major use of the technology will be as a passive in-situ treatment method; however, the technology has the potential to replace air stripping, activated carbon and advanced photo or thermal oxidation systems. Advantages: adaptable for in-situ passive treatment; the reaction requires no external energy source or additives (e.g., nutrients); the reactants are relatively inexpensive; the contaminants are degraded rather than transferred to another medium; and, applicable for a wide range of chlorinated organic compounds.

Company Name/POC: EnviroMetal Technologies, Inc./John Vogan

Address : 42 Arrow Road/Guelph Ontario Canada N1K 1S6

Phone Number : 519 824-0432

Fax Number : 519 763-2378

Technology Maturity : Field demo complete

Performance History : Performance data are available. Industrial Facility California: The objective of studies at this site is to examine the feasibility of installing an in-situ permeable wall containing reactive media. Volatile organic compounds in groundwater beneath this facility, including trichloroethene, cis-1,2-dichloroethene, vinyl chloride and Freon 113, were degraded rapidly in laboratory column studies with reactive media containing 15 percent iron. Industrial Facility, New Jersey: The shallow bedrock groundwater beneath this facility contains up to 15 mg/L tetrachloroethene and 1 mg/L TCE. The groundwater is to be collected in shallow trenches and directed into a treatment system containing a high percentage of iron. Military Facility, Minnesota: The Minnesota Pollution Control Agency has sponsored a laboratory study to determine if the EnviroMetal process can treat PCE, TCE and cis-1,2-DCE in groundwater from a military facility in Minnesota. DOE Facility, Hanford, Washington: Successful laboratory tests were performed to demonstrate the technology's effectiveness in degrading carbon tetrachloride, trichloromethane, and trichloroethane in groundwater from the Hanford site.

Comments : The in-situ application limitation may be inorganic precipitates within the treatment section which may require removal every 5-10 years. The ex-situ application currently appears limited to flow rates of 10 gpm or less and/or low concentrations due to the residence time required and the corresponding size of vessel needed. Although the process has been shown to degrade most chlorinated VOCs, dichloromethane, chloromethane, and 1,2-dichloroethane have not been degraded in tests to date. BTEX compounds will also not degrade, based on previous test results. The process is easy and cost effective to use due to a phased approach. Phase 1 is a feasibility evaluation using data reviews or laboratory tests to determine if the site geochemical and hydrogeologic conditions can support the process. Phase 2 is a pilot-scale field test to confirm laboratory results and to develop design parameters required for full-scale implementation. Phase 3 will include construction, commissioning and monitoring of the full-scale treatment system. The personnel skills and construction techniques should be readily available from ETI or others.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Passive Treatment Walls***Technology Name :** Electrochemical Barriers**Application :** In-situ (vadose zone)
In-situ (saturated zone)**Brief Description :** Electrokinetic (EK) "fences" - underground permeable (to H₂O) barrier (to metal ion and nuclides)**Company Name/POC:** Geokinetics/Dr. Lageman**Address :** Dannenberg 16, 7461 TK/Rijssen, NL**Phone Number :** 05480-40584**Fax Number :** 5485 4069**Technology Maturity :** Commercial use experience**Performance History :** Conceptual, based on proven EK technology. Contact company for performance data.**Comments :** Extent of barrier wall can be up to 100m deep and 1/2km wide.**Source of Information :** International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Passive Treatment Walls***Technology Name :** In-Situ Trench Stripping (ISTS)**Application :** In-situ (saturated zone)

Brief Description : ISTS strips volatile organics from groundwater as it flows through an engineered packed trench or well installed across the aquifer. Stripping is achieved with an upward air flow, injected at the bottom of, and extracted at the top of the packed trench or well. May eliminate the need for groundwater pumping, passively relying on natural groundwater flow to cross the trench. Achieves stripping in a controlled medium (engineered, typically gravel packed trench or well).

Company Name/POC: GRS/Pier Mantovani**Address :** 13 Villa Croix Nivert/75015 Paris, France**Phone Number :** 33 1 53 69 61 80**Fax Number :** 33 4734 6855**Technology Maturity :**

Bench scale testing, only

Performance History : In-situ well stripping is widely used and successfully implemented by other vendors on VOC contaminated aquifers in Europe. In-trench stripping is not demonstrated yet full-scale.

Comments : ISTS is limited to aquifers less than 30 ft. deep, preferably non-fractured. ISTS applies to all VOCs. ISTS is not limited by low aquifer permeabilities. ISTS aims to achieve semi-passive groundwater treatment (no pumping). Operations can be expected to be unmanned, except for daily or weekly inspections and maintenance by technician. Periodic groundwater monitoring and sampling results are interpreted by a hydrologist. When implemented without pumping, ISTS provides semi-passive aquifer remediation, resulting in long treatment times. Scaling, fouling, clogging of packed material must be prevented or controlled. Beyond the obvious application to volatile organics, ISTS can also be implemented to achieve bioremediation of degradable dissolved organics. This is achieved through simple aeration, and/or nutrient and bacterial additions. Residuals include: Extracted vapors (to be treated on-site by adsorption, oxidation or biofiltration - can be recycled) treated and contaminated soils and/or water generated during trench construction or dewatering stages, also needing on-site or TSD treatment.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Containment***Technology Name :** Asphaltic Concrete Linings**Application :** On-site Ex-situ**Brief Description :** Asphaltic concrete can be designed to a high level of impermeability as a containment barrier to the passage of liquids and gasses. Having over 60 years proven performance in dam construction and other water retaining structures the technology now has a track record in continental Europe as a flexible lining membrane in a landfill environment.**Company Name/POC:** Alfred McAlpine Asphalt Limited/Alan W. Christie**Address :** Ashton Road/Billinge, Near Wigan/Lancashire, WN5 7XY, U.K.**Phone Number :** 1744 892481**Fax Number :** 1744 89320**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.

Early 1940;s to date - Numerous hydraulic schemes worldwide have experience with this material.

1979 to date - Switzerland has approx 15 landfill sites using asphaltic concrete as a containment barrier and is one of three approved methods.

1993 to date - Other European countries now examining the material.

Comments : Most specialist asphalt manufacturers and contractors could use this material given the necessary training skills and technical support. A support pack is available from the company on this technology and includes:

- Independent report from Harwell Laboratory on the performance
- Various technical papers on the use of the material in continental Europe
- UK Patent Certificate

- Technical papers from the UK

- The material has the support of the UK National Rivers Authority

- Has now been included in the draft document for Consultation of Waste -management

Paper 26B,

Landfill Design Construction and Operational Practice

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Containment*

Technology Name : Treatment Agents for In-Situ Infiltration

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : This technology uses modified natural clays (MNCs) to immobilize target contaminants such as heavy metals, radionuclides, and organics. The MNCs can be directly mixed into the material containing the contaminants or can be molded or injected to form in-situ barriers, preventing contaminant migration. MNCs drastically reduce contaminant migration by restricting hydraulic conductivity through a barrier constructed of MNCs and by providing reactive surfaces for contaminant adsorption and immobilization. MNCs, especially combined with binding agents, will impede the flow of contaminated-laden soil moisture and groundwater.

Company Name/POC: Fluid Tech, Inc./Dean Rowsell

Address : 4335 West Tropicana Avenue/Suite 3/Las Vegas, NV 89103

Phone Number : 702 871 1884

Fax Number : 702 871-3629

Technology Maturity : Pilot plant testing

Performance History : In-situ immobilization currently under R&D.

Comments : Treatability testing is required to formulate reagent for waste streams of peculiar characteristics (high salt concentrations, high level of chelating or complexing agents). Acidic, basic, reductive, and oxidative waste streams may require pretreatment. Slurried clay is easy to work with, requires less infrastructure than grout, and can be applied in many environments and remains stable (clays form in soils). The greatest challenge to this technology is bringing an awareness of the use of the technology to potential users. Matching MNC to the need in very complex environments requires bench testing. Finally, finding reliable data is difficult for comparison of critical factors such as volume expansion, thermodynamic stability in soils, susceptibility to freeze/thaw cycle stresses, stability to heat or radioactive decay, and energy usage, product cost, and final waste form disposal charges.

Source of Information : TechCon

GROUND WATER

CONTAMINANTS:

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Containment

Technology Name : Cut Off Walls/Hydrodynamic Isolation

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : The method isolates and fixates hazardous waste through the use of bentonite, slurry, synthetic and clay membranes, hydrodynamic barriers, caps and liners.

Company Name/POC: GZA Geoenvironmental, Inc./John J. Balco

Address : 320 Needham Street/Newton Upper Falls, Massachusetts 02164

Phone Number : 617 969-0700

Fax Number : 615 965-776

Technology Maturity : Commercial use experience

Performance History : Performance data area available.

Comments :

Technology with/without heating used on 9 sites (250 m [squared] to 22,000 m [squared]) in Holland, Germany and Denmark. First project initiated in 1992 and two projects are in operation in Copenhagen. Projects are successful except 1 which did not function, due to flooding of the area. Clients include oil companies (BP) and OM, Denmark.

The main limitation for the technology is the presence of very low permeable layers like clay, unless the contamination is mainly limited to fissures or fractures in the low permeable layer. The technology is simple to use with high flexibility to work with highly varying volume and areal distribution of contamination. The technology is self-running, but needs monitoring to secure a cost beneficial operation and the necessary documentation of the remediation activities to the relevant authorities. The company has 4 units.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : Vacuum Vapor Extraction

Technology Name : VACU-POINT

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Vacuum vapor extraction rapidly removes contamination from soil and groundwater and produces rapid site cleanup. In some cases, WES has remediated sites under 90 days. This technology has been tested and proven reliable and is now accepted by Florida Department of Environmental Protection (FDEP) as a short-term remedial technique.

Company Name/POC: W.E.S. Environmental Division/Anthony DeLoach

Address : 6389 Tower Lane/Sarasota, Florida 34240

Phone Number : 941 371-7617

Fax Number : 941 378-5218

Technology Maturity : Commercial use experience Field demo complete

Performance History : WES has successfully demonstrated and pilot-tested more than 12 projects and installed four systems which have either remediated or reduced contaminants completely.

Chevron USA - 45 GPM, no problems. W.D. Howard 404 984-3085
Amoco Oil - 4 projects, 1-100 GPM no problems. Bill Batts 813 661-4839
Chevron USA - 55 GPM, no problems. John Machen 404 984-3192

Comments : This technology works well in sandy and tighter clay conditions. If water disposal after treatment is not possible, this creates a problem. For use where both groundwater and saturated soil are contaminated and the client wishes to reduce cleanup time at an accelerated rate. Examples include landfills, industrial sites, pipeline leaks, underground storage tanks, and fuel spills. VACU-POINT is a patented and trademarked technology developed by W.E.S. Environmental Division for the rapid cleanup of contaminated water and soil. To date, the State of Florida has classified this technology as a "Short-Term Remedial Approach" to site restoration.

Source of Information : TechCon

GROUND WATER

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Bioreactors*

Technology Name : Bionergies, Biosmose, Biosurf

Application : In-situ (vadose zone) Off-site Ex-situ
In-situ (saturated zone)

Brief Description : Bioremediation of organic pollutions (in soils, water, effluents) by using: 1. exogenous specific bacterial consortium (non toxic, environment safe, European Federation of Biotechnology class I in order to control a full, complete and non selective biodegradation. 2. Biofixations (mineral natural support). 3. Biosurfactants (produced by selected bacteria) provide an effective, fast and secure alternative to common place bioremediation because Bionergies controls the biodegradation of the pollutant (and metabolites) by using specialized bacteria and feasibility tests (in labs, on the field).

Company Name/POC: Bionergies Laboratories, Biosurf/M. Jacques FAUDIN

Address : 59/100, rue des 4 termes/B.P. 1009/Z.I. des Paluds/13781 AUBAGNE Cedex, France

Phone Number : 33 42 84 30 07

Fax Number : 33 42 84 23 3

Technology Maturity : Commercial use experience

Performance History : Contact company for performance data.

Comments : Each case is analyzed in order to optimize the treatment and the on site materials and personnel. Bioenergies controls the bacterial action by using exogenous specific bacterial strains, biofixations and biosurfactants. None of the bacteria is genetically engineered. They are classified into class I (one) of the European Federation of Biotechnology, and produced under French and European Community regulations. The company is looking for join-ventures in U.S. in order to cover the environmental and industrial field.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Bioreactors*

Technology Name : GAC Fluid Bed Reactor

Application : On-site Ex-situ

Brief Description : The GAC-Fluid Bed Reactor employs biological treatment and activated carbon adsorption in a single vessel. The bioreactor is utilized to treat a wide variety of toxic organic compounds in water. Removal efficiencies typically exceed 95+ percent, with final effluent concentrations of specific organics in the low ppb range.

Company Name/POC: Envirex, Inc./Michael Doyle, P.E.

Address : 1901 South Prairie Avenue/ Waukesha, Wisconsin 53186

Phone Number : 414 547-0141

Fax Number : 414 547 4120

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Comments :

Envirex currently has more than 20 full-scale fluidized bed reactor systems in operation or in the design stage throughout the U.S. The full-scale systems range in size from the Model 30 skid-mounted unit (20 degrees dia. reactor) to a 36 MGD denitrification application on municipal wastewater. The largest GAC-FBR installation treats up to 4,000 gpm of gasoline-contaminated groundwater at a decommissioned refinery, and has been operating successfully for over two years. Some typical performance data is on file. While this data focuses primarily on BTEX compounds, Envirex has a broad database of other specific organic compounds. Client list: Chevron, BP Oil, Shell Oil, Northville Industries, Celgene, Monsanto, Formosa Plastics, Groundwater Technology, Inc., The Adverit Group, E.I. DuPont, Upjohn, Ciba-Geigy, Arco Pipeline, Gulf Power.

Not applicable for inorganic contaminants such as sulfates, chlorides, radionuclides. Not generally applicable for heavy metals or non-biodegradable organics such as PCBs, dioxin, perchloroethylene, and trichloroethylene (though research on methanotrophic TCE degradation is being conducted). The GAC-FBR has been engineered to provide a high degree of automation with low manpower demand. Manpower requirements range from 1-4 hours/day, typically. Routine maintenance of rotating equipment (pumps and compressors) and electrical powered controls systems is required. Understanding of biological treatment by operating personnel is helpful, but not required as Envirex provides process support. Operator assistance can be provided by Envirex's field personnel through a service contract.

Source of Information : TechCon

GROUND WATER

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☒ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Bioreactors*

Technology Name : Soil Flushing & Bioremediation

Application : On-site Ex-situ

Brief Description : EODT Services has several in-situ treatment methods. One of these methods is soil flushing and in-situ bioremediation of ground water, which involves the elutriation of organic and/or inorganic contaminants from soil for removal and treatment. First the site is flooded with appropriate washing solution/biodispersant, and then elutriate is collected in a series of shallow wellpoints or subsurface drains. The elutriate is then treated above ground within a liquid phase bioreactor and then released into the ground water table. Depending on the subsurface soil condition, bacteria is also recirculated into the subsurface soil to enhance the biodegradation.

Company Name/POC: EODT Services, Inc./Paul Greene, Monirul Haque

Address : 10511 Hardin Valley Road/Building C/Knoxville, Tennessee 37932

Phone Number : 423 690-6061

Fax Number : 423 690-606

Technology Maturity : Pilot plant testing

Performance History : Not available.

Comments : The key component of this process is the biodispersant which basically desorbs the contaminant chemical and also serves as a high energy nutrient for the microorganisms.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Bioreactors*

Technology Name : Biological Groundwater Treatment (Biopur)

Application : On-site Ex-situ

Brief Description : Biological treatment of contaminated groundwater and soil vapor in a fixed film bioreactor.

Company Name/POC: Maple Environmental Services Ltd./John Haanstra

Address : 201 County Court Blvd/Suite 600/Brampton, Ontario 16W 4L2

Phone Number : 905 457-6444

Fax Number : 905 457-2498

Technology Maturity : Commercial use experience

Performance History : First successful pilot installation in 1989. Since then 40-50 full scale applications.

Comments : After start up and commissioning a minimal amount of maintenance is required. Can be remotely monitored by computer modem. A skilled equipment operator can maintain system on a part time (1 hr/day) basis. Biopur system is well proven. The present challenge to design system suitable for the treatment of complex chlorinated hydrocarbons, contaminated groundwater, and soil vapor.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Bioreactors***Technology Name :** AQUAFERM (R)**Application:**

On-site

Ex-situ

Brief Description : Contaminants in extracted groundwater are put into contact with micro organisms through attached systems. The microorganisms are established on an inert support matrix to denitrificate, to aerobical degradation of contaminants.

Company Name/POC: Umweltschutz Nord GmbH/Hans-Peter Ratzke**Address :** Industrie Park 6, 27767 Ganderkesee/ Germany**Phone Number :** 49 4222 47 106**Fax Number :** 49 4222 47 142**Technology Maturity :** Commercial use experience**Performance History :** Contact company for performance data.

Comments : In general for biological treatment of biodegradable contaminants, constant charges as well as constant quality of the pollutants are needed. Mobile treatment plants, offer high flexibility and control standard operation. Exhausting air treatment for aerobic reactors is needed.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Bioreactors*

Technology Name : On-site Biological Treatment of Leachate

Application : On-site Ex-situ

Brief Description : On-site biological treatment of leachate contaminated with aerobically biodegradable compounds in suspended continuous reactors. The technique is applicable in cases with concentrations in the ppm level or in a modified concept in the ppb level with the addition of primary substances. The reactor consists of a stirred full-scale chemostat with feedback control of oxygen and other important parameters governing the aerobic process. In most cases, a starter culture is added to the reactor, and the flow rate is adjusted in the initial phase with the adaptation of the culture.

Company Name/POC: VKI Water Quality Institute/Bjorn Jensen

Address : Agern Alle 11/DK 2970 Hoersholm, Denmark

Phone Number : 45 42 86 52 11

Fax Number : 45 42 86 72 73

Technology Maturity : Pilot plant testing

Performance History : The prototype has not been applied full scale, but has been developed on a test scale. The biodegradation kinetics for most relevant compounds have been modelled.

Comments : The technology requires that the compounds are pumped up to the ground level before they can be treated, which in some cases might be a problem because of the inhomogeneities of the subsurface geology or partitioning of the contamination.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Bioreactors***Technology Name :** BIO-WASH**Application :** On-site Ex-situ

Brief Description : W.E.S. Environmental Division has its own R&D group that has tested both vegetative and spore bacteria to break down various types of organic contaminants such as benzene, toluene, xylene, acetone and waste oil. Some tests have been conducted on radioactive nuclei, but are still under testing with W.E.S. The biological approach eliminates the need to dispose of a residue that is hazardous. Normal process allows end-user to dispose of process waste as non-hazardous material after the bacteria has digested the organics.

Company Name/POC: W.E.S. Environmental Division/Anthony DeLoach**Address :** 6389 Tower Lane/Sarasota, Florida 34240**Phone Number :** 941 371-7617**Fax Number :** 941 378-521**Technology Maturity :** Commercial use experience**Performance History :** Bill DeLoach, DeLoach Industries 813 371-4995 - Acetone treatment

W.D. Howard, Chevron USA 404 984-3085 - hydrocarbon treatment

Comments : High levels of chlorinated solvents will destroy bacteria growth. Contact time must be insured for proper treatment and acclimation. Once product has been acclimated to organic selection, the use of it is very simple and flexible.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Filtration*

Technology Name : High Efficiency Filter

Application : On-site Ex-situ

Brief Description : This technology is a non-precoat, air backwashable, high efficiency filter. Filter media is chemical and radiation resistant. Filter pore size can be <0.1 microns. Replaces precoat and fiber filters that generate greater, overall waste volume. It is air back-washable, thus eliminating back-wash water volume. Filter module can be made in different sizes and flow rates.

Company Name/POC: ADTECHS, Inc. (a wholly owned subsidiary of JGC Corp.)/Ken Sauda, Dennis Wilkie

Address : 2411 Dulles Corner Park/Suite 520/Herndon, Virginia 22071

Phone Number : 703 713-9000

Fax Number : 703 713-9101

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Currently used in fossil power plant water filtration. Used in nuclear power plant liquid radwaste processing systems where low backwash waste volume is important.

Comments : Filter modules are mounted inside a pressure vessel. Upper temperature limit is 185 degrees F. Pore size can vary, but is normally $\approx$ 0.5 μ m. Therefore, filter is applicable as a final filter. Filter modules are mounted in an in-line pressure vessel that can be automatically or manually backwashed.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Filtration*

Technology Name : Uranium removal from groundwater

Application : ☐ On-site ☐ Ex-situ

Brief Description : A filter system, known as EXPURRT, was developed for removing uranium and radium from drinking water. The removal methods are based on ion exchange and sorption. The filter system was developed to the commercial stage and tested in a household water supply for a two year period. A larger-scale system was designed and successfully tested for removing U from harbour water. The technology is 90 percent efficient for U removal and 70 percent efficient for Ra removal. This technology is very selective for U and Ra. It is both very inexpensive and very efficient.

Company Name/POC: AECL Research/C. A. McDowall

Address : Whiteshell Laboratories/Pinawa, Manitoba, R0 E1L0, Canada

Phone Number : 204 753-2311

Fax Number : 204 753-292

Technology Maturity : ☐ Field demo complete

Performance History : There has been one major long term test (tested in a household water supply (well) for a two year period), several short term lab tests, and one commercial pilot scale industrial test for the Low Level Waste Management Office AECL, Ottawa, Ontario; Contact: Dennis Main; Tel: (613) 273-3270.

Comments : Suspended sediment will block the filters and there is a finite chemical capacity for the filters (spent filters must be replaced). There is also a need for the disposal of spent material. This technology is easy to use for small-scale operations. Minimal infrastructure is required and the skills requirement is low. Larger scale operations will require some increase in infrastructure and training. There is a possibility for the regeneration and reuse of the uranium filters rather than disposing of them.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Filtration*

Technology Name : Microfiltration

Application : On-site Ex-situ

Brief Description : Fine microfiltration of precipitated metals with tight, low-cost Tyvek (R) T-980 filtration media and patented Profix stabilization agent (to pass TCLP) in a fully-automatic Oberlin automatic pressure filter (APF).

Company Name/POC: DuPont/Dr. Ernest Mayer

Address : Engineering Dept. L1359/P.O. Box 6090/Newark, Delaware 19714///Oberlin. Filter Co./Mr. Mike Hughs/404 Pilot Court/Waukesha, WI 53188

Phone Number : 302 774-1000

Fax Number : 302 774-7321

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Comments : Demonstrations: Industrial partnerships/collaboration potential: participated in USEPA SITE program (w/Oberlin & Enviroguard Mfg. of Profix Stabilization Agent), John Martin, Cincinnati, Ohio; working w/SRS on various wastes; testing other hazardous waste (Oberlin/DuPont/Enviroguard).

Utilities required for the DuPont/Oberlin microfiltration technology demonstration included water, electricity and telephone service. Flow rates above about 250 gpm require multiple units. Easy to use and implement (6 installations that are operational and functioning well); minimal personnel skill required since simple.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Filtration***Technology Name :** Membrane Filtration of Soil Washing Water**Application :** On-site ☒ Ex-situ ☒**Brief Description :** Filters heavy metals and radionuclides from soil washing water to removal levels in the range of 0.05-.001 ppm. Replaces clarification and sand filtration and ion exchange. Advantages are consistently lower discharge concentrations and lower cost of operation. Works on high concentration feed sources.**Company Name/POC:** MEMTEK Corporation/Jayne Caterino**Address :** 28 Cook Street, Billerica, Massachusetts 01821**Phone Number :** 508 667-2828**Fax Number :** 508 667-173**Technology Maturity :** Commercial use experience**Performance History :** UMTRA Cleanup projects at Cannonsburg PA; Lakewood OR; Vitro UT; Grand Junction CO; Rifle CO. Contact Erich Tiepel, Research Technology Group, 303 969-8511.**Comments :** Limited experience with organic removal, other than oil and grease. BOD and COD. Treatability test determines treatment chemistry and filtration rate to size full-scale system. System very flexible to changes in feed-stream composition. Knowledgeable licensed wastewater treatment plant operator needed. This technology has proven itself in UMTRA remediation programs. It is directly applicable to waters produced from soil washing extraction processes.**Source of Information :** TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Ion Exchange*

Technology Name : Radionuclide Separation Process (RASEP)

Application : On-site Ex-situ

Brief Description : This process provides for the selective removal of radioactive metallic ions, only, from liquid waste streams. Process uses filtration, selective adsorption, and electrodeposition fixation followed by cement solidification.

Company Name/POC: ADTECHS, Inc. (a wholly owned subsidiary of JGC Corp.)/Dennis Wilkie

Address : 2411 Dulles Corner Park/Suite 520/Herndon, Virginia 22071

Phone Number : 703 713-9000

Fax Number : 703 713-9101

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Comments :

The technology was developed for the selective removal of radioactive nuclides from a nuclear power plant liquid waste stream. Development program was sponsored by five large Japanese utilities with nuclear power plants.

Comparable to other ion exchange systems. This technology is used by nuclear power plants in fuel reprocessing. To date, it has been used exclusively in Japan.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Ion Exchange*

Technology Name : Uranium Selective Chelate Resin

Application : On-site Ex-situ

Brief Description : This ion exchange resin, which is highly selective for removing uranium, is used to treat liquid waste streams.

Company Name/POC: ADTECHS, Inc. (a wholly owned subsidiary of JGC Corp.)/Ken Sauda, Dennis Wilkie

Address : 2411 Dulles Corner Park/Suite 520/Herndon, Virginia 22071

Phone Number : 703 713-9000

Fax Number : 703 713-910

Technology Maturity : Commercial use experience

Performance History : This technology is used in Japan in fuel reprocessing and in combination with other resins in nuclear power plants liquid waste stream processing.

Comments : System is safer to operate than those that use H₂SO₄ and NaOH. Initial resin charge is more expensive than other less selective resins.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Ion Exchange*

Technology Name : Forager (TM) Sponge for Heavy Metals

Application : In-situ (vadose zone) Off-site Ex-situ
In-situ (saturated zone)

Brief Description : FORAGER (TM) Sponge selectively removes heavy metals from water. This is accomplished by virtue of a proprietary chelating resin deposited within small (1-cm) cubes of open cell cellulosic sponge. A multitude of the cubes is disposed within a vertical column through which water is passed. Flow rates of 0.1 bvm achieve 90+percent removals. Because of the low cost and high absorption capacity of FORAGER (TM) Sponge, one-time-use and disposal is economically feasible. This product can be used on dirty or mixed-waste streams or sludges that would ruin conventional bead form resins.

Company Name/POC: Dynaphore, Inc./N. Rainer

Address : 2709 Willard Rd/Richmond, Virginia 23294

Phone Number : 804 288-7109

Fax Number : 804 282-1325

Technology Maturity : Field demo complete

Performance History : FORAGER (TM) Sponge is currently being sold in 8 gal. modular drums for the treatment of small volume industrial effluents. Most of the users are either reluctant to talk about results obtained, or do not have accurate data concerning performance. A preliminary trial was run at an EPA Superfund (Groundwater) site in early 1993. 90 + percent removals were achieved for Cd, Cu, Pb, and V. 70 + percent removals were achieved for Cr, Hg, Zn, and Ni.

Comments : Will not remove Rb, Cs. Will remove Sr, Ba, and Ra only in the absence of Ca. A multi-column installation employing FORAGER (TM) Sponge involves no moving parts except for a pump. In those installations which include valves for staging or sequencing operations, manipulation of the valve is simple, and can be automated. A single semi-skilled operator can handle units having flow rates of 2-20 gallons/min. Because the system can be trailer mounted, it can easily service effluents in different locations.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Ion Exchange*

Technology Name : Water Treatment Process

Application : ☐ On-site ☐ Ex-situ

Brief Description : Combined ion exchange and reverse osmosis treatment of uranium containing eluate. Radium removal by a radium selective ion exchange-complexer. Precipitation of arsenic by addition of ferric chloride. Flotation of ferric-arsenic sludge. Immobilization of the contaminated material by solidification with fly ash and additional activities. Deposition of the final residues.

Company Name/POC: URT Umwelttechnik GmbH/Gerd Braun

Address : 50354 Hurth/Siemensstr. 1/Germany

Phone Number : 02233 7994 0

Fax Number : 02233 7819

Technology Maturity : Commercial use experience

Performance History : Contact company for performance history.

Comments : This process targets uranium mill tailings.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Precipitation*

Technology Name : Autocatalytic Fluid Bed Heavy Metal Removal Plant

Application : On-site Ex-situ

Brief Description : The plant is a fluid bed reactor, capable of removing up to 99 percent of heavy metals and organic matter in water. The process is adsorption-coprecipitation on a granular medium.

Company Name/POC: Kruger A.S./Kurt Ambo Nielsen

Address : 363 Gladsaxevejs/2860 Soeborg, Denmark

Phone Number : 011 45 396 90222

Fax Number : 011 45 31674950

Technology Maturity : Commercial use experience

Performance History : Experience with 5 m(3)/hr plant used for chromate removal from flash leachate over 2.5 years. 95 percent removal.
Pilot plant experiments with arsenic, nickel. 90-95 percent removal.
Bench scale with organics. Up to 99 percent removal.
Batch experiments with Zn, Se, Cd.

Comments : High implementation potential. Easy to construct and operate. Needs little space.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Ultraviolet Oxidation*

Technology Name : Titanium Dioxide Photocatalytic Treatment Systems

Application : On-site Ex-situ

Brief Description : Removes and destroys organic pollutants in air and water.
 Fixed TiO₂ semiconductor and UV light generate hydroxyl radicals which readily attack and destroy organic pollutants.
 Typical VOC removal in air is 1200 ppm TCE, PCE, removal at 50 CFM; 7.7 kW system.
 Typical VOC removal in water - BTEX destruction nominally 25 ppm/minute retention time.

Company Name/POC: Matrix Photocatalytic, Inc. (formerly NuTech)/Bob Henderson

Address : 22 Pegler St./London, Ontario, Canada N5W 4C8

Phone Number : 519 660-8669

Fax Number : 519 660-852

Technology Maturity : Field demo complete

Performance History : 23 units produced to date
 Specific customer information is proprietary (contact Matrix Photocatalytic, Inc.)
 Successful pilot test at Savannah River for soil vapor extraction

Comments : Limitations include (1) Flow rates greater than: air 1000 CFM, water 100 GPM;
 (2) certain organic compounds are refractory and take extensive time to break down

Equipment is very simple and easy to install (one man, 4 hours)
 Uses common hand tools
 Maintenance procedure is easy to follow and only required every 5000 hours
 Equipment is very mobile and can easily be moved from site to site
 Equipment is modular in construction, therefore can easily be increased/decreased as flow rates vary over time

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Ultraviolet Oxidation***Technology Name :** Rayox**Application :** On-site Ex-situ

Brief Description : Ultraviolet oxidation uses hydrogen peroxide catalyzed by UV light to quickly oxidize and decompose toxic organics in ground or process water with no residual by-products. Replaces carbon or airstripping; destroys contaminants rather than transferring them to other media or concentrate. Contaminates treated include: TCE, PCE, DCE, BTEX, TNT, DNT, vinyl chloride, NDMA, chlorobenzene, 1,4-dioxane, PCP and phenols.

Company Name/POC: Solarchem Environmental Systems/Robert Notarfonzo**Address :** 130 Royal Crest Court/Markham, Ontario L3R 0A1/Canada**Phone Number :** 905 477 9242**Fax Number :** 905 477-4511**Technology Maturity :** Commercial use experience**Performance History :** Performance Data are available.

Forty full-scale installations world-wide, including: NASA, Kennedy Space Center, Florida; Kelly AFB, Texas; WR Grace Superfund Site, Woburn, Mass. References: Jeff Merriman, Environmental Process Engineer, Uniroyal Chemical, Elmira, Ontario, phone 519/669-1671 (they have several large 270 kW systems treating NDMA [dimethylnitrosamine] and chlorobenzene. Maryellen Johns, Sr. Project Engineer, W.R. Grace & Co., Lexington, MA, phone 617/861-6000, ext. 2359 (supervises the groundwater treatment facility at the WRG Superfund Site at Woburn, which has a 10 kW system treating TCE, PCE, DCE, and VC).

Comments : Limited to organic concentrations <1000 ppm and flow rates of <1000 gpm. Turnkey system, fully automated, operates with minimal supervision and maintenance costs. Relatively high capital costs relative to conventional technologies of activated carbon and air stripping.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides☐ Heavy Metals☐ PCB☒ Explosives/Propellants☒ Petroleum Hydrocarbons☐ Radionuclides☐ SVOC☐ Other Contaminant☒ Nonhalogenated VOC☒ Halogenated VOC☐ N/ATECHNOLOGY TYPE : *Ultraviolet Oxidation*

Technology Name : UV/Oxidation Water Treatment

Application :

On-site

Ex-situ

Brief Description : The Ultrox process destroys organic contaminants in groundwater using a combination of ultraviolet light, ozone, and/or hydrogen peroxide. VOCs are oxidized in a treatment vessel in a pump-and-treat configuration that can remove VOCs to below detection limits.

Company Name/POC: Ultrox (Division of Zimpro Environmental, Inc./Bill Himebaugh

Address : 7755 Center Ave./Suite 1100/Huntington Beach, California 92647

Phone Number : 714 545 5557

Fax Number : 714 372-496

Technology Maturity : Commercial use experience

Performance History : 20+ installations nationwide. GE: Dr. Robert Heads, 408/925-6556; U.S. EPA: Normal Lewis, 513/569-7665; Sealed Power Corp., Harold Larabee, 616/724-1688.

Comments : Much more effective on unsaturated compounds (TCE, PCE, vinyl chloride) and aromatic compounds (BTEX, phenols). Less effective on saturated compounds (TCA, DCA, CC14). Units are skid mounted and easily installed on-site. Minimal operator attention required. Some applications require pretreatment for iron, manganese, TSS, floating oils.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides☐ Heavy Metals☐ PCB☐ Explosives/Propellants☐ Petroleum Hydrocarbons☐ Radionuclides☐ SVOC☐ Other Contaminant☐ Nonhalogenated VOC☒ Halogenated VOC☐ N/A**TECHNOLOGY TYPE :** *Biofiltration***Technology Name :** BioPur**Application :**

On-site

Ex-situ

Brief Description :

Ex situ biological filter is a self-inoculating groundwater remediation system. Gasoline hydrocarbons reduced to <0.5 ppb.

Company Name/POC: Tauw Milieu/ L. Urlings**Address :**

Handelskade 11/ P.O. Box 133/7400 AC Deventer, Netherlands

Phone Number :

31 57 0099911

Fax Number :

31 57 0699666

Technology Maturity :

Commercial use experience

Performance History :

"Several"; mostly gasoline spills to groundwater all have successfully been treated to Netherland standard. (L. Urlings 011-57-009-9862)

Comments :

Easy to use. Trailer-mounted. Currently being developed for chlorinated hydrochons and PCB's. Tauw owns basic patent to this biofilter system. Must be licensed before use.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Membrane Separation*

Technology Name : AMT Membrane Cartridge System

Application : In-situ (vadose zone) Ex-situ
 In-situ (saturated zone)

Brief Description : Membrane Air Stripping Cartridges remove VOCs from water using air stripping across patented, highly permeable membrane fibers. Small, low-cost membrane modules are commercially available to treat low water-flow rates. Modules based on new designs, capable of effectively handling large volumes, should become commercially available in the near future.

Company Name/POC: Applied Membrane Technology, Inc./Stephen Conover

Address : 11558 Encore Circle/Minnetonka, MN 55343

Phone Number : 612 933 5121 **Fax Number :** 612 933-8837

Technology Maturity : Pilot plant testing

Performance History : The current membrane stripping cartridges were recently used in a pilot test for removal of chlorinated and non-chlorinated VOCs from groundwater. Removal rates of 99% were achieved in ~one hour at efficient water and air-flow rates using recirculated water. Scale-up of a complete on-site system, using commercially available modules is planned following State regulatory agency approval. The pilot test on membrane air strippers was conducted for the Crosby Group, Inc., McKissick Products Division, P.O. Box 3128, 2927 Dawson Road, Tulsa, OK 74101. Contact Pat Gordon 918/834-4611. Contaminants treated to date include Trichloroethene (TCE), 1,1,1-Trichloroethane (TCA), 1,2-Dichloroethane (DCA), 1,1-Dichloroethene (DCE), methylene chloride, vinyl chloride, tetrachloroethene, benzene, toluene, xylenes.

Comments : Membrane air stripping cartridges are readily adaptable to small water volumes for either continuous or intermittent treatment regimes. By varying the size and number of cartridges used in series or in parallel, one can engineer processes which optimize the stripping rate of selected or all of the organic water contaminants. Compared to other available air-stripping technology, AMT can treat water contaminated with VOCs by air stripping using small membrane cartridges that are lower in cost to install and operate. The small modules are suitable for situations with intermittent and/or low flow-rate requirements. Larger modules in series and in parallel configurations should be commercially available this year. These modules will provide higher flow-rate treatments and flexibility to deal with variations in flow rates and contaminant concentrations.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Membrane Separation***Technology Name :** Spiral Wound Membrane Technology**Application :** In-situ (saturated zone) Ex-situ

Brief Description : Spiral-wound membrane technology offers a cost-effective, energy-efficient method of making separations using the principles of osmosis. The technology used by Desalination Systems, Inc. allows for the recovery and reuse of waste stream constituents from acids to metals. SWMT needs no additional chemicals, making this technology environmentally friendly. A highly trained operator is unnecessary. There are no additional sludge costs with membrane technology. A membrane system is a small fraction of the cost of installing a Dissolved Air Flotation (DAF) device.

Company Name/POC: Desalination Systems, Inc./Bridgete Owens**Address :** 760 Shadowridge Dr./Vista, California 92083**Phone Number :** 619 598-3334**Fax Number :** 619 598-3335**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available from the company.

Comments : SSWM systems are small compared to other technologies such as DAF. Membrane systems require electricity to run the motor and pump. SWM systems need little support services from an outside operator. These systems can also be located outdoors. A SWM system can be used easily. A technician can be trained in a few hours to take readings, if needed, and watch the system. The membrane system is flexible in that it can be installed inside or outside the facility, so no large infrastructures need to be built. The size of a membrane system is so small that it fits almost anywhere.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propejllants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Other

Technology Name : Catalytic Separation

Application : ☒ On-site ☐ Ex-situ
☐ Off-site

Brief Description : This technology/service provides (cradle to grave) understanding of production, health and safety, isotope separation and removal processes. The key elements are the low temperature hydrophobic catalyst separation processes which are patented. The technology can be made available under license of or by direct contract with AECL or its partners. There are many public papers describing the basic processes. The technology has been used in the cooperative projects since 1982 and for 4 major contracts valued at \$3.5 million without any major problems.

Company Name/POC: AECL Research/C. A. McDowall

Address : Whiteshell Laboratories/Pinawa, Manitoba, R0E1L0, Canada

Phone Number : 204 753-2311

Fax Number : 204 753-292

Technology Maturity : Commercial use experience

Performance History : The technology has been applied for projects at: Brookhaven National Lab - Fermi Labs - Westinghouse Idaho Nuclear Co. - Ontario Hydro. Projects ranged in size from lab scale to industrial scale with no problems experienced.

Comments : This technology is simple to operate for technicians with general operations training. The challenge associated with this technology is to identify/develop more efficient and cheaper catalysts..

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Other***Technology Name :** In-Situ Electro-Enhanced Remediation/Electrofrac**Application :** In-situ (vadose zone)
In-situ (saturated zone)**Brief Description :** In situ electro-thermal treatment uses volatilization, pyrolysis and fusion to treat the soil. This technology replaces excavation of soil.**Company Name/POC:** Bio-Electrics, Inc./E. Sarapuu**Address :** 1301 Woodswether/Kansas City, Missouri 64105**Phone Number :** 816 474-4895**Fax Number :** 816 842-1245**Technology Maturity :** Pilot plant testing**Performance History :** Refer to EPA's VISITT 3.0 Database.**Comments :** Qualified engineering personnel required for problem evaluation. This technology was originally developed for in situ processing of mineral fuels. This technology cannot be used for under-water decontamination.**Source of Information :** TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : Other

Technology Name : Prepolishing with Organoclay

Application : Ex-situ

Brief Description : Organically modified clays remove mechanically emulsified and free oil, fats, greases, PCP, PCB from water at 7 times the rate of activated carbon, by partition. This technology will reduce the cost (operations) of carbon changeouts by 50 percent.

Company Name/POC: Biomin, Inc./George Alther

Address : P.O. Box 20028/Ferndale, Michigan 48220

Phone Number : 810 544-2552

Fax Number : 810 544-373

Technology Maturity : Commercial use experience

Performance History : Hill AFB, Utah - 90,000 lb every 2-3 years (Jeff Watkins 801 777 4924).

Comments : VOCs are not removed effectively with clay. Use organoclay in the same manner as activated carbon.

Source of Information : TechCon

CONTAMINANTS :

- ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Other***Technology Name :** Catalytic Oxidation**Application :**

Brief Description : This process is used to remove organic compounds dissolved in water streams (effective range 0-5,000 ppm COD). The polluted compounds are broken down in situ to CO₂ and H₂O. The process uses O₃ and O₂ in a catalytic reaction. All organic compounds, with few exceptions, are broken down.

Company Name/POC: ECO Purification Systems USA, Inc./John Johns**Address :** 8813 Waltham Woods Road, Suite 304/Baltimore, Maryland 21234**Phone Number :** 410 882-1566**Fax Number :** 410 882-2910**Technology Maturity :** Commercial use experience

Performance History : One commercial demonstration unit for ground water treatment with a capacity of 20 m³/hr is in use for converting 1,000-5,000 ppb dichlorotrichloroethane to 20 ppb. Plant is situated in Stork/Bronswijk Heat Transfer B.V., Stationsweg 22, Nijerk, the Netherlands.

Comments : The plant can be fully automated and requires minimal attention. Operators require skills and experience in handling state-of-the-art automated process control equipment. Best treatment range is 0-5,000 ppm COD. Maximum reactor diameter so far is 2.5m. Capacity range of 1-1000 m³/hr are available. System can operate over full water temperature range at standard pressure. Catalyst life is at least 3 years and could be much longer. Lab and pilot tests are required; based on the resulting data process design and duty specifications, treatment capability can be predicted with accuracy, using computer model. All materials available in USA. Takes around 9 months to build a complete turnkey installation. Normal infrastructure required: concrete slab, electricity, water and protective building for process control equipment and O₃ generators.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Other**Technology Name :** RECLAIM (TM) In Situ VOCs Partitioning/Extraction**Application :** In-situ (vadose zone)
In-situ (saturated zone)**Brief Description :** "RECLAIM" passive remediation is accomplished by exposing "RECLAIM" porous polymer (proprietary material) to solution-phase and/or vapor-phase volatile organics. This exposure is most often achieved through the placement of stainless mesh containers that hold the spherical beads of "RECLAIM" polymer as a unit ("canister") in monitoring or recovery wells that access VOC-contaminated soil, groundwater, or both. "RECLAIM" is an extremely hydrophobic material, very stable chemically and thermally. It adsorbs and concentrates VOCs based on partial pressures available, achieving concentrations as much as 2,000 times greater on the polymer body than in the atmosphere of the well.**Company Name/POC:** Environmental Fuel Systems, Inc./Cal Chapman**Address :** P.O. Box 1899/709 Main Street/Bandera, Texas 78003**Phone Number :** 210 796-7767**Fax Number :** 210 796-748**Technology Maturity :** Commercial use experience**Performance History :** The company has performed "RECLAIM" service commercially at eighteen sites with VOC contamination in soil and/or groundwater for periods up to seven months. TPH and BTEX levels have been reduced provided no new contaminants have been introduced. The radius of influence for the RECLAIM canister has been estimated based on weights of fuel residues recovered, and periodic TPH and BTEX measurements through the treatment time frame. It appears that well grids of 40 feet are sufficient for sandy soil/water clean-up; well grid spacing tightens with lower permeabilities. At sites still dispensing fuel, a number of spills and leaks have been isolated and products often identified through gas chromatographic testing of condensates.**Comments :** "RECLAIM" passive remediation is limited by the permeability of geologic structures, concentrations and vapor pressures of contaminants available, and hydraulic gradient. As these decrease, the rate of recovery decreases (as is the case with all clean-up methods). The service is labor- and travel-intensive, as a technician must provide periodic service and support at a site on a periodic basis (as with other approaches). When comparing rates of recovery of the passive "RECLAIM" approach for active methods such as vapor extraction or groundwater pumping and treatment, "RECLAIM" is usually found to be a slower process, but it is much less expensive. "RECLAIM" is only effective with organics.**Source of Information :** VISITT 3.0

CONTAMINANTS:

Pesticides/Herbicides

■ Heavy Metals

 PCB

Explosives/Propellants

Petroleum Hydrocarbons

■ Radionuclides

Other Contaminant

Nonhalogenated VOC

Halogenated VOC

N/A

TECHNOLOGY TYPE: *Other*

Technology Name : Mobile Cleaning Unit (Biotreatment)

Application :	On-site	Ex-situ
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Brief Description : Technology Type: Biodegradation (Ex-situ). Biodegradation of VOCs and PAHs in water (aerobic degradation). Replaces activated carbon.

Company Name/POC: Hedeselskabet/Mr Thomas Larsen

Address : Ringstedvej 20/DK-4000 Roskilde, Denmark

Phone Number : 45 4630 03 10

Fax Number : 45 4630 0311

Technology Maturity : Commercial use experience

Performance History : Technology first used at (Texaco) gas station (~1990)
 Approx. 10 units currently employed at gas stations
 Water to be treated may reach toxic levels, impairing biodegradation
 PAHs require rel. long residence time

Comments :

- Only applies to substances that are readily biodegradable under aerobic conditions.
- Under special conditions, toxic by-products may occur.
- Easily relocated, based on standard freight containers.
- Easily monitored by modem/cellular phone.
- Short mobilization and start-up time.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Other***Technology Name :** Magnetic Separation

Application : In-situ (vadose zone) Off-site Ex-situ
 In-situ (saturated zone)

Brief Description : The MAG SEP process uses specially designed particles to selectively absorb contaminants from water. The particles are composite particles with a magnetite core (to make the particle magnetic), a polymer coating (for durability), and selective adsorbers on the surface. Examples are amidoxime, clinoptilolite, zeolites, etc. The selective adsorbers can recover contaminants down to ppb levels without recovering nonhazardous ions. The particles (with contamination) are collected in a magnetic filter. The particles are regenerated for reuse. The regeneration solution can be treated for disposal or recovery of a recycleable material. The alternatives to this technology are precipitation, filtration, ion exchange and reverse osmosis. The advantage of the MAG SEP technology compared to all others is the reduced operating costs due to low pump head costs for magnetic filtration, and reduced waste disposal costs because the process is selective. This can reduce waste volumes by more than an order of magnitude when recovering low ppm or ppb levels of contamination from water containing several hundred ppm total dissolved solids.

Company Name/POC: Rust Remedial Services/John Westcott**Address :** Clemson Technical Center, 100 Technology Drive, Clemson Research Park/ Anderson SC 29625**Phone Number :** 803 648-2413**Fax Number :** 803 646-531**Technology Maturity :** Field demo complete

Performance History : Several successful pilot-scale demonstrations have been completed. Magnetic filters are standard commercial equipment. Currently the process is being demonstrated as part of the in-situ soil treatment demonstration, the in-situ groundwater project, and the Resource Recovery Project.

Comments : The only issue is the ability to selectively adsorb the contaminant of interest which must be determined by a treatability study. Easy to use, takes up minimal space, minimal utility requirements, and will generally require 2 people of moderate technical ability to operate. Equipment and service support is available worldwide.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Other***Technology Name :** Ultrasound Particle Separation (SONOSEP)

Application :

On-site Ex-situ
Off-site

Brief Description : Particle separation technology that utilizes ultrasound to coagulate, flocculate and separate particles suspended in a liquid. The technology can separate solid or liquid particles (emulsions) from a liquid. Separation of up to 99 percent of suspended particles may be achieved.

Company Name/POC: Triton Enviromental Consultants/John Poppleton**Address :** 120 - 13511 Commerce Parkway/Richmond, B.C., Canada V6V 2L1**Phone Number :** 604 279-2093**Fax Number :** 604 279-2047**Technology Maturity :** Pilot plant testing

Performance History : This technology is at early pilot-scale. Over 6 years of applied research has been performed. Equipment is available for batch and continous-flow testing.

Comments : Particles in suspension with a diameter less than 0.5 microns are difficult to flocculate. Flow through the acoustic treatment chamber must be close to laminar - this limits flow velocity. There is a maximum distance between transducer and reflector. This limits flow rates. The technology achieves flocculation at a higher rate than conventional systems without the use of chemical additives. The equipment is simple and maintenance free since there are no moving parts. The equipment is compact. Primary challenge is scale-up.

Source of Information : International TechCon

Surface Water

Treatment

Surface Water

Treatment

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Biodegradation (In Situ)***Technology Name :** Biogard method

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : The Biogard Method combines absorption and encapsulation of free hydrocarbons with a catalyzing effect of naturally occurring oil degrading bacteria.

Biogard is a powder product that is mixed into polluted soil or spread over surface water with the above- mentioned effect.

The degradation time will, due to the catalyzing effect, be decreased substantially.

Company Name/POC: AEC/Jan Hyttel, Managing Director**Address :** GI Kongevej 131/DK-1850 Frederiksberg C/Denmark**Phone Number :** 45 31247122**Fax Number :** 45 31247222**Technology Maturity :** Commercial use experience

Performance History : Invented by a German scientist in the late seventies. Patented in the US (and almost world wide) in 1980/1981.

Comments : Hundreds of references in Denmark, Europe, and the Middle East.

Biogard is able to treat all sorts of oil pollution on sea and on land.

Easy and flexible to use. No need for special equipment or infrastructure.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : Bionergies, Biosmose, Biosurf

Application : In-situ (vadose zone) Off-site Ex-situ
In-situ (saturated zone)

Brief Description : Bioremediation of organic pollutions (in soils, water, effluents) by using: 1. exogenous specific bacterial consortium (non toxic, environment safe, European Federation of Biotechnology class I in order to control a full, complete and non selective biodegradation. 2. Biofixations (mineral natural support). 3. Biosurfactants (produced by selected bacteria) provide an effective, fast and secure alternative to common place bioremediation because Bionergies controls the biodegradation of the pollutant (and metabolites) by using specialized bacteria and feasibility tests (in labs, on the field).

Company Name/POC: Bionergies Laboratories, Biosurf/M. Jacques FAUDIN

Address : 59/100, rue des 4 termes/B.P. 1009/Z.I. des Paluds/13781 AUBAGNE Cedex, France

Phone Number : 33 42 84 30 07

Fax Number : 33 42 84 23 3

Technology Maturity : Commercial use experience

Performance History : Contact company for performance data.

Comments : Each case is analyzed in order to optimize the treatment and the on site materials and personnel. Bioenergies controls the bacterial action by using exogenous specific bacterial strains, biofixations and biosurfactants. None of the bacteria is genetically engineered. They are classified into class I (one) of the European Federation of Biotechnology, and produced under French and European Community regulations. The company is looking for join-ventures in U.S. in order to cover the environmental and industrial field.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : In Situ Bioremediation

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Process for degradation of TCE and its sister compounds, vinyl chloride and dichloroethylene, from aquifer solids using TCE-degrading bacteria capable of penetrating soil, maintaining activity and reaching the TCE contamination. Replaces pump-and-treat and soil vapor extraction combined with carbon adsorption or incineration. Envirogen's in-situ system will save 90 percent of the cost and shorten cleanup time by many years.

Company Name/POC: Envirogen, Inc./William J. Guarini

Address : 4100 Quakerbridge Rd./Lawrenceville, New Jersey 08648

Phone Number : 609 936-9300

Fax Number : 609 936-9221

Technology Maturity :

Bench scale testing, only

Performance History : Bench-scale results demonstrate technology feasibility.

Comments : System requires either horizontal or vertical well installation, pumping of microorganisms into soil, and sampling and analysis of soil. System will provide cleanup of contamination at the source. Little operator-attention is required.

Source of Information : TechCon

CONTAMINANTS:

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : Biodegradation (In Situ)

Technology Name : Phytostabilized Bioremediation

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Uses enhanced biotechnology to degrade organics - e.g., phenol, PCB, dioxin and inorganics - nitrate, ammonia etc. The technology can be used in a soil matrix to treat flowing groundwater/effluent or by direct planting into soil. Non-stabilized bioremediated and many types of conventional water treatment. Microorganisms (fungi and bacteria) which develop in the planted soil are responsible for most of the treatment. The root and rhizone systems of the reeds bring air into the soil surrounding them while further away the environment is anaerobic creating a unique mosaic of treatment spheres which facilitates the impressive ability of reed beds to remove complex and previously intractable pollutants. The majority of treatment is by soil microbes but certain contaminants (such as heavy metals, sulphur and phosphorous) are removed via soil processes.

Company Name/POC: OEEL Ltd/ESU Ltd/ Lucian S. Gill

Address : 4 Cumberland House/Greenide Land/Lidget Green/Bradford W. Yorkshire BD89TF England

Phone Number : 1274 480033

Fax Number : 1274 48300

Technology Maturity : Commercial use experience

Performance History : Over 500 applications worldwide including PCB, Pesticide, Dioxins, Organics - including solvents, phenolics, PAH's, ammonia, nitrates, cyanide etc., sewage, farm slurries, metal entrapment/extraction.

Comments : Requires adaptation and monitoring over the first 3 years to maturity but then continues in some cases with little or no attention. Requires larger land areas than conventional "packaged" systems. Requires three years adaption period. Once adapted is extremely flexible and will readapt to changes in input. The technique involves genetics selection of plant types to withstand toxic material. The plant/soil/bacterial matrix is then adapted to the site conditions and once stabilized - continues to treat the toxic material indefinitely. Effluent/groundwater is fed into a basin containing the PL/SO/BAC matrix. Plants are allowed to develop and penetrate their rhizomes into the toxic soil. Because each site has a unique problem, no hard rule for system costs can be given. Smallest system - 10 sq. meters, largest 20 hectares; volume 1 m(cubed) per day to 5000 m(cubed) per day.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment***Technology Name :** Bionergies, Biosmose, Biosurf

Application : In-situ (vadose zone) Off-site Ex-situ
 In-situ (saturated zone)

Brief Description : Bioremediation of organic pollutions (in soils, water, effluents) by using: 1. exogenous specific bacterial consortium (non toxic, environment safe, European Federation of Biotechnology class I in order to control a full, complete and non selective biodegradation. 2. Biofixations (mineral natural support). 3. Biosurfactants (produced by selected bacteria) provide an effective, fast and secure alternative to common place bioremediation because Bionergies controls the biodegradation of the pollutant (and metabolites) by using specialized bacteria and feasibility tests (in labs, on the field).

Company Name/POC: Bionergies Laboratories, Biosurf/M. Jacques FAUDIN**Address :** 59/100, rue des 4 termes/B.P. 1009/Z.I. des Paluds/13781 AUBAGNE Cedex, France**Phone Number :** 33 42 84 30 07**Fax Number :** 33 42 84 23 33**Technology Maturity :** Commercial use experience**Performance History :** Contact company for performance data.

Comments : Each case is analyzed in order to optimize the treatment and the on site materials and personnel. Bionergies controls the bacterial action by using exogenous specific bacterial strains, biofixations and biosurfactants. None of the bacteria is genetically engineered. They are classified into class I (one) of the European Federation of Biotechnology, and produced under French and European Community regulations. The company is looking for join-ventures in U.S. in order to cover the environmental and industrial field.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : Biodegradation of VOCs

Application : On-site Ex-situ

Brief Description : Reactor system to biologically degrade trichloroethylene, vinyl chloride, dichloroethylene and related compounds in the vapor phase. The system has been proven to destroy >90 percent of the VOCs while maintaining biocatalytic life over extended periods.

Company Name/POC: Envirogen, Inc./William J. Guarini

Address : 4100 Quakerbridge Rd./Lawrenceville, New Jersey 08648

Phone Number : 609 936-9300

Fax Number : 609 936-922

Technology Maturity :

Field demo complete

Performance History : Technology based on successful pilot results in DOE-OTD Argonne National Lab funded project. Currently being field tested at a commercial site in New York State.

Comments : Full-scale operating parameters to be determined. Simple operation, minimal operator attention.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Chemical Reduction/Oxidation*

Technology Name : E-Process

Application :

On-site Ex-situ

Brief Description :

Process injects ozone to oxidize both VOC and metal ions; precipitates and separates these. Final metal ion removal is with metal removal medium (MRM). Ion exchange can be added to the end of the process for water polishing.

Company Name/POC: ADTECHS, Inc. (a wholly owned subsidiary of JGC Corp.)/Lou Reynolds, Dennis Wilkie

Address : 2411 Dulles Corner Park/Suite 520/Herndon, Virginia 22071

Phone Number : 703 713-9000

Fax Number : 703 713-9101

Technology Maturity:

Bench scale testing, only

Performance History : Performance data are available.

Comments :

Bench scale phase of EPA SITE Program. Completed field demonstration EPA SITE Program. For its applications, the technology has no particular limitations. System can be made in different sizes, depending on floor requirements. No unusual personnel requirements. Uses commercially available process components and equipment.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Chemical Reduction/Oxidation*

Technology Name : E-Process

Application : On-site
Off-site

Brief Description : Process injects ozone to oxidize both VOC and metal ions. Precipitates and separates these. Final metal ion removal is with a metal removal medium (MRM). Ion exchange can be added to the end of the process for water polishing.

Company Name/POC: H2O, Inc./c/o ADTECHS, Inc./a wholly owned subsidiary of JGC Corp./Lou Reynolds/Dennis Wilkie

Address : 2411 Dulles Corner Park/Suite 520/Herndon, Virginia 22071

Phone Number : 703 713-9000

Fax Number : 703 713-910

Technology Maturity :

Bench scale testing, only

Performance History : Bench scale phase of EPA SITE Program.

Comments : Requires proof of full scale system. Requires demonstration over a range of VOC and metal ion contamination. The E-Process is presently being evaluated by the EPA. It is next scheduled for a full scale site application. Process has passed exclusive lab scale testing. Process has flexibility for treating wide range of suspended particle sizes and dissolved solids. Processing cost is less than \$5 per thousand gallons.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Solidification/Stabilization (Ex Situ)*

Technology Name : Polymerization of Heavy Metal Ions

Application :

On-site Ex-situ
Off-site

Brief Description : Process uses a polymerized sulfide agent to chemically and physically stabilize heavy metal ions. The final waste product meets U.S. EPA leaching criteria. Stabilized product is low in volume and is chemically inert.

Company Name/POC: ADTECHS, Inc. (a wholly owned subsidiary of JGC Corp.)/Ken Sauda

Address : 2411 Dulles Corner Park/Suite 520/Herndon, Virginia 22071

Phone Number : 703 713-9000

Fax Number : 703 713-9101

Technology Maturity : Commercial use experience

Performance History : This process has been in use for 10 years for chemically binding heavy metals in municipal incinerator effluent streams. It is now also being used for processing electronics and electroplating manufacturing wastes. This process has been used for 10 years in Japan to fix heavy metal ions in process waste streams. It will work with radioactive or non-radioactive metal ions. Full scale, operational systems have been in service for several years.

Comments : Materials handling and processing equipment are required, depending on the through-put rates and material form. May require soil washing and crushing equipment. Does require tanks for precipitation of waste dissolved water. Heavy metal ions must be wetted or in solution to react with the polymer. The basic challenge is the handling of the contaminated material.

Source of Information : TechCon

CONTAMINANTS: ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE: *Electrical Separation*

Technology Name: Electrochemical Treatment of Inorganics

Application: In-situ (saturated zone) Ex-situ

Brief Description: The electrochemical cell generates a ferrous ion into solution when a direct current is passed across the carbon steel electrodes inside the electrochemical cell. The iron ions will form a solid insoluble matrix that removes other contaminants from solution and maintains them in a tightly bound insoluble form. If contaminants such as hexavalent chromium are present, the ferrous ion will also reduce the chromium to its less hazardous trivalent form.

Company Name/POC: Andco Environmental Processes, Inc./Daryl Zurawski

Address: 595 Commerce Drive/Amherst, NY 14228

Phone Number: 716 691-2100

Fax Number: 716 691-288

Technology Maturity: Commercial use experience

Performance History: The Gleason Works/Rochester, NY/Ken Miller/716-473-1000
 Xerox Corporation/Webster, NY/Jim Jakubonis/716-422-1090
 Lockheed Corporation/Tucson, AZ/Steve Sexton/602-573-8628
 Lockheed Corporation/Charleston, SC/Sonny Moore/803-747-6331
 Chrysler Corporation/Huntsville, AL/Steve Smith/205-464-2132
 General Motors/St. Therese, Quebec/John Deearie/514-433-4494
 Blount Industries/Guelph, Ontario/Jackie Campbell/519-822-6870

Comments: Performance Data are available. List of groundwater installations available.

The technology has been utilized for numerous industrial and groundwater applications. The electrochemical process comes as a user friendly system controlled by a PLC. The process can be automated to the extent that operator attention is only required on an infrequent basis. The operator should have an understanding of mechanical equipment as well as a basic knowledge of chemistry so that accurate sampling procedures can be followed in order to confirm the system's operation. Andco engineers are also available for consultation.

Source of Information: TechCon

CONTAMINANTS:

Pesticides/Herbicides

Heavy Metals

PCB

Explosives/Propellants

■ Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

■ **Nonhalogenated VOC**

Halogenated VOC

■ N/A

TECHNOLOGY TYPE: *Hot Water or Steam Flushing/Stripping*

Technology Name : AQUADETOX/SVE Integrated System

Application : In-situ (vadose zone)

Ex-situ

In-situ (saturated zone)

Brief Description :

A low-pressure steam-stripping technology for the removal of volatile organic compounds (VOCs) from the groundwater, and a soil vapor extraction (SVE) system that treats VOCs from the soil. This system is capable of simultaneously cleaning soil and groundwater without emitting pollutants into the air. The advantages include a closed-loop system with no air emissions (reduced cost) and a removal efficiency in excess of 99.9 percent for groundwater and >99 percent for soil vapor treatment.

Company Name/POC: DOW Environmental/C.J. Davenport

Address : 15204 Omega Drive/Suite 200/Rockville, Maryland 02850

Phone Number : 713 978-3107

Fax Number : 713 978-2959

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Approximately 45 to 50 units are in operation as of September 1993 ranging in size from 5 to 3,000 gpm with the average unit at 300 gpm. Unit experiences typical facility start-up problems which have been routinely resolved. More persistent problems which require pretreatment have been caused by high alkalinity of groundwater, biofouling, and high iron content, and scaling in the unit. Reference: Lockheed Aeronautical Systems Co., David Jensen (818) 847-0792; Exxon, Gary Hope (713) 425-5793.

Comments :

SVE portion of unit requires fairly porous soils. The AQUADETOX system is completely computer controlled and after installed and tested requires only one trained operator. The operator will receive training from AWD along with detailed manuals of operation. The training is minimal and no unusual personnel skills are required.

Source of Information : TechCon

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Bioreactors*

Technology Name: Bionergies, Biosmose, Biosurf

Application: In-situ (vadose zone) Off-site Ex-situ
 In-situ (saturated zone)

Brief Description: Bioremediation of organic pollutions (in soils, water, effluents) by using: 1. exogenous specific bacterial consortium (non toxic, environment safe, European Federation of Biotechnology class I in order to control a full, complete and non selective biodegradation. 2. Biofixations (mineral natural support). 3. Biosurfactants (produced by selected bacteria) provide an effective, fast and secure alternative to common place bioremediation because Bionergies controls the biodegradation of the pollutant (and metabolites) by using specialized bacteria and feasibility tests (in labs, on the field).

Company Name/POC: Bionergies Laboratories, Biosurf/M. Jacques FAUDIN

Address: 59/100, rue des 4 termes/B.P. 1009/Z.I. des Paluds/13781 AUBAGNE Cedex, France

Phone Number: 33 42 84 30 07

Fax Number: 33 42 84 23 3

Technology Maturity: Commercial use experience

Performance History: Contact company for performance data.

Comments: Each case is analyzed in order to optimize the treatment and the on site materials and personnel. Bionergies controls the bacterial action by using exogenous specific bacterial strains, biofixations and biosurfactants. None of the bacteria is genetically engineered. They are classified into class I (one) of the European Federation of Biotechnology, and produced under French and European Community regulations. The company is looking for join-ventures in U.S. in order to cover the environmental and industrial field.

Source of Information: International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Bioreactors***Technology Name :** GAC Fluid Bed Reactor**Application :** On-site Ex-situ

Brief Description : The GAC-Fluid Bed Reactor employs biological treatment and activated carbon adsorption in a single vessel. The bioreactor is utilized to treat a wide variety of toxic organic compounds in water. Removal efficiencies typically exceed 95+ percent, with final effluent concentrations of specific organics in the low ppb range.

Company Name/POC: Envirex, Inc./Michael Doyle, P.E.**Address :** 1901 South Prairie Avenue/ Waukesha, Wisconsin 53186**Phone Number :** 414 547-0141**Fax Number :** 414 547 4120**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.**Comments :**

Envirex currently has more than 20 full-scale fluidized bed reactor systems in operation or in the design stage throughout the U.S. The full-scale systems range in size from the Model 30 skid-mounted unit (20 degrees dia. reactor) to a 36 MGD denitrification application on municipal wastewater. The largest GAC-FBR installation treats up to 4,000 gpm of gasoline-contaminated groundwater at a decommissioned refinery, and has been operating successfully for over two years. Some typical performance data is on file. While this data focuses primarily on BTEX compounds, Envirex has a broad database of other specific organic compounds. Client list: Chevron, BP Oil, Shell Oil, Northville Industries, Celgene, Monsanto, Formosa Plastics, Groundwater Technology, Inc., The Advent Group, E.I. DuPont, Upjohn, Ciba-Geigy, Arco Pipeline, Gulf Power.

Not applicable for inorganic contaminants such as sulfates, chlorides, radionuclides. Not generally applicable for heavy metals or non-biodegradable organics such as PCBs, dioxin, perchloroethylene, and trichloroethylene (though research on methanotrophic TCE degradation is being conducted). The GAC-FBR has been engineered to provide a high degree of automation with low manpower demand. Manpower requirements range from 1-4 hours/day, typically. Routine maintenance of rotating equipment (pumps and compressors) and electrical powered controls systems is required. Understanding of biological treatment by operating personnel is helpful, but not required as Envirex provides process support. Operator assistance can be provided by Envirex's field personnel through a service contract.

Source of Information : TechCon

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Filtration

Technology Name : High Efficiency Filter

Application : ☒ On-site ☒ Ex-situ

Brief Description : This technology is a non-precoat, air backwashable, high efficiency filter. Filter media is chemical and radiation resistant. Filter pore size can be <0.1 microns. Replaces precoat and fiber filters that generate greater, overall waste volume. It is air back-washable, thus eliminating back-wash water volume. Filter module can be made in different sizes and flow rates.

Company Name/POC: ADTECHS, Inc. (a wholly owned subsidiary of JGC Corp.)/Ken Sauda, Dennis Wilkie

Address : 2411 Dulles Corner Park/Suite 520/Herndon, Virginia 22071

Phone Number : 703 713-9000

Fax Number : 703 713-910

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Comments :

Currently used in fossil power plant water filtration. Used in nuclear power plant liquid radwaste processing systems where low backwash waste volume is important.

Filter modules are mounted inside a pressure vessel. Upper temperature limit is 185 degrees F. Pore size can vary, but is normally $\approx$ 0.5 μ m. Therefore, filter is applicable as a final filter. Filter modules are mounted in an in-line pressure vessel that can be automatically or manually backwashed.

Source of Information : TechCon

CONTAMINANTS:

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

■ Petroleum Hydrocarbons

■ Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

■ Halogenated VOC

■ N/A

TECHNOLOGY TYPE : *Filtration*

Technology Name : Uranium removal from groundwater

Application :	On-site	Ex-situ
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Brief Description : A filter system, known as EXPURRT, was developed for removing uranium and radium from drinking water. The removal methods are based on ion exchange and sorption. The filter system was developed to the commercial stage and tested in a household water supply for a two year period. A larger-scale system was designed and successfully tested for removing U from harbour water. The technology is 90 percent efficient for U removal and 70 percent efficient for Ra removal. This technology is very selective for U and Ra. It is both very inexpensive and very efficient.

Company Name/POC: AECL Research/C. A. McDowall

Address : Whiteshell Laboratories/Pinawa,Manitoba, R0 E1L0, Canada

Phone Number : 204 753-2311

Fax Number : 204 753-2922

Technology Maturity :	Field demo complete
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Performance History : There has been one major long term test (tested in a household water supply (well) for a two year period), several short term lab tests, and one commercial pilot scale industrial test for the Low Level Waste Management Office AECL, Ottawa, Ontario; Contact: Dennis Main; Tel: (613) 273-3270.

Comments : Suspended sediment will block the filters and there is a finite chemical capacity for the filters (spent filters must be replaced). There is also a need for the disposal of spent material. This technology is easy to use for small scale operations. Minimal infrastructure is required and the skills requirement is low. Larger scale operations will require some increase in infrastructure and training. There is a possibility for the regeneration and reuse of the uranium filters rather than disposing of them.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Filtration*

Technology Name : Microfiltration

Application : On-site Ex-situ

Brief Description : Fine microfiltration of precipitated metals with tight, low-cost Tyvek (R) T-980 filtration media and patented Profix stabilization agent (to pass TCLP) in a fully-automatic Oberlin automatic pressure filter (APF).

Company Name/POC: DuPont/Dr. Ernest Mayer

Address : Engineering Dept. L1359/P.O. Box 6090/Newark, Delaware 19714///Oberlin Filter Co./Mr. Mike Hughs/404 Pilot Court/Waukesha, WI 53188

Phone Number : 302 774-1000

Fax Number : 302 774-732

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Comments : Demonstrations: Industrial partnerships/collaboration potential: participated in USEPA SITE program (w/Oberlin & Enviroguard Mfg. of Profix Stabilization Agent), John Martin, Cincinnati, Ohio; working w/SRS on various wastes; testing other hazardous waste (Oberlin/DuPont/Enviroguard). Utilities required for the DuPont/Oberlin microfiltration technology demonstration included water, electricity and telephone service. Flow rates above about 250 gpm require multiple units. Easy to use and implement (6 installations that are operational and functioning well); minimal personnel skill required since simple.

Source of Information : TechCon

CONTAMINANTS :

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

Halogenated VOC

■ N/A

TECHNOLOGY TYPE: Ion Exchange

Technology Name : Radionuclide Separation Process (RASEP)

Application :	On-site	Ex-situ
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Brief Description : This process provides for the selective removal of radioactive metallic ions, only, from liquid waste streams. Process uses filtration, selective adsorption, and electrodeposition fixation followed by cement solidification.

Company Name/POC: ADTECHS, Inc. (a wholly owned subsidiary of JGC Corp.)/Dennis Wilkie

Address : 2411 Dulles Corner Park/Suite 520/Herndon, Virginia 22071

Phone Number : 703 713-9000

Fax Number : 703 713-9101

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

The technology was developed for the selective removal of radioactive nuclides from a nuclear power plant liquid waste stream. Development program was sponsored by five large Japanese utilities with nuclear power plants.

Comments :	Comparable to other ion exchange systems. This technology is used by nuclear power plants in fuel reprocessing. To date, it has been used exclusively in Japan.
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Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : Ion Exchange

Technology Name : Uranium Selective Chelate Resin

Application : On-site Ex-situ

Brief Description : This ion exchange resin, which is highly selective for removing uranium, is used to treat liquid waste streams.

Company Name/POC: ADTECHS, Inc. (a wholly owned subsidiary of JGC Corp.)/Ken Sauda, Dennis Wilkie

Address : 2411 Dullles Corner Park/Suite 520/Herndon, Virginia 22071

Phone Number : 703 713-9000

Fax Number : 703 713-910

Technology Maturity : Commercial use experience

Performance History : This technology is used in Japan in fuel reprocessing and in combination with other resins in nuclear power plants liquid waste stream processing.

Comments : System is safer to operate than those that use H₂SO₄ and NaOH. Initial resin charge is more expensive than other less selective resins.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Ion Exchange***Technology Name :** Forager (TM) Sponge for Heavy Metals

Application : In-situ (vadose zone) Off-site Ex-situ
 In-situ (saturated zone)

Brief Description : FORAGER (TM) Sponge selectively removes heavy metals from water. This is accomplished by virtue of a proprietary chelating resin deposited within small (1 cm) cubes of open cell cellulosic sponge. A multitude of the cubes is disposed within a vertical column through which water is passed. Flow rates of 0.1 bvm achieve 90+percent removals. Because of the low cost and high absorption capacity of FORAGER (TM) Sponge, one-time-use and disposal is economically feasible. This product can be used on dirty or mixed-waste streams or sludges that would ruin conventional bead form resins.

Company Name/POC: Dynaphore, Inc./N. Rainer**Address :** 2709 Willard Rd/Richmond, Virginia 23294**Phone Number :** 804 288-7109**Fax Number :** 804 282-1325**Technology Maturity :**

Field demo complete

Performance History : FORAGER (TM) Sponge is currently being sold in 8 gal. modular drums for the treatment of small volume industrial effluents. Most of the users are either reluctant to talk about results obtained, or do not have accurate data concerning performance. A preliminary trial was run at an EPA Superfund (Groundwater) site in early 1993. 90 + percent removals were achieved for Cd, Cu, Pb, and V. 70 + percent removals were achieved for Cr, Hg, Zn, and Ni.

Comments :

Will not remove Rb, Cs. Will remove Sr, Ba, and Ra only in the absence of Ca. A multi-column installation employing FORAGER (TM) Sponge involves no moving parts except for a pump. In those installations which include valves for staging or sequencing operations, manipulation of the valve is simple, and can be automated. A single semi-skilled operator can handle units having flow rates of 2-20 gallons/min. Because the system can be trailer mounted, it can easily service effluents in different locations.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Ion Exchange***Technology Name :** Water Treatment Process**Application :** On-site Ex-situ

Brief Description : Combined ion exchange and reverse osmosis treatment of uranium containing eluate. Radium removal by a radium selective ion exchange-complexer. Precipitation of arsenic by addition of ferric chloride. Flotation of ferric-arsenic sludge. Immobilization of the contaminated material by solidification with fly ash and additional activities. Deposition of the final residues.

Company Name/POC: URT Umwelttechnik GmbH/Gerd Braun**Address :** 50354 Hurth/Siemensstr. 1/Germany**Phone Number :** 02233 7994 0**Fax Number :** 02233 7819**Technology Maturity :** Commercial use experience**Performance History :** Contact company for performance history.**Comments :** This process targets uranium mill tailings.**Source of Information :** International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Precipitation***Technology Name :** Autocatalytic Fluid Bed Heavy Metal Removal Plant**Application :** On-site Ex-situ**Brief Description :** The plant is a fluid bed reactor, capable of removing up to 99 percent of heavy metals and organic matter in water. The process is adsorption-coprecipitation on a granular medium.**Company Name/POC:** Kruger A.S./Kurt Ambo Nielsen**Address :** 363 Gladsaxevejs/2860 Soeborg, Denmark**Phone Number :** 011 45 396 90222**Fax Number :** 011 45 31674950**Technology Maturity :** Commercial use experience

Performance History : Experience with 5 m(3)/hr plant used for chromate removal from flash leachate over 2.5 years. 95 percent removal.
 Pilot plant experiments with arsenic, nickel. 90-95 percent removal.
 Bench scale with organics. Up to 99 percent removal.
 Batch experiments with Zn, Se, Cd.

Comments : High implementation potential. Easy to construct and operate. Needs little space.**Source of Information :** International TechCon

SURFACE WATER

CONTAMINANTS:

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Ultraviolet Oxidation*

Technology Name : Titanium Dioxide Photocatalytic Treatment Systems

Application : On-site Ex-situ

Brief Description : Removes and destroys organic pollutants in air and water.
Fixed TiO₂ semiconductor and UV light generate hydroxyl radicals which readily attack and destroy organic pollutants.
Typical VOC removal in air is 1200 ppm TCE, PCE, removal at 50 CFM; 7.7 kW system.
Typical VOC removal in water - BTEX destruction nominally 25 ppm/minute retention time.

Company Name/POC: Matrix Photocatalytic, Inc. (formerly NuTech)/Brian Butters

Address : 22 Pegler St./London, Ontario, Canada N5W 4C8

Phone Number : 519 660-8669

Fax Number : 519 660-852

Technology Maturity :

Field demo complete

Performance History : 23 units produced to date
Specific customer information is proprietary (contact Matrix Photocatalytic, Inc.)
Successful pilot test at Savannah River for soil vapor extraction

Comments : Limitations include (1) Flood rates greater than: air 1000 CFM, water 100 GPM;
(2) certain organic compounds are refractory and take extensive time to break down

Equipment is very simple and easy to install (one man, 4 hours)
Uses common hand tools
Maintenance procedure is easy to follow and only required every 5000 hours
Equipment is very mobile and can easily be moved from site to site
Equipment is modular in construction, therefore can easily be increased/decreased as flow rates vary over time

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Membrane Separation***Technology Name :** Spiral Wound Membrane Technology**Application :** In-situ (saturated zone) Ex-situ

Brief Description : Spiral-wound membrane technology offers a cost-effective, energy-efficient method of making separations using the principles of osmosis. The technology used by Desalination Systems, Inc. allows for the recovery and reuse of waste stream constituents from acids to metals. SWMT needs no additional chemicals, making this technology environmentally friendly. A highly trained operator is unnecessary. There are no additional sludge costs with membrane technology. A membrane system is a small fraction of the cost of installing a Dissolved Air Flotation (DAF) device.

Company Name/POC: Desalination Systems, Inc./Bridgete Owens**Address :** 760 Shadowridge Dr./Vista, California 92083**Phone Number :** 619 598-3334**Fax Number :** 619 598-3335**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available from the company.**Comments :**

SSWM systems are small compared to other technologies such as DAF. Membrane systems require electricity to run the motor and pump. SWM systems need little support services from an outside operator. These systems can also be located outdoors. A SWM system can be used easily. A technician can be trained in a few hours to take readings, if needed, and watch the system. The membrane system is flexible in that it can be installed inside or outside the facility, so no large infrastructures need to be built. The size of a membrane system is so small that it fits almost anywhere.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : Other

Technology Name : Catalytic Separation

Application : ☐ On-site ☐ Ex-situ
☐ Off-site

Brief Description : This technology/service provides (cradle to grave) understanding of production, health and safety, isotope separation and removal processes. The key elements are the low temperature hydrophobic catalyst separation processes which are patented. The technology can be made available under license of or by direct contract with AECL or its partners. There are many public papers describing the basic processes. The technology has been used in the cooperative projects since 1982 and for 4 major contracts valued at \$3.5 million without any major problems.

Company Name/POC: AECL Research/C. A. McDowall

Address : Whiteshell Laboratories/Pinawa, Manitoba, R0 E1L0, Canada

Phone Number : 204 753-2311

Fax Number : 204 753-292

Technology Maturity : Commercial use experience

Performance History : The technology has been applied for projects at: Brookhaven National Lab - Fermi Labs - Westinghouse Idaho Nuclear Co. - Ontario Hydro. Projects ranged in size from lab scale to industrial scale with no problems experienced.

Comments : This technology is simple to operate for technicians with general operations training. The challenge associated with this technology is to identify/develop more efficient and cheaper catalysts.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides☐ Heavy Metals☒ PCB☐ Explosives/Propellants☐ Petroleum Hydrocarbons☐ Radionuclides☒ SVOC☒ Other Contaminant☐ Nonhalogenated VOC☐ Halogenated VOC☐ N/ATECHNOLOGY TYPE : *Other*

Technology Name : Prepolishing with Organoclay

Application :

Ex-situ

Brief Description : Organically modified clays remove mechanically emulsified and free oil, fats, greases, PCP, PCB from water at 7 times the rate of activated carbon, by partition. This technology will reduce the cost (operations) of carbon changeouts by 50 percent.

Company Name/POC: Biomin, Inc./George Alther

Address : P.O. Box 20028/Ferndale, Michigan 48220

Phone Number : 810 544-2552

Fax Number : 810 544-3733

Technology Maturity : Commercial use experience

Performance History : Hill AFB, Utah - 90,000 lb every 2-3 years (Jeff Watkins 801 777 4924).

Comments : VOCs are not removed effectively with clay. Use organoclay in the same manner as activated carbon.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Other*

Technology Name : Catalytic Oxidation

Application :

Brief Description : This process is used to remove organic compounds dissolved in water streams (effective range 0-5,000 ppm COD). The polluted compounds are broken down in situ to CO₂ and H₂O. The process uses O₃ and O₂ in a catalytic reaction. All organic compounds, with few exceptions, are broken down.

Company Name/POC: ECO Purification Systems USA, Inc./John Johns

Address : 8813 Waltham Woods Road, Suite 304/Baltimore, Maryland 21234

Phone Number : 410 882-1566

Fax Number : 410 882-291

Technology Maturity : Commercial use experience

Performance History : One commercial demonstration unit for ground water treatment with a capacity of 20 m³/hr is in use for converting 1,000-5,000 ppb dichlorotrichloroethane to 20 ppb. Plant is situated in Stork/Bronswerk Heat Transfer B.V., Stationsweg 22, Nijerk, the Netherlands.

Comments : The plant can be fully automated and requires minimal attention. Operators require skills and experience in handling state-of-the-art automated process control equipment. Best treatment range is 0-5,000 ppm COD. Maximum reactor diameter so far is 2.5m. Capacity range of 1-1000 m³/hr are available. System can operate over full water temperature range at standard pressure. Catalyst life is at least 3 years and could be much longer. Lab and pilot tests are required; based on the resulting data process design and duty specifications, treatment capability can be predicted with accuracy, using computer model. All materials available in USA. Takes around 9 months to build a complete turnkey installation. Normal infrastructure required: concrete slab, electricity, water and protective building for process control equipment and O₃ generators.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Other**Technology Name :** Magnetic Separation

Application : In-situ (vadose zone) Off-site Ex-situ
 In-situ (saturated zone)

Brief Description : The MAG SEP process uses specially designed particles to selectively adsorb contaminants from water. The particles are composite particles with a magnetite core (to make the particle magnetic), a polymer coating (for durability), and selective absorbers on the surface. Examples are amidoxime, clinoptilolite, zeolites, etc. The selective adsorbers can recover contaminants down to ppb levels without recovering nonhazardous ions. The particles (with contamination) are collected in a magnetic filter. The particles are regenerated for reuse. The regeneration solution can be treated for disposal or recovery of a recyclable material. The alternatives to this technology are precipitation, filtration, ion exchange and reverse osmosis. The advantage of the MAG SEP technology compared to all others is the reduced operating costs due to low pump head costs for magnetic filtration, and reduced waste disposal costs because the process is selective. This can reduce waste volumes by more than an order of magnitude when recovering low ppm or ppb levels of contamination from water containing several hundred ppm total dissolved solids.

Company Name/POC: Rust Remedial Services/John Westcott**Address :** Clemson Technical Center, 100 Technology Drive, Clemson Research Park/ Anderson SC 29625**Phone Number :** 803 648-2413**Fax Number :** 803 646-5311**Technology Maturity :** Field demo complete

Performance History : Several successful pilot-scale demonstrations have been completed. Magnetic filters are standard commercial equipment. Currently the process is being demonstrated as part of the in-situ soil treatment demonstration, the in-situ groundwater project, and the Resource Recovery Project.

Comments : The only issue is the ability to selectively adsorb the contaminant of interest which must be determined by a treatability study. Easy to use, takes up minimal space, minimal utility requirements, and will generally require 2 people of moderate technical ability to operate. Equipment and service support is available worldwide.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Other*

Technology Name : Ultrasound Particle Separation (SONOSEP)

Application : On-site Ex-situ
Off-site

Brief Description : Particle separation technology that utilizes ultrasound to coagulate, flocculate and separate particles suspended in a liquid. The technology can separate solid or liquid particles (emulsions) from a liquid. Separation of up to 99 percent of suspended particles may be achieved.

Company Name/POC: Triton Environmental Consultants/John Poppleton

Address : 120- 13511 Commerce Parkway/Richmond, B.C., Canada V6V 2L1

Phone Number : 604 279-2093

Fax Number : 604 279-204

Technology Maturity : Pilot plant testing

Performance History : This technology is at early pilot-scale. Over 6 years of applied research has been performed. Equipment is available for batch and continuous-flow testing.

Comments : Particles in suspension with a diameter less than 0.5 microns are difficult to flocculate. Flow through the acoustic treatment chamber must be close to laminar - this limits flow velocity. There is a maximum distance between transducer and reflector. This limits flow rates. The technology achieves flocculation at a higher rate than conventional systems without the use of chemical additives. The equipment is simple and maintenance free since there are no moving parts. The equipment is compact. Primary challenge is scale-up.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Dust Control*

Technology Name : Long Duration Foam

Application : On-site Ex-situ

Brief Description : Rusmar Long Duration foam is applied over an emitting surface to control odors, VOC's, dust and other emissions. The foam creates a continuous barrier between the surface and the atmosphere. Rusmar Long Duration Foam Technology is very effective in controlling any emission. Long Duration Foam is utilized in place of soils, tarps and other cover materials to control odors, VOC's, dust, windblown emissions, etc. Long Duration Foam completely covers any surface to which it is applied and it will conform to irregular and vertical surfaces. Long Duration Foam can be applied quickly, easily and provides a superior barrier to emissions than soil or tarps. It is non-toxic, non-hazardous, non-flammable and biodegradable.

Company Name/POC: Rusmar Incorporated/Laura White

Address : 216 Garfield Avenue/West Chester, Pennsylvania 19380

Phone Number : 610 436-4314

Fax Number : 610 436-8436

Technology Maturity : Commercial use experience

Performance History : Rusmar Long Duration Foam has been used throughout the United States and abroad for a variety of applications including: remediation projects, Superfund projects, lagoon and pond closures. It has been used as odor control on a liquid surface, for dust and VOC's suppression, emergency response, vapor and odor suppression in industrial applications and erosion control and to prevent surface water infiltration on stock piled soils. Additionally, Long Duration Foam has been used for in transit odor control on sludge filled containers and dust control during demolition of asbestos contaminated buildings.

Comments : Some of the Long Duration Foam products require water to dilute the product prior to use. The water must have less than 300 PPM of hardness. The smaller Pneumatic Foam Units are trailer mounted and require a piece of equipment to tow them around the site. During months of freezing weather, all Long Duration Foam products must be protected from freezing. The Pneumatic Foam Units are completely self contained and require no outside source of power. During freezing weather, a source of electricity is required to operate the freeze protection system on the larger Pneumatic Foam Units. There are no application temperature limitations on Long Duration Foam Products. Care must be exercised when applying AC-900 Series products with respect to weather, a heavy rain will not allow the membrane to form. After the first day, AC-900 Series products are unaffected by weather, i.e., rain, snow, wind, etc. Long Duration Foam is easily applied utilizing a Rusmar Incorporated Pneumatic Foam Unit. Long Duration Foam is a single component material requiring non chemical mixing and no post application cleanup. The Pnuematic Foam Units are simple and easy to operate; they require no special training. Long Duration Foam is available with durations ranging from a few hours to six months. The Pnuematic Foam Units are available in a variety of sizes ranging from a small skid mounted unit to a large self propelled track mounted unit. These units are available for purchase or rental. Long Duration Foam and Pnuematic Foam Units have been in use in the field for the past nine years. They do not face any general challenges. Long Duration Foam can be applied at a rate of 500 square feet per minute and requires only one operator.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides

☐ Heavy Metals

☐ PCB

☐ Explosives/Propellants

☐ Petroleum Hydrocarbons

☐ Radionuclides

☐ SVOC

☐ Other Contaminant

☐ Nonhalogenated VOC

☐ Halogenated VOC

☐ N/A

TECHNOLOGY TYPE :

Technology Name :

Application :

Brief Description :

Company Name/POC: Blank

Address :

Phone Number :

Fax Number :

Technology Maturity :

Performance History :

Comments:

Source of Information :

Process Wastes/Sludge

Treatment

Process Wastes/Sludge

Treatment

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : Bioremediation

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : ChemPete, Inc. has developed and proven an effective, continuous, and timely clean-up method for transforming gasoline, diesel fuel, fuel oil, kerosene, and chlorinated solvents to nonhazardous organic matter, carbon dioxide, and water. ChemPete currently uses bacteria, nutrients, and a catalyst developed by Alpha Environmental Biosystems Inc., which has a worldwide reputation for success.

Company Name/POC: ChemPete, Inc./John Peterson

Address : 405 E. Pierce Street/Elburn, Illinois 60119

Phone Number : 708 365-2007

Fax Number : 708 365-9099

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Comments :

By combining Alpha Inc., material with ChemPete's 15-year experience in chemical process design and fermentation, ChemPete Inc., was the first company to close both gasoline and fuel oil sites in situ in accordance with Illinois' rigorous closure guidelines (5 ppb benzene). ChemPete has reduced 140 ppm benzene to nondetectable levels in aboveground sandy piles in as short a time as 40 days. ChemPete has reduced 85 ppm fuel oil (TPH) to 4 ppb in 75 days at a depth of 27 feet.

ChemPete Inc. has the capability of doing ex situ work and treating groundwater, utilizing bioreactors. ChemPete uses trenches, vertical wells, biobarriers and other techniques, depending on the soils' hydraulic conductivities, to set up an effective bioremediation system to conclude the process in a timely manner. The major limitations to the ChemPete system are refractory materials that would not allow the bacteria to exist. Examples of materials that are refractory are strong acids, strong bases, biocides or soils heavily contaminated with solvents.

Source of Information : VISITT 3.0

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : Biocatalytic Contaminant Degradation (BCD)

Application : In-situ (vadose zone) Ex-situ
 In-situ (saturated zone)

Brief Description : ECO-TEC, Inc. (ETI), utilizes "Enviomech Gold", (EMG), a proprietary biocatalyst to dramatically accelerate the biodegradation of petroleum hydrocarbons and other biodegradable contaminants. The biocatalytic contaminant degradation (BCD) process can be applied to soil or groundwater, ex situ or in situ. A pH-balanced microbial inoculum (BMI) consisting of water, EMG, indigenous microbes, contaminant specific microbes (if needed) and all trace minerals and nutrients required for microbial proliferation is created.

Company Name/POC: ECO-TEC, Inc./Ecology Technology, Inc./Herbert R. Pearce

Address : P.O. Box 1113/Issaquah, Washington 98027-1113

Phone Number : 206 392-0304

Fax Number : 206 392-057

Technology Maturity : Commercial use experience

Performance History : The Biocatalytic contaminant degradation, (BCD), technology has been successfully demonstrated many times on full-scale remediation projects in Washington State.

Comments : Generally, BCD technology can be applied to various sites and media, and can be implemented utilizing equipment that is readily available. Since many variable parameters exist between sites, no one BMI or application technology is best suited to all situations. The BCD process will be modified to meet site-specific criteria. The Biocatalytic contaminant degradation, (BCD), process is not the one cure for all remediation problems, although it can be utilized in conjunction with other remediation technologies. The BCD process is limited by the availability of oxygen, range of temperature and the availability of moisture. All of these limiting factors can be controlled in modern site remediation operations.

Source of Information : VISITT 3.0

CONTAMINANTS :	☐ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants
	☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
	☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : Anaerobic Metal Removal Technology (AMR)

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : The AMR process was developed to release, separate and remove toxic metal contaminants in solids (soils, sediments, sludges) and can simultaneously bioremediate organic pollutants. The AMR technology involves the use of indigenous anaerobic heterotrophic denitrifying microbial populations which are resistant to and will aid in the solubilization of metal sulfides in the presence of other organic pollutants. AMR technology operates in the absence of oxygen, thereby eliminating the need for aeration. The process produces no acid which eliminates the secondary pollution problems. The addition of a low-cost and readily available soluble alternate electron acceptor source (nitrate) allows the system to be operated at low cost.

Company Name/POC: Geo-Microbial Technologies, Inc./D.O. Hitzman

Address : P.O. Box 132, East Main Street/Ochelata, Oklahoma 74051

Phone Number : 918 535-2281 **Fax Number :** 918 535-2564

Technology Maturity : Bench scale testing, only

Performance History : Development for removal of metals from spent coal liquification catalysts (DOE contracts).

Comments : The elimination of oxygen requirements allows broad usage. Microbial ecology would be easily manipulated by minimum alternate electron acceptor amendments. The system has broad potential applications with minimum requirements for implementation. The ease and flexibility of amendment addition and use of indigenous microflora expand the range of applications.

Source of Information : TechCon

CONTAMINANTS:

- ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : Phytostabilized Bioremediation

Application : In-situ (vadose zone)

In-situ (saturated zone)

Brief Description : Uses enhanced biotechnology to degrade organics - e.g., phenol, PCB, dioxin and inorganics - nitrate, ammonia etc. The technology can be used in a soil matrix to treat flowing groundwater/effluent or by direct planting into soil. Non-stabilized bioremediated and many types of conventional water treatment. Microorganisms (fungi and bacteria) which develop in the planted soil are responsible for most of the treatment. The root and rhizone systems of the reeds bring air into the soil surrounding them while further away the environment is anaerobic creating a unique mosaic of treatment spheres which facilitates the impressive ability of reed beds to remove complex and previously intractable pollutants. The majority of treatment is by soil microbes but certain contaminants (such as heavy metals, sulphur and phosphorous) are removed via soil processes.

Company Name/POC: OEEL Ltd/ESU Ltd/ Lucian S. Gill

Address : 4 Cumberland House/Greenide Land/Lidget Green/Bradford W. Yorkshire BD89TF England

Phone Number : 1274 480033

Fax Number : 1274 48300

Technology Maturity : Commercial use experience

Performance History : Over 500 applications worldwide including PCB, Pesticide, Dioxins, Organics - including solvents, phenolics, PAH's, ammonia, nitrates, cyanide etc., sewage, farm slurries, metal entrapment/extraction.

Comments : Requires adaptation and monitoring over the first 3 years to maturity but then continues in some cases with little or no attention. Requires larger land areas than conventional "packaged" systems. Requires three years adaption period. Once adapted is extremely flexible and will readapt to changes in input. The technique involves genetics selection of plant types to withstand toxic material. The plant/soil/bacterial matrix is then adapted to the site conditions and once stabilized - continues to treat the toxic material indefinitely. Effluent/groundwater is fed into a basin containing the PL/SO/BAC matrix. Plants are allowed to develop and penetrate their rhizomes into the toxic soil. Because each site has a unique problem, no hard rule for system costs can be given. Smallest system - 10 sq. meters, largest 20 hectares; volume 1 m(cubed) per day to 5000 m(cubed) per day.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : Mixflo (TM)

Application : On-site

Brief Description : Praxair's MIXFLO System dissolves oxygen into a slurry from a lagoon in a two-stage process. In the first stage, slurry is pumped from the lagoon and pressurized to between 2 and 4 atmospheres. Pure oxygen gas is injected into the slurry. The resulting mixture passes through a pipeline contactor in which approximately 60 percent of the injected oxygen dissolves. In the second stage, the oxygen/slurry mixture is reinjected into the lagoon through a liquid/liquid eductor which ingests unoxygenated slurry from the lagoon and mixes it with the oxygenated slurry. This technology can also be used to assist a slurry-phase bioremediation system.

Company Name/POC: Praxair, Inc./Gary E. Storms

Address : Linde Division/39 Old Ridgeburg Rd./Danbury, CN 06810

Phone Number : 203 837-2000

Fax Number : 203 837-2505

Technology Maturity : Commercial use experience

Performance History : Over 150 secondary wastewater treatment installations, including both tanks and lagoons, are successfully using this technology in Europe and South America. A full-scale in situ lagoon phase bioremediation began in early 1992 at the French, Ltd. Superfund site in Crosby, Texas using the MIXFLO technology. The technology met all its design expectations and the remediation was completed ahead of schedule.

Comments : Praxair's MIXFLO System is compatible with all aerobic lagoon phase bioremediation processes that would otherwise use air. This technology is only applicable to slurry-phase type of bioremediation. Therefore, as an in situ process, it is applicable to lagoons, pits, ponds, etc. Slurry must be pumpable and pass through a 1/2-inch mesh.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Solidification/Stabilization (In Situ)***Technology Name :** Stabilization/Solidification

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : STC Omega specializes in the development and application of technologies for the treatment of organic and inorganic contaminated soils, sludges and wastewaters. STC Omega's chemical fixation and solidification technologies have been utilized successfully to treat over 500,000 cubic yards of contaminated soils and sludges on >30 full-scale hazardous waste remediation projects across the U.S. and in Italy. STC Omega's technologies have been applied to industrial in-process treatment, hazardous waste site remediation projects, RCRA Landban treatment in a Part B permitted hazardous waste landfill facility, and organic and inorganic industrial wastewater treatment systems. Technology allows treatment to be performed in-situ. Full-scale treatment performance can be determined effectively on a laboratory- and pilot-scale basis before full scale.

Company Name/POC: STC Omega, Inc./Greg Maupin**Address :** 7650 E. Redfield Road/Suite D5/Scottsdale, Arizona 85260**Phone Number :** 602 948-7100**Fax Number :** 602 991-317**Technology Maturity :** Commercial use experience**Performance History :** Performance Data are Available.

Comments: This technology is quite versatile. It has been used inside buildings, in rural areas with minimal access to power, and normal construction sites. Soil matrix such as stiff clay can reduce the treatment rate production. STC Omega has been successful in treating all types of soil matrices. STC Omega treatment can be provided with standard rental construction equipment. Main attribute after treatment is significantly reducing the leachability and mobilization of contaminants. This reduction can be determined with such tests as the EPA TCLP and American Nuclear Society ANS 16-1.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Solid Phase Biological Treatment*

Technology Name : Biocatalytic Contaminant Degradation (BCD)

Application : On-site Ex-situ

Brief Description : ECO-TEC, Inc. (ETI), utilizes "Enviomech Gold", (EMG), a proprietary biocatalyst to dramatically accelerate the biodegradation of petroleum hydrocarbons and other biodegradable contaminants. The biocatalytic contaminant degradation (BCD) process can be applied to soil or groundwater, ex situ or in situ. A pH-balanced microbial inoculum (BMI) consisting of water, EMG, indigenous microbes, contaminant specific microbes (if needed) and all trace minerals and nutrients required for microbial proliferation is created.

Company Name/POC: ECO-TEC, Inc./Ecology Technology, Inc./Herbert R. Pearse

Address : P.O. Box 1113/Issaquah, Washington 98027-1113

Phone Number : 206 392-0304

Fax Number : 206 392-0575

Technology Maturity : Commercial use experience

Performance History : The Biocatalytic contaminant degradation, (BCD), technology has been successfully demonstrated many times on full-scale remediation projects in Washington State.

Comments : Generally, BCD technology can be applied to various sites and media, and can be implemented utilizing equipment that is readily available. Since many variable parameters exist between sites, no one BMI or application technology is best suited to all situations. The BCD process will be modified to meet site-specific criteria. The Biocatalytic contaminant degradation, (BCD), process is not the one cure for all remediation problems, although it can be utilized in conjunction with other remediation technologies. The BCD process is limited by the availability of oxygen, range of temperature and the availability of moisture. All of these limiting factors can be controlled in modern site remediation operations.

Source of Information : VISITT 3.0

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Solid Phase Biological Treatment*

Technology Name : CNP-Plus Bioremediation

Application : ☐ On-site ☐ Ex-situ

Brief Description : The CNP-Plus is a speciality belended biological activator that stimulates indigenous microbial growth when applied to soils containing organic contaminants. The stimulating characteristics of CNP-Plus causes extensive proliferation in the indigenous microbial population to the point where the organic contaminants become their basic food source and biodegradation takes place.

Company Name/POC: Etus, Inc./Mark Wernhoff

Address : 1511 Kastner Place/Sanford, Florida 32771

Phone Number : 407 321-7910

Fax Number : 407 321-309

Technology Maturity : Commercial use experience

Performance History : Full-scale process installations have been used to reduce organic hydrocarbon contaminant loadings in soils to within the established parameters of the State and local regulatory agencies. Pilot-scale demonstrations have been performed at sites to treat soils and sludges contaminated with diesel fuels, TPHs, and PCBs.

Comments : The treatment process may be applied both in situ or ex situ, while the ex situ process is greatly accelerated by the optimization of all the factors relevant to microbial proliferation. The main limiting factor of the process is sustained ambient air temperature below 50 degrees Fahrenheit but this can be overcome with the use of mechanical devices. The use of the enhanced bioremediation technology for organic hydrocarbon contaminants will achieve up to 90 percent reduction in concentration levels within 60 to 180 days.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Solid Phase Biological Treatment*

Technology Name : Biofast

Application : On-site Ex-situ

Brief Description : The most typical application is related to leaking underground storage tanks where excavated soil must be treated. The BIOFAST system is installed in the pit generated during tank removal; a liner is placed in the pit to prevent further contaminant migration. Excavated soil is treated with nutrients, lime and moisture as recommended by a simple bench-scale assessment. Layers of soil and air exchange conduits are placed in the lined pit until the pit is refilled. The pit is then typically covered with an asphalt cap.

Company Name/POC: IT Corporation/Duane Graves

Address : 312 Directors Drive/Knoxville, Tennessee 37923

Phone Number : 615 690-3211

Fax Number : 615 690-3626

Technology Maturity : Commercial use experience

Performance History : The BIOFAST system has been successfully deployed at full scale. Full-scale systems have been employed to treat gasoline and diesel impacted soil at service stations and at a trucking terminal.

Comments : The BIOFAST system provides an unobtrusive soil treatment alternative which is well suited for the treatment of contaminated soils associated with underground storage tanks and other remedial activities which involve the excavation of contaminated soil. The system is space efficient and generally does not interfere with site operations. The system has the capability to treat a variety of soil types and will accommodate almost any volume of soil. A subsurface BIOFAST system will support heavy ground traffic if properly compacted.

Source of Information : VISITT 3.0

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : Drill Cuttings Bioremediation

Application : On-site Ex-situ

Brief Description : BioGEE International, Inc., has designed a unique method of removing the oil from oil-based cuttings which allows the cuttings to be handled as non-hazardous waste (NOW). The methodology consists of applying the BioGEE HC along with certain compatible organic solvents and enzymes on the cuttings as they are gathered into a cuttings tank. This begins the remediation process. The cuttings are then pumped to specially constructed tanks with an air compressor and mixer at the bottom which agitates and aerates the cuttings in a slurry form. The solvents help break loose the oil from the cuttings and allow the bacteria to better contact the oil for digestion.

Company Name/POC: BIOGEE International, Inc./Trey Barber

Address : 16300 Katy Freeway/Suite 100/Houston, Texas 77094-1609

Phone Number : 713 578-3111

Fax Number : 713 578-111

Technology Maturity : Pilot plant testing

Performance History : Patent on processing methodology is pending (U.S. # 07/878,484). License is available for qualified equipment manufacturers and service contractors. Engineers from BioGEE are available to design specific equipment and tank requirements for drilling operation. Use of this proprietary process is subject to a license and use fee payable to BioGEE International and/or its assignees.

Comments : After the BioGEE HC bacteria have metabolized the oil from the cuttings, the cuttings can be safely discharged overboard in the case of an offshore drilling rig or for land-based drilling operation, spread over the land at the site and tilled into the soil after drying. Technical limitation is related to retention time. A minimum of a six hour hydraulic retention time is needed.

Source of Information : VISITT 3.0

CONTAMINANTS :	☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
	☒ Petroleum Hydrocarbons	☐ Radionuclides	☒ SVOC	☐ Other Contaminant
	☐ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : Bionergies, Biosmose, Biosurf

Application : In-situ (vadose zone) Off-site Ex-situ
In-situ (saturated zone)

Brief Description : Bioremediation of organic pollutions (in soils, water, effluents) by using: 1. exogenous specific bacterial consortium (non toxic, environment safe, European Federation of Biotechnology class I in order to control a full, complete and non selective biodegradation. 2. Biofixations (mineral natural support). 3. Biosurfactants (produced by selected bacteria) provide an effective, fast and secure alternative to common place bioremediation because Bionergies controls the biodegradation of the pollutant (and metabolites) by using specialized bacteria and feasibility tests (in labs, on the field).

Company Name/POC: Bionergies Laboratories, Biosurf/M. Jacques FAUDIN

Address : 59/100, rue des 4 termes/B.P. 1009/Z.I. des Paluds/13781 AUBAGNE Cedex, France

Phone Number : 33 42 84 30 07 **Fax Number :** 33 42 84 23 33

Technology Maturity : Commercial use experience

Performance History : Contact company for performance data.

Comments : Each case is analyzed in order to optimize the treatment and the on site materials and personnel. Bioenergies controls the bacterial action by using exogenous specific bacterial strains, biofixations and biosurfactants. None of the bacteria is genetically engineered. They are classified into class I (one) of the European Federation of Biotechnology, and produced under French and European Community regulations. The company is looking for join-ventures in U.S. in order to cover the environmental and industrial field.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : Bevrox Biotreatment Train Process

Application : On-site Ex-situ

Brief Description : Contaminated material is excavated, derocked, pulverized, and slurried with water containing elevated concentrations of acclimated, cultured bacteria. The slurry is then pumped into the biotreatment digester. Agitation and aeration maintain suspension of solids and dissolved oxygen levels. The aerobic biological degradation continues until the mandated treatment level is achieved. Monitoring of the digester parameters is done on site. After reaching treatment levels, the slurry is pumped to a dewatering system consisting of a hydrocyclone, vibrating filter belt, etc., as appropriate. The damp soil is conveyed to a stockpile. The water, containing the biomass, is recycled to an incubator to "pump up" the concentration of bacteria. The water is then returned to the slurrying system for reuse.

Company Name/POC: Bogart Environmental Services, Inc./Jim League

Address : 3586 N. Mt. Juliet Road/P.O. Box 717/Mt. Juliet, Tennessee 37122

Phone Number : 615 754-2847

Fax Number : 615 754-284

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Comments : The technology is operational, having been used on contaminated sites since 1984. The main consideration is that the material must be excavated. The system is designed for low permeability materials, such as clays, that are not amenable to "in situ" applications. High levels of metals have not inhibited the bioremediation process. Even levels of 400 ppm arsenic have not been detrimental.

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : Slurry Phase Bioremediation

Application : On-site Ex-situ

Brief Description : Slurry-Phase Bioreactors - Bioslurry reactors combine excavated contaminated soils, sludges, or sediments with water and nutrients in above-ground agitated tanks to create a slurry. Mechanical agitation not only introduces oxygen but maximizes the availability of nutrients to the indigenous microorganisms capable of degrading the target compounds. Following treatment, the cleaned soils is separated from the slurry and is replaced on-site. Bioslurry reactors are particularly effective for a site where seasonal climatic changes are unfavorable for solid-phase treatment. Anaerobic slurry reactors can be utilized for the remediation of recalcitrant compounds such as chlorinated aliphatics and substituted aromatics.

Company Name/POC: COGNIS, Inc./Ron Wilson

Address : 2331 Circadian Way/Santa Rosa, California 95407

Phone Number : 707 575-7155

Fax Number : 707 575-7833

Technology Maturity : Bench scale testing, only

Performance History : This remediation technology is being developed rapidly and was to have completed pilot plant testing by early 1993. Capability to remediate chlorinated organics within this system will be developed.

Comments : May be coupled with acid extraction to address soils contaminated with metals and organics. Metals which adversely affect bioremediation are removed before the bioreactor step.

Source of Information : VISITT 3.0

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Slurry Phase Biological Treatment***Technology Name:** Slurry Phase Bioremediation**Application:** Ex-situ

Brief Description: Bioslurry reactor systems aerobically biodegrade aqueous slurries created through the mixing of soils or sludges with water. The most common mode of bioslurry treatment is batch; however, IT can operate several reactors in series to provide semicontinuous flow operation. Aeration is provided through floating, submerged aerators alone, or in conjunction with mechanical mixers. Nutrient addition and pH adjustment are accomplished through metered chemical addition to the reactor vessel. IT prefers to stimulate indigenous bacteria rather than add bacteria to the system. Following aeration, the treated slurry is dewatered via standard dewatering equipment, such as clarifiers or filtration.

Company Name/POC: IT Corporation/Kandi Brown**Address:** 312 Directors Drive/Knoxville, Tennessee 37923**Phone Number:** 615 690-3211**Fax Number:** 615 690-362**Technology Maturity:** Pilot plant testing

Performance History: The treatability studies for bioslurry treatment of a creosote-impacted soil included a batch slurry study and a bioslurry reactor study. The batch slurry study produced supporting data for the enhanced operation of the pilot-scale bioslurry reactor. Batch slurry testing was conducted in sealed, 1-L vessels at solids loadings of 30 and 40 percent. The batch study demonstrated total PAH percent removals ranging from 83 to 87 percent; CPAH removals ranged from 71 to 79 percent. Initial PAH concentration in the treatment vessels ranged from 1,100 to 1,600 mg/kg; CPAH concentrations ranged from 390 to 550 mg/kg. The CPAH concentration were reduced to 170 mg/kg at week 3. Following the batch study, a 3-month, pilot-scale bioslurry study was conducted. The 60-L, stainless-steel Eimco Biolift slurry reactor was operated in continuous-flow and batch mode. Following 4 weeks of treatment, PAH and CPAH concentrations averaged 320 and 180 mg/kg, respectively.

Comments: The process may require pretreatment of the waste matrix to produce general characteristics which are appropriate for bioslurry treatment. The contaminant must be transferred to the aqueous phase for biodegradation to take place. The contaminant removal efficiency for petroleum-impacted matrices is generally around 80 percent. Therefore, treated soils may require additional treatment depending on their ultimate disposal.

Source of Information: VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment.*

Technology Name : Biotechnology/Bioremediation

Application : On-site Ex-situ

Brief Description : Biological decontamination of soil/wastewater using bioadapted micro-organisms. Microbes use hazardous organic substances as food sources thereby degrading them to nonhazardous end products like CO₂ and H₂O. Achieves a high level of decontamination in a short time; inexpensive.

Company Name/POC: KAM Biotechnology Ltd./Mongi Ferchichi

Address : 9710 187th St., #101/Surrey B.C. V4N 3N6

Phone Number : 604 888-4336

Fax Number : 604 888-6623

Technology Maturity : Commercial use experience

Performance History : Successfully completed decontamination of soils, wastewaters, sludges, transformer oils etc.

Comments : Bacteria cannot degrade all compounds and some are in fact inhibitory to their growth. Equipment easily transported. Minimal infrastructure required. Most bacterial additives are "not controlled" plus not "hazardous."

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : Biolift Reactor

Application : On-site Ex-situ

Brief Description : The reactor uses a rake/thickener mechanism to control settled solid particles by raking them to either a central airlift or multiple airlifts at the tank periphery. Internal or external airlifts will affect the recirculation of soils. Airlift(s) effect(s) internal (external) recirculation of solids. Flexible membrane tube diffusers are provided in a stacked arrangement rotating on the rake arms to effect aeration of the slurry. Depending on the application, one or several mixers are provided. The reactor is gas-sealed and volatile emissions are controlled through gas recirculation allowing for their eventual biodegradation.

Company Name/POC: Tekno Associates/Gunter Brox

Address : 3466 South Westwood Drive/Salt Lake City, Utah 84109

Phone Number : 801 272-2288

Fax Number : 801 272-228

Technology Maturity: Commercial use experience

Performance History : Performance data are available.

Equipment was evaluated during the demonstration of Biotrol, Inc.'s soil washer under EPA's SITE Program. The Biolift Reactor has treated creosote contaminated soil for an EPA BDAT study project executed by ECOVA Corporation and for the SBP Site demonstration project at American Creosote Works in Florida. The reactor has also treated BTEX and TPH contaminated soils from the Ninth Avenue Superfund Site.

Comments : Contaminants have to be biodegradable. High metal concentration may be inhibitory. Soil has to be processed into a uniform slurry by applying mineral processing techniques. The reactor does not provide enough kinetic energy to affect slurrying of freshly "as is" excavated soil.

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : Auto-Heating Thermophilic Aerobic Reactor (ATAR)

Application : On-site Ex-situ

Brief Description : A-TAR is a self-heating slurry-phase bioreactor operating in the thermophilic temperature range (45-65 degrees Centigrade) with no external heating support and no nutrient addition. This technology is being developed for accelerated bioremediation soils, sediments and sludges contaminated with biodegradable hazardous organics. The aerobic bioreactor degrades complex organic substrates and the energy released in exothermic reactions is captured to maintain the reactor temperature. Significant biological destruction of polycyclic aromatic hydrocarbon is achieved over a 5-10-day treatment time.

Company Name/POC: Wastewater Technology Centre/Deonarine Phagoo

Address : 867 Lakeshore Road/P.O. Box 5068/Burlington, Ontario, Canada L7R 4L7

Phone Number : 905 336-6478

Fax Number : 905 336-4765

Technology Maturity : Pilot plant testing

Performance History : Bench-scale treatability study on contaminated soils from a manufactured gas plant site. These trials have demonstrated over 90% removals of PAHs at a 5-day retention time for contaminated soil in the feed of up to 10% by weight. Pilot scale experiments were conducted using a 1000 L slurry bioreactor for treating contaminated sediments from Hamilton Harbour and the results demonstrated over 95% removal of total PAHs, about 80% removal of total petroleum hydrocarbon (TPH), and about 70% removal of oil and grease (O&G) over an 8-day reactor retention time, without external heating support.

Comments : Requires high oxygen transfer efficiency and good mixing. Primary applicable for the treatment of contaminated fines in soils, sediment and sludges.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Slurry Phase Biological Treatment

Technology Name : Slurry-Phase Bioremediation

Application : ☒ On-site ☒ Ex-situ

Brief Description : Engineered bioreactor for slurry-phase remediation of contaminated soils, sediments, and or sludges at higher treatment rates than conventional solid phase bioremediation.

Company Name/POC: Wastewater Technology Centre/Kevin Hosler

Address : 867 Lakeshore Road/P.O. Box 5068/Burlington, Ontario, Canada L7R 4L7

Phone Number : 905 336-6021

Fax Number : 905 336-476

Technology Maturity : Bench scale testing, only

Performance History : Contact company for performance data.

Comments : Limited to biologically-degradable contaminants. Will be easy to use at full-scale; available as a transportable unit, fully automated. Scale-up considerations have not yet been fully addressed.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : Biocat-II (TM)

Application : Ex-situ

Brief Description : The process uses natural microorganisms to remove toxic organic and inorganic waste constituents with recovery of metals, sulfur and energy from mixed hazardous wastes. Applications include bioremediation of industrial wastewater, sludges, slurries and contaminated groundwater.

Company Name/POC: Yellowstone Environmental Science, Inc./Mary M. Hunter

Address : 320 S. Willson Avenue/Bozeman, Montana 59715

Phone Number : 406 586-3905

Fax Number : 406 587-5109

Technology Maturity : Bench scale testing, only

Performance History : Laboratory studies by Yellowstone Environmental Science, Inc. (YES) and others have confirmed removal of the following constituents during the indicated process steps: (1) denitrification: benzene, toluene, ethylbenzene, o-xylene, m-xylene, p-xylene, phenol, o-cresol, p-cresol, and carbon tetrachloride; (2) sulfate-reduction: phenol, p-cresole, and carbon tetrachloride; (3) methanogenesis: benzene, toluene, ethylbenzene, o-xylene, phenol, p-cresol, 1,1,1-trichloroethane (TCA), tetrachloroethylene (PCE), trichloroethylene (TCE), carbon tetrachloride, chloroform, bromoform, methylene chloride, chlorophenols, and trichlorofluoromethane (FREON II); and (4) aerobic respiration: benzene, toluene, phenol, m-cresol, p-cresol, TCE, and vinyl chloride.

Comments : The BIOCAT-II (TM) process is applicable to situations wherein the wastes can be exposed to a sequence of treatment environments. This is most easily accomplished in a series of reactors.

Source of Information : VISITT 3.0

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Chemical Reduction/Oxidation*

Technology Name : Wet Oxidation

Application : On-site Ex-situ
Off-site

Brief Description : This technology uses wet oxidation to treat radioactive organics and other organics in mixed waste. It converts organics into CO₂ and H₂O.

Company Name/POC: ADTECHS, Inc. (a wholly owned subsidiary of JGC Corp.)/Dennis Wilkie

Address : 2411 Dulles Corner Park/Suite 520/Herndon, Virginia 22071

Phone Number : 703 713-9000

Fax Number : 703 713-910

Technology Maturity : Pilot plant testing

Performance History : Process has been fully tested as a pilot plant. ADTECHS is actively seeking a site in the U.S. to construct a commercial system. Full-scale pilot plant is operational overseas.

Comments : No unusual site requirements. Processes use H₂SO₄, H₂O₂, NaOH for process chemicals. Process requires usual support/facilities for a chemical process. Process through-put is determined by the size of the unit and the speed of the chemical process.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Chemical Reduction/Oxidation*

Technology Name : Thermo Catalytic Cracking

Application : On-site Ex-situ

Brief Description : The technology uses a cheap but very reliable catalyser, which operates at approximately 600 degrees C to reduce molecules (e.g., nerve agents, other toxic gases or vapors). It might need a pyrolysisator in front to generate gases and vapors.

Company Name/POC: Alba Industrie Umweltschutzservice GmbH/Dr. K. Faber

Address : Rehrhoferweg 160/D29625 Munster, Germany

Phone Number : 051 929 63212

Fax Number : 051 929 6331

Technology Maturity : Pilot plant testing

Performance History : The technology has run successfully for one year. It was used to destroy chemical weapons (e.g., in British hand grenades, but also Lewesite, Adamsite).

Comments : 30 Kg/h throughput.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Chemical Reduction/Oxidation*

Technology Name : Light Activated Reduction of Chemicals (LARC)

Application : On-site Ex-situ

Brief Description : LARC is a patented photochemical process (U.S. Patent No. 4, 144, 152) which uses ultraviolet light and an optimized reducing environment to dehalogenate chlorinated, brominated, and iodinated organic compounds. The photochemical conditions supplied by the LARC reactor lead to a rapid, highly controllable reaction which yields only biphenyl and sodium chloride as the final products from PCBs. No oxygenated derivatives, chlorinated dibenzofurans, or chlorinated dioxins have ever been observed in gas chromatographs or mass spectra of the intermediates or products in the LARC degradation of chlorinated organics.

Company Name/POC: Arctech, Inc./Dr. Daman Walia

Address : 14100 Park Meadow Drive/Chantilly, Virginia 22021

Phone Number : 703 222-0280

Fax Number : 703 222-029

Technology Maturity : Pilot plant testing

Performance History : LARC is extremely cost-competitive with the existing technologies for treatment of PCBs (significantly lower in cost than incineration). Samples containing in excess of 1,000 ppm of PCBs have been successfully decontaminated to meet federal, state, and local clean-up levels. In a pilot-test study, Arochlor 1260 was reduced from 3,000 ppm to 20 ppm, when treated by the LARC technology.

Comments : The LARC technology is not useful for treatment of metals-only or radioactive wastes. The process is designed specifically for treatment of halogen containing materials. Inorganic materials present in wastes do not interfere with the efficiency of the process.

Source of Information : VISITT 3.0

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Chemical Reduction/Oxidation*

Technology Name : Low Temperature Resin Oxidation

Application : On-site Ex-situ

Brief Description : Through a joint EPRI development for the destruction of organic ion exchange resin, an aqueous reaction at 95 degrees C was developed that oxidizes the resin to carbon dioxide and nitrogen. The residual inorganics plus the radioactive contamination can then be solidified in an all inorganic waste form. Overall volume reduction is 10. Organic chelants can also be destroyed.

Company Name/POC: Bradtec Ltd./George Elder

Address : University of the West of England/Cold Harbour Lane/Bristol BS 16 1QY, United Kingdom

Phone Number : 44 117 976 3937

Fax Number : 44 117 976 3892

Technology Maturity : Pilot plant testing

Performance History : The process was developed at lab scale in 1980-87. Large lab scale testing was performed in 1988-89. Pilot plant tests occurred in 1991, EPRI report NP-7368-S. Further process optimization at lab scale took place in 1992, EPRI report TR-101046.

Comments : This technology is not for use with volatile radionuclides (e.g., tritium). Mobile or fixed plant would be possible. The technology requires development to full scale for application. The previous pilot plant has been dismantled.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Chemical Reduction/Oxidation*

Technology Name : Fully Integrated Hazardous Waste management Transportation, Treatment and Disposal

Application : Off-site Ex-situ

Brief Description : Company offers a total treatment service which includes: incineration, stabilization, solidification, and chemical neutralization

Company Name/POC: CHEM-SECURITY Alberta/Art Mathes

Address : #4 Manning Close N.E./Calgary, AB T2E 7N5, Canada

Phone Number : 403 235-8361 **Fax Number :** 403 248-343

Technology Maturity : Commercial use experience

Performance History : The following references relate to Mercury Stabilization Work:

Battelle Pacific N. W. Division
 Marine Research Lab
 Brenda LaSorsa, PhD
 439 W. Suquire Bay Rd.
 Sequia, WA 98362
 206 681-4151

Ratec Remediations Tech. Inc.
 Hans. F. Stroo, PhD
 1011 S. W. Klickitat Way
 Suite 207
 Seattle, WA 98134
 206 624-9349

Comments : CHEM-SECURITY operates a fully integrated Special Waste System in Canada Including:
 Transport of waste
 Incineration (2 Rotary Kilns)
 Roasting furnace for decontamination of PCB (and other) contaminated transformers and metals.
 Chemical neutralization and treatment of acid and basic waste liquids
 Stabilization and solidification using advanced state of the art processes and equipment
 Secure landfill
 Two laboratories which conduct characterization and analysis and compliance testing as well as stabilization and solidification technology development.

Affiliated companies provide a full range of environmental evaluation and risk analysis services and manufacture instrumentation for emission and environmental monitoring.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE: *Chemical Reduction/Oxidation*

Technology Name : Gas Phase Chemical Reduction

Application :	On-site	Ex-situ
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Brief Description : The ECO LOGIC Process involves the gas-phase reduction of hazardous organic contaminants. The system is capable of treating any form of organic contamination at any concentration with proven destruction and removal efficiencies (DREs) of at least 99.9999 percent. Contaminants entrained in liquids, soils and bulk solids can be destroyed without the formation of hazardous organic residuals. The system has been verified by various government agencies worldwide including the US EPA through the Superfund Innovative Technology Evaluation program. The ECO LOGIC Process is currently offered as a commercial-scale system for on-site treatment. The closed-loop destruction process ensures that no uncontrolled emissions result while the use of a reducing atmosphere ensures that dioxins and furans are not formed as byproducts. The system is mobile and may be utilized for on-site destruction.

Company Name/POC: ELI Eco Logic International Inc./Jim Nash

Address : 143 Dennis Street/Rockwood, Ontario, Canada NOB2KO

Phone Number : 519 856-9591

Fax Number : 519 856-9235

Technology Maturity : Commercial use experience

Performance History : Development of the technology began in 1986 and proceeded through the bench-scale and laboratory-scale. In 1991, a pilot-scale unit was constructed and tested extensively at Hamilton Harbour, Ontario, Canada. Demonstrations on sediment contaminated with 300,000 ppm PAH and 400 ppm PCBs confirmed DREs of 99.9999 percent. The pilot-scale unit was tested in Bay City, Michigan, the following year for the US EPA and PCB contaminated oil (25 percent PCBs), water and soil. Once again DREs of at least 99.9999 percent were confirmed. Following the Bay City demonstration further modifications were made to the front-end preprocessing units as well as scaling up the technology to a commercial-scale. At the time of this writing, (May 1995) the first commercial-scale unit was operating in Australia on pesticide residuals and PCB contaminated electrical equipment. The second and third commercial-scale units are presently being constructed and will be utilized by General Motors of Canada Ltd. and the steel manufacturing firm Dofasco Inc.

Comments : The ECO LOGIC Process treats only the organic portion of the waste stream. Any inorganic co-contaminants will remain in the treated soil or be separated in the grit and scrubber as metal hydrides, depending on their physical characteristics. Additionally, the radioactive component of a mixed low level waste stream would be captured at various specific locations in the Process. With the ECO LOGIC Process, a mixed waste stream would undergo significant volume reduction and separate the radioactive component into a form that is more amenable to traditional methods of disposal. The ECO LOGIC Process is mobile and mounted on several drop-deck highway trailers. It may be transported to the waste site and set-up within four weeks. Once the on-site waste has been destroyed, the system is simply moved to the next site. The mobility and closed-loop destruction process have garnered significant public acceptance for the technology while being offered at a competitive cost. The ECO LOGIC Process is at an advanced state of development for an alternative remediation technology and is presently offered at a commercial-scale.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Chemical Reduction/Oxidation

Technology Name : Chemical Treatment-Oxidation/Reduction

Application : On-site Ex-situ

Brief Description : The operating principle is based upon the reaction of either an acid or caustic, with either the pollutant or a mixture of the pollutant and aluminum oxide, to chemically convert the hydrocarbons to carbon and non-hazardous aluminum compounds. The treatment takes place in a heated pressure chamber. Steam and other gases are vented to a separate chamber for further processing if necessary. Residual hazardous materials can be adsorbed by rehydratable alumina and retreated. It is unique as a closed system.

Company Name/POC: G.E.M., Inc./Cleve A. Bond

Address : P.O. Box 397/Highway 67 South/Malvern, Arkansas 72104

Phone Number : 501 337-9410

Fax Number : 501 337-120

Technology Maturity : Bench scale testing, only

Performance History : Not available.

Comments : The greatest advantage is that this is a closed system, where nothing is released into the atmosphere during operation, and allows for retreatment in the event that the procedure is not smooth. Pretreatment to reduce the quantity of inert material mixed with the hazardous waste is desirable for economic reasons. It is also undesirable for the waste to contain excess water.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Chemical Reduction/Oxidation***Technology Name :** Fenton's Chemistry (Fe catalyzed H₂O₂)**Application :** On-site Ex-situ**Brief Description :** Organic chemicals, i.e., aromatics, chlorohydrocarbons, alcohols, acids, aldehydes and amines react completely with OH to form CO₂ and H₂O. Hydroxyl radical is generated by Fe catalyzed hydrogen peroxide in water at atmospheric pressure and temperature. Reaction is controlled by ORP, pH, time temperature and concentration.**Company Name/POC:** Technotreat Corporation/Richard J. Bigda**Address :** 6216 S. Lewis/Suite 106/Tulsa, Oklahoma 74136.**Phone Number :** 918 445-0966**Fax Number :** 918 445-0994**Technology Maturity :** Commercial use experience**Performance History :** Six Technotreat Fenton's Reactors have been put into service for the treatment of paint stripper waste water containing phenol, formic acid, chrome, methylene chloride, benzene and toluene. References and contacts:

Aero Corporation: 904-752-7911, Joe Bonds

KC Aviation: 214-902-7511, Clyde Phillips

TAP Air Portugal: 011-351-1-841-6022, Abrantes Machado

Comments :

Units are skid mounted. 5000 gal/batch capacity system requires about 9' x 20' by 12'h area, requires 12-20 KVA power supply, and compressed air at 69 to 90 psi. Temperatures below 60 degrees Fahrenheit inhibit initiation of reaction. Automated, computer controlled system with proprietary software drives the unit through 55 steps with minimum operator's input or knowledge of chemistry. Various safety shut down devices protect against harm and run-away reactions. Interlocks prevent accidental spills and discharges to environment. Double containment can be incorporated. The system operates at atmospheric pressure and low temp. (100-140 degrees Fahrenheit)

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Soil Washing*

Technology Name : Ranator Detoxification Process (RDP)

Application : On-site Ex-situ

Brief Description : On-site and non-destructive remediation, by separation of chemical substance such as PCB's, creosote, dioxins, oil and other petroleum products from soil, sludge, sediments and other contaminated material, by taking advantage of the very special physical and chemical properties of the substances in a three-step process with process chemicals recirculated in closed systems. The contaminating substances are recovered as a concentrate.

Company Name/POC: Ranator AB/Torgny A. Mellin

Address : Roslagsvagen 101, hus/15, S - 104 05/ Stockholm, Sweden

Phone Number : 46 8 153880

Fax Number : 46 8 159717

Technology Maturity : Pilot plant testing

Performance History : RDP was successfully tested on a pilot plant test scale (50-100 kg/hr) in 1994, supported by the Swedish EPA. Presently a full-scale RDP test plant is in the final construction phase, scheduled for operations in June - August 1995 on a creosote contaminated, first reference object in Sweden. The test with the full scale RDP plant will provide data relevant to several of the questions in this form; during fall 1995 more details of RDP performance will be available. The project results show that the contaminant separation from the material easily may be regulated during treatment; thus, the degree of decontamination can reach as close to 100% as is required.

Comments : RDP is not capable of heavy metal decontamination, with a possible exception of mercury (R&D in progress); fine-grained material with very high organic content reduces the RDP efficiency. An industrial RDP plant is mobile and designed according to the module principle, in order to permit transport to any contaminated area, in suitable size and productivity, for on-site decontamination operations.

Source of Information : International TechCon

CONTAMINANTS :☒ Pesticides/Herbicides☒ Heavy Metals☒ PCB☒ Explosives/Propellants☒ Petroleum Hydrocarbons☒ Radionuclides☒ SVOC☒ Other Contaminant☒ Nonhalogenated VOC☒ Halogenated VOC☒ N/A**TECHNOLOGY TYPE :** *Soil Washing***Technology Name :** Soil Washing**Application :**

On-site

Ex-situ

Off-site

Brief Description :

This technology achieves soil, sediment, and sludge treatment for volume reduction or recycle. Treatment removes hydrocarbons, heavy metals, and radionuclides from contaminated media. It utilizes a patented system with countercurrent augers augmented by high pressure, heated water and co-surfactants as needed according to requirements as determined by treatability tests in the company's in-house lab. Full-scale performance with the technology has achieved state and federal cleanup standards at competitive prices. Advantages include limited or no emissions, volume reduction, low water usage, 60' x 60' footprint, and simultaneous hydrocarbon/metals treatment.

Company Name/POC : TVIES, Inc./W. R. (Randy) Hall**Address :** 2835 Holmes Road/Houston, Texas 77051**Phone Number :** 713 799-5243**Fax Number :** 713 799-5548**Technology Maturity :** Commercial use experience**Performance History :** Performance Data are Available.**Comments :**

HYDROCARBONS: (3, 500-15,000 tons) successfully achieved cleanup requirements in all cases. Problems included consistency in contamination level and soil/media particle size of feed, and water treatment/recycle if large swings in contamination level are experienced.

NORM: (3, 2-500 bbls) treated to <5pCi/gm with volume reduction of 70-95 percent.

HEAVY METALS: (2, 100-800 tons) achieved state cleanup standard.

Process is modular and as such, it is very flexible. Most functions are automated and labor intensity is not high. Equipment is not complex and tolerances are not high. Operation/maintenance and supplies/equipment are readily available and easy to install.

Current feed rates are 10-40 tons/hr. Could achieve higher rates with added modules.

Higher capacity or greater efficiency equates to lower cost.

Considered BDAT for heavy metals and low-level radionuclides.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : Soil Washing**Technology Name :** Soil Washing**Application :** On-site Ex-situ

Brief Description : The process uses well known mineral-handling technology to separate the contaminated material into two or more fractions. The fractions are cleaned, using physical (e.g., scrubbing heat, pressure jets) and chemical steps (e.g., pH adjustment, oxidation). The washing fluid may be water or water with chelating agents or surfactants, acids or bases, depending on the contaminant to be cleaned. The equipment is mobile and operates continuously. The process works best on particles greater than 270 mesh (approximately 0.05 mm).

Company Name/POC: West PAC Environmental, Inc./Mark McCullough**Address :** P.O. Box 80743 (zipcode 98108)/54 South Dawson Street/Seattle, Washington 98134**Phone Number :** 206 762-1190**Fax Number :** 206 762-936**Technology Maturity :** Commercial use experience

Performance History : Metals such as lead and arsenic have been treated with up to 95 percent reduction. TPHs have been treated, reducing levels from over 50,000 ppm to 300 ppm. West PAC has pilot-, treatability-, and production-level equipment on hand. Over the last five years, West PAC has conducted research and development work on soil washing for total petroleum hydrocarbons (TPH) and metal removal.

Comments : Efficient cleaning of the finer or clay fractions (<270 mesh) has required a combination of soil washing with another technology, such as solidification, bioremediation, or simply disposal of the fine fraction. Complex waste mixtures make fluid formulation of the washing fluid difficult. Based on tests to date, the mixture of metals with organics has been identified as problematic.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides☒ Heavy Metals☒ PCB☐ Explosives/Propellants☒ Petroleum Hydrocarbons☒ Radionuclides☒ SVOC☐ Other Contaminant☒ Nonhalogenated VOC☒ Halogenated VOC☐ N/ATECHNOLOGY TYPE : *Soil Washing*

Technology Name : Westinghouse Soil Washing System

Application : On-site Ex-situ

Brief Description : The Westinghouse Soil Washing Process (WSWP) can treat soils contaminated with organics, heavy metals, radionuclides, and combinations of contaminants. The full-scale units are integrated process trains which use equipment originally developed for the mining industry. The process is arranged to form three functional units: an initial screening and wash of coarse materials; breakup of the remaining solids followed by a thorough wash; a high intensity leaching and separation of the contaminated fines from the clean soil.

Company Name/POC: Westinghouse Remediation Services, Inc./William E. Norton, P.E.

Address : 675 Park North Boulevard/Building F/Suite 100/Clarkston, Georgia 30021

Phone Number : 404 299-4736

Fax Number : 404 296-9752

Technology Maturity : Commercial use experience

Performance History : Westinghouse has completed a major soil washing project which involved remediation of 16,000 cubic yards of material contaminated with metals at a site near Bruni, Texas. In addition, Westinghouse has completed bench-, and full-scale pilot testing for the remediation of a wood treating site. Westinghouse has also successfully performed numerous bench-, and pilot-scale treatability studies.

Comments : Westinghouse maintains two full-scale soil washing units. Both process a continuous feed of soil, the larger unit at 20 tons per hour, and the smaller one from 2 to 4 tons per hour. Both units are trailer-mounted and can be easily mobilized. This technology has been proven effective in handling soils that are difficult to wash, such as clays. Aqueous-based, biodegradable leachates are used so that soil washing residuals will not pose future contamination problems.

Source of Information : VISITT 3.0

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Solidification/Stabilization (Ex Situ)*

Technology Name : Customized Grout Applications for Waste Management

Application :

☐ On-site	☐ Ex-situ
☐ Off-site	

Brief Description : The company offers design and specification of customized grout formulations and mobile and fixed mixing plants to carry out void filling of drums containing solid wastes, plastics, etc. End products are large containers of decommissioned waste from soil stabilization or hydraulic cut-offs that sensibly meet the present regulations.

Company Name/POC: A-Z WASTE TEK Ltd./David J. Brown

Address : 32A Pooch Rd/Upton Poole/Dorset England BH16 5JB

Phone Number : 01144 1202 624985

Fax Number : 01144 1202 62517

Technology Maturity : Commercial use experience

Performance History : DJ Brown/A-Z is the originator of designs of many of the acceptable cement based grout. Currently used in the UK nuclear industry. A-Z has extended designs/specifications into a second generation of high performance grouting systems that have greater flexibility, longer working times and better end product performances.

Comments : Technology uses readily available equipment. Organic wastes can be a problem. A-Z can demonstrate the acceptability to grout containers with solid or decommissioned wastes from 200 liters to large ISO freight sizes. In its own laboratories A-Z have designed and demonstrated novel grouts and grouting systems to handle:

- Thickened slurries
- Solid simulated asbestos waste
- To produce special absorbents
- Synergized performance grouts

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides☒ Heavy Metals☐ PCB☐ Explosives/Propellants☐ Petroleum Hydrocarbons☒ Radionuclides☐ SVOC☐ Other Contaminant☐ Nonhalogenated VOC☐ Halogenated VOC☐ N/A**TECHNOLOGY TYPE :** *Solidification/Stabilization (Ex Situ)***Technology Name :** Polymerization of Heavy Metal Ions**Application :**

On-site

Ex-situ

Off-site

Brief Description :

Process uses a polymerized sulfide agent to chemically and physically stabilize heavy metal ions. The final waste product meets U.S. EPA leaching criteria. Stabilized product is low in volume and is chemically inert.

Company Name/POC: ADTECHS, Inc. (a wholly owned subsidiary of JGC Corp.)/Ken Sauda**Address :** 2411 Dulles Corner Park/Suite 520/Herndon, Virginia 22071**Phone Number :** 703 713-9000**Fax Number :** 703 713-9101**Technology Maturity :** Commercial use experience

Performance History : This process has been in use for 10 years for chemically binding heavy metals in municipal incinerator effluent streams. It is now also being used for processing electronics and electroplating manufacturing wastes. This process has been used for 10 years in Japan to fix heavy metal ions in process waste streams. It will work with radioactive or non-radioactive metal ions. Full scale, operational systems have been in service for several years.

Comments :

Materials handling and processing equipment are required, depending on the through-put rates and material form. May require soil washing and crushing equipment. Does require tanks for precipitation of waste dissolved water. Heavy metal ions must be wetted or in solution to react with the polymer. The basic challenge is the handling of the contaminated material.

Source of Information : TechCon

PROCESS WASTES/SLUDGE

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Solidification/Stabilization (Ex Situ)*

Technology Name : Fully Integrated Hazardous Waste management Transportation, Treatment and Disposal

Application : Off-site Ex-situ

Brief Description : Company offers a total treatment service which includes: incineration, stabilization, solidification, and chemical neutralization

Company Name/POC: CHEM-SECURITY Alberta/Art Mathes

Address : #4 Manning Close N.E./Calgary, AB T2E 7N5, Canada

Phone Number : 403 235-8361

Fax Number : 403 248-343

Technology Maturity : Commercial use experience

Performance History : The following references relate to Mercury Stabilization Work:

Battelle Pacific N. W. Division
Marine Research Lab
Brenda LaSorsa, PhD
439 W. Suquire Bay Rd.
Sequim, WA 98362
206 681-4151

Ratec Remediations Tech. Inc.
Hans. F. Stroo, PhD
1011 S. W. Klickitat Way
Suite 207
Seattle, WA 98134
206 624-9349

Comments : CHEM-SECURITY operates a fully integrated Special Waste System in Canada including:

Transport of waste
Incineration (2 Rotary Kilns)
Roasting furnace for decontamination of PCB (and other) contaminated transformers and metals.
Chemical neutralization and treatment of acid and basic waste liquids
Stabilization and solidification using advanced state of the art processes and equipment
Secure landfill
Two laboratories which conduct characterization and analysis and compliance testing as well as stabilization and solidification technology development.

Affiliated companies provide a full range of environmental evaluation and risk analysis services and manufacture instrumentation for emission and environmental monitoring.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Solidification/Stabilization (Ex Situ)*

Technology Name : Heitkamp Process of Solidification

Application : On-site Ex-situ
 Off-site

Brief Description : The Heitkamp Process is a patented solidification process for hazardous organics, metals, and radionuclides in soil, sediments, and sludges.

Company Name/POC: Heitkamp Umwelttechnik Gmb H

Address : Heinrichstr 67/44805 Bochum, Germany

Phone Number : 49 234 87905 236

Fax Number : 49 234 87905 115

Technology Maturity : Commercial use experience

Performance History : The Heitkamp Process - Immobilization of contaminants by solidification was developed in 1986. The year of issue of the patent grant was 1989. From 1987 to 1995 22 projects were carried out with hazardous organics and heavy metals contaminated soils and sludges. In 1994 tests with radioactive contaminated overburden of uranium mines were performed. The result of these experiments was a reduction of the mobile radioactive components down to 3 percent.

Comments : The mobile equipment is easy to handle, highly flexible and requires only short mobilization (1 week). No fixed installed infrastructure needed for the mobile equipment. The capacity depends on size and type of equipment (mobile around 250 t/d, portable 1,000 t/d, field erected more than 1,000 t/d).

Source of Information : International TechCon

PROCESS WASTES/SLUDGE

CONTAMINANTS: ☐ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE: *Solidification/Stabilization (Ex Situ)*

Technology Name: Phoenix Ash Technology (P.A.T.)

Application: On-site Ex-situ

Brief Description: This is a mobile or fixed-based ex-situ treatment technology that can be designed and built in a variety of capacities. The technology employs well established pozzolanic reaction chemistry to encapsulate a wide variety of potential waste streams. The P.A.T. technology uses C-grade fly ash from coal-fired power plants to encapsulate wastes into a fly-ash matrix in a form the size of standard construction bricks. Fly ash and waste are mixed and compressed into waste/ash bricks. The product shows significant leach resistance, low permeability, high compressive strength, resistance to spalling and cracking, and low thermal conductivity. The final waste form produced has been shown to pass the TCLP test and to have potential recycling applications in a variety of construction formats. The produced brick has potential application in construction of on site vaults for long term storage of bricks containing waste. The process is relatively inexpensive, operates at ambient temperatures, has a high loading rate, uses abundant and cheap fly ash, and produces a block configuration with high leach resistance and structural strength. The bricks have short cure times of approximately 15 minutes and have an advantage in not requiring special containers for storage.

Company Name/POC: Informatic Inc./John Theis/Mike Riddle

Address: 1900 Randolph Road, SE/Suite A/Albuquerque, New Mexico 87106

Phone Number: 505 248-1191

Fax Number: 505 248-119

Technology Maturity: Commercial use experience

Performance History: Performance Data are Available.

Commercial application - 900 tons of mine tailings at the Shiny Rock Mining Co site near Salem Oregon mine site in October 1992. Testing conducted at ORNL during 1993; shows TCLP results for metals similar to cement-based solidification/stabilization, Roger Spence (MMES ORNL 615-574-6782. Testing conducted at LANL in 1993, Karl Standhammer, 505-667-9333. Bruce King (Dr.) NETAC, 412-826-5511 wrote study for EPA on the results of stabilizing sodium salts into final waste forms.

Comments: The feed material to the process requires reactive grade Class C fly ash. The waste stream is restricted to a maximum of 20 percent moisture. Higher levels of moisture content can be pre-treated using additional fly ash which is an inert material. Additional data is needed to fully define the range of materials that can be treated using this technology. In addition, the current level of regulatory acceptance associated with the technology needs to be more fully defined. In particular, the final waste form has the technical potential to be utilized in construction of on-site vaults for long term repositories. Another alternative that should be explored more fully is the use of the bricks containing waste in recycling or resource recovery applications. This technology is based on the use of pozzolanic reactions in stabilization/solidification. These reactions are a well established process in construction applications going back in history more than 2,000 years and are noted for their long term stability. The Phoenix Ash Technology [PAT] employs these reactions but is a newly developed technology with a very limited track record. It can frequently be considered as similar to cementitious reactions which are frequently rejected because of the containment strategy, volume growth, limited long term stability, and long cure times. The PAT technology provides rapid cure times, volume reduction potential and very long term stability. The technology has been used to remediate a small lead-mill-tailings site in Oregon using a mobile treatment configuration with a capacity of 40 tons/day [8 hour shift]. An 80 ton/day [8 hour shift] unit has been built and is currently available from TIDE to be used in providing field services.

Source of Information: TechCon

CONTAMINANTS :

Pesticides/Herbicides

Heavy Metals

PCB

Explosives/Propellants

■ Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

Halogenated VOC

N/A

TECHNOLOGY TYPE: Solidification/Stabilization (Ex Situ)

Technology Name : Radwaste Cementation and Process Control

Application :

On-site

Ex-situ

Off-site

Brief Description : The quality of cemented waste has to be proven. Process control is preferable to end control. The advantage of process control is that during operation the system can be improved. Various on-line measuring techniques have been developed to check the mechanical, chemical and radiological properties during the cementation process.

Company Name/POC: KEMA Nederland B.V./H.A.W. Cornelissen

Address : P.O. Box 9035, NL-6800 ET/ARNHEM, The Netherlands

Phone Number : 31 2635 63370

Fax Number : 31 2644 23635

Technology Maturity :

Field demo complete

Performance History : During a four year European project, measurement techniques and procedures were developed and validated at a radwaste campaign at a BWR power plant.

Comments : None.

Source of Information : International TechCon

PROCESS WASTES/SLUDGE

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Solidification/Stabilization (Ex Situ)*

Technology Name : Stabilization/Solidificaiton

Application : On-site Ex-situ

Brief Description : Severson (in conjunction with VFL Technology of Malvern, PA) works extensively with a variety of reagents (both individually and in combination) to meet treatment criteria. The stabilization process uses generic custom reagents which chemically react with contaminated materials to immobilize contaminants and prevent leaching. The technique has been widely used in many applications. The advantages of S/S is the relatively inexpensive price and wide acceptance for a variety of situations.

Company Name/POC: Severson Extraction Technology, Inc./Philip R. DeLuca

Address : 2749 Lockport Road/Niagara Falls, NY 14302-0396

Phone Number : 716 284-0431

Fax Number: 716 284-179

Technology Maturity : Commercial use experience

Performance History : Contact company for performance history data.

Comments : The technique has been widely used on soils and sludges. Applicability to DOE needs can be determined with a high degree of accuracy through treatability studies. Although VFL has conducted some treatability studies on low-level radioactive and mixed wastes, more detailed studies need to be done. The firm operates a full-service laboratory facility capable of conducting detailed treatability work.

Source of Information : TechCon

CONTAMINANTS:

Pesticides/Herbicides

Heavy Metals

PCB

Explosives/Propellants

■ Petroleum Hydrocarbons

■ Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

Halogenated VOC

■ **N/A**

TECHNOLOGY TYPE : *Solidification/Stabilization (Ex Situ)*

Technology Name : Molecular Bonding System

Application :

On-site

Ex-situ

Brief Description :

The Molecular Bonding System (MBS) is a patented process that stabilizes heavy metals in soils, sludges and ash. The MBS process chemically renders leachable metal ions inert by bonding them to non-leachable molecules. MBS powder is added to excavated soil or sludge in a pug-mill operation. Moisture is added to enhance mixing. Curing is immediate and the soil is conveyed to a retention bin where, once dried, it is either returned to the site or disposed of off-site at subtitle "D" landfills.

Company Name/POC: Solucorp Inc./Michael DeLuca

Address : 520 Victor Street/Saddle Brook, New Jersey 07663

Phone Number : 201 368-7902

Fax Number : 201 368-8522

Technology Maturity : Commercial use experience

Performance History : MBS has been performed on bench-scale, pilot, and commercial projects and in all cases has successfully reduced contaminated levels to non-detectable or well below EPA acceptable limits. Depending on the size of the equipment, the system can treat between 20-100 tons/hr. Curing time is immediate.

Comments :

The total system is ~75 feet long, 10 feet high except for the silo, which is 33 feet high and 16 feet wide. This equipment is powered by a diesel generator. As 15-20 percent moisture is required, a water source is necessary. Two workers and one supervisor are required to operate machinery. The MBS technology is not suitable for treating contaminated liquids. Treated material can be returned to the site in basically the same form. Material is easily transported since the handling characteristics are not changed. Curing time is immediate.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : Solidification/Stabilization (Ex Situ)

Technology Name : Stabilization/Solidification

Application : Off-site Ex-situ

Brief Description : STC Omega specializes in the development and application of technologies for the treatment of organic and inorganic contaminated soils, sludges and wastewaters. STC Omega's chemical fixation and solidification technologies have been utilized successfully to treat over 500,000 cubic yards of contaminated soils and sludges on >30 full-scale hazardous waste remediation projects across the U.S. and in Italy. STC Omega's technologies have been applied to industrial in-process treatment, hazardous waste site remediation projects, RCRA Landban treatment in a Part B permitted hazardous waste landfill facility, and organic and inorganic industrial wastewater treatment systems. Technology allows treatment to be performed in-situ. Full-scale treatment performance can be determined effectively on a laboratory- and pilot-scale basis before full scale.

Company Name/POC: STC Omega, Inc./Greg Maupin

Address : 7650 E. Redfield Road/Suite D5/Scottsdale, Arizona 85260

Phone Number : 602 948-7100

Fax Number : 602 991-317

Technology Maturity : Commercial use experience

Performance History : Performance Data are Available.

Comments : This technology is quite versatile. It has been used inside buildings, in rural areas with minimal access to power, and normal construction sites. Soil matrix such as stiff clay can reduce the treatment rate production. STC Omega has been successful in treating all types of soil matrices. STC Omega treatment can be provided with standard rental construction equipment. Main attribute after treatment is significantly reducing the leachability and mobilization of contaminants. This reduction can be determined with such tests as the EPA TCLP and American Nuclear Society ANS 16-1.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Solidification/Stabilization (Ex Situ)*

Technology Name : Stabilization/Solidification

Application :

On-site Ex-situ

Brief Description : Use of generic low-cost cementing additives to produce monolithic stabilized waste forms of residual leachability.

Company Name/POC: Wastewater Technology Centre/Rockcliffe Research Management/Julia Stegemann

Address : 867 Lakeshore Rd./P.O. Box 5068/Burlington, Ontario, L7R 4L7, Canada

Phone Number : 905 336-4738

Fax Number : 905 336-4765

Technology Maturity : Commercial use experience

Performance History : Considerable body of work conducted in support of Ontario Waste Management Corporation Facility design 1985-1992. Call contact for additional references.

Comments : WTC/RRM has extensive information development capability. Would need to work with contractor for full-scale application.

Source of Information : International TechCon

PROCESS WASTES/SLUDGE

CONTAMINANTS: ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE: *Solidification/Stabilization (Ex Situ)*

Technology Name: Waste-to-Energy/Ash Stabilization (WESPHIX)

Application: ☐ On-site ☐ Ex-situ
☐ Off-site

Brief Description: WesPhix is a patented commercial technology used to stabilize heavy metals (Pb, Cd) in waste materials, including ash residues from trash-to-energy facilities, certain contaminated soils and sludges. Use of this process renders heavy metals stable, thereby allowing materials to pass TCLP tests on a routine basis. Avoids disposal of heavy-metals-bearing materials in hazardous waste facilities, thereby significantly reducing disposal costs.

Company Name/POC: Wheelabrator Technologies, Inc./Mark Lyons

Address: Liberty Lane/Hampton, NH 03842

Phone Number: 603 929 3374

Fax Number: 603 929-336

Technology Maturity: Commercial use experience

Performance History: WesPhix has been successfully used in several commercial trash-to-energy facilities to stabilize heavy metals in ash residue.

Comments: Standard Licensing Agreement with Wheelabrator for the use of technology. Wheelabrator will install, train, and start up the process.

Source of Information: TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Chemical Extraction***Technology Name :** Low Energy Extraction Process (LEEP)**Application :** On-site Ex-situ

Brief Description : LEEP (Low Energy Extraction Process), a patented process, uses common organic solvents to extract and concentrate organic pollutants from soil, sediments, and sludges. After a pre-treatment step, the solid matrix is washed using a unique dual solvent approach. A combination of proprietary hydrophilic and hydrophobic solvents guarantees the efficient removal of the contaminants. The extracted pollutants are concentrated in a sacrificial solvent by liquid-liquid extraction or by distillation and are removed from the process for off-site disposal or recycling. The leaching solvents are internally recycled and the treated soil can be used as clean fill at the site.

Company Name/POC: Art International, Inc./Werner Steiner, Genya Mallach**Address :** 100 Ford Road/Denville, New Jersey 07834**Phone Number :** 201 627-7601**Fax Number :** 201 627-6524**Technology Maturity :** Pilot plant testing**Performance History :** Performance data are available.

LEEP was accepted into the SITE Emerging Technologies Program, and has been successfully demonstrated at bench- and pilot-scales. Bench-scale treatability studies are routinely conducted for government and private clients. Treatment of tar contaminated soil from manufactured gas plant sites containing up to 5 percent tar has been successfully demonstrated in pilot-plant tests. A 200-pound per hour pilot plant has been used in the test program for scaling-up the commercial size plant. Operating permits have been obtained under TSCA, and RCRA. This removal efficiency of organic contaminants is as high as 99 percent and the volume reduction of the original waste is over 90 percent.

Comments : LEEP is a high efficiency mobile process for removal of virtually any organic pollutants from soil, sediments, and sludges. The matrix can contain particle sizes down to the submicron range and water concentration from a few percent up to 90 percent. This process can remediate organic pollutants and is not applicable for inorganics such as heavy metals. The process is designed for zero air emissions.

Source of Information : VISITT 3.0

PROCESS WASTES/SLUDGE

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Chemical Extraction*

Technology Name : Carver-Greenfield Process

Application : Ex-situ

Brief Description : The Carver-Greenfield (C-G) Process can be used to treat sludges, soils, and other water-bearing wastes containing hazardous compounds, including polychlorinated biphenyls (PCB), polycyclic aromatics (PNA), and dioxins. This unique process efficiently separates hazardous solid/liquid feed materials into three product streams convenient for disposal: (1) a clean, dry solid, (2) a water product virtually free of solids and oils, and (3) a concentrated mixture of the extracted compounds. The recovered solvent is reused in the process. The full-scale system is normally continuous, but can be operated in a batch or semicontinuous mode depending on the particular process/capacity requirements.

Company Name/POC: Dehydro-Tech Corp./Theodore D. Trowbridge

Address : 6 Great Meadow Lane/East Hanover, New Jersey 07936

Phone Number : 201 887-2182

Fax Number : 201 887-254

Technology Maturity : Pilot plant testing

Performance History : Performance data are available.

Comments : The successful pilot plant demonstration under the SITE Program was carried out in summer 1991 to separate oily drilling muds into their constituent oil, water, and solid phases. Other soil remediation tests have also been carried out.

Feeds to the process must include solids (5 to 95 percent), water (5 to 95 percent) and oil soluble contaminants (percentage level to over 75 percent) to maximize its capability. Note that the technology separates and concentrates feeds into solids, water and oil-soluble streams but does not destroy them. In the last 30 years, over 80 commercial C-G Process facilities have been licensed in a dozen countries to solve waste disposal problems in a wide variety of fields.

Source of Information : VISITT 3.0

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Chemical Extraction***Technology Name :** RCC Solvent Extraction**Application :** On-site Ex-situ

Brief Description : This technology extracts PCBs, pesticides and PAHs from soils, sludges, and sediments; produces water suitable for discharge; reduces waste volumes 90 - 99 percent+; treated solids can be returned to the site; and reduces the organic concentrations below TCLP limits. No air emissions.

Company Name/POC: Resource Conservation Company (a Halliburton Company)/Lanny Weimer**Address :** 3006 Northup Way/Bellevue, Washington 98004**Phone Number :** 301 596-6066**Fax Number :** 410 465-2887**Technology Maturity :** Field demo complete

Performance History : RCC has designed, constructed and operated three pilot plants and one commercial-scale unit (70 tons/day). The commercial scale unit is designed to process only pumpable sludges and sediments. The current pilot plant and future commercial-scale units will be configured to treat pumpable and non-pumpable (soils and filter cake) wastes.

Comments : Modular systems designed to be suitable for meeting a variety of site area and utility conditions. Typically, a 75-100 ton/day will require a 75 x 100-foot area and 400 amp electrical service. System operates at ambient pressure and moderate temperatures; bench scale treatability testing required for all applications. Can process soil, sludge and sediment containing clay and silt without increased difficulty. Process operates at near ambient pressures and moderate temperatures (up to 212 degrees Fahrenheit). Operation is stable and does not require specialized skills. Waste volume reduction (removing water and organics) can be 90 - 99 percent in sludges and soils.

Source of Information : TechCon

PROCESS WASTES/SLUDGE

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Chemical Extraction*

Technology Name : Metals Recovery Process

Application : On-site Ex-situ
Off-site

Brief Description : This technology removes metals (arsenic, cadmium, copper, lead, mercury, nickel, and zinc) from soil washing concentrate by using acid pH & polystyrene beads loaded with chelator and Electro-Reduction with water recyclable after treatment.

Company Name/POC: Toronto Harbour Commissioners/Dennis Lang

Address : 60 Harbour St./Toronto, Ontario, Canada M5J 1B7

Phone Number : 416 863-2047

Fax Number :

Technology Maturity : Field demo complete

Performance History : EPA SITE program demonstration was successful for the 4000 ton scale. Toronto Harbor Commission was both contractor & customer. (Soil-washing performed by Bergman USA)

Comments : Very easy to use: off-the-shelf equipment, efficient, reliable. Need supplier of chelator beads. Process converts soil/sludge wash wastewater to recyclable metals & process water. Major cost reduction compared to landfill.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *High Temperature Thermal Desorption*

Technology Name : Thermal Desorption System

Application : On-site Ex-situ

Brief Description : Use of two stage process to remove a wide variety of contaminants from soils, sediments, and sludges. System components consist of rotary kiln, soil discharge/dust suppression system, cyclone, quench tower, baghouse, ID fan and stack. In the rotary kiln, heat volatilizes contaminants from the soils at temperatures ranging from 600 to 1000 degrees Fahrenheit. The volatilized contaminants are then destroyed in a high efficiency afterburner. Off-gases are cooled and filtered prior to discharge. Clean soils can be re-used as backfill. The system is suitable for a wide range of feed characteristics, from dry gravel to high moisture tars to clays.

Company Name/POC: Maxymillian Technologies, Inc./Neal Maxymillian (Boston)/John Anthony (HQ)

Address : 1801 East St./Pittsfield, Massachusetts 01201

Phone Number : 413 499-3050

Fax Number : 413 443-0511

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Comments :

The system has processed over 250,000 tons of petroleum contaminated soils, many with heavy clays and high moisture content. The system is currently processing PAH contaminated soils at a coal tar site. The system processes soil with high tar content.

The system can be limited by the BTU value of the feed. Additionally, certain contaminants, such as metals, limit throughput if scrubbing technology is not employed.

Boston contact number: 617-557-6077

Source of Information : VISITT 3.0

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *High Temperature Thermal Desorption*

Technology Name : Mercury Recovery Services (MRS)

Application : On-site Ex-situ

Brief Description : In this process, the contaminated feed is blended with a proprietary additive which promotes decomposition of stable mercury compounds and loaded into a batch-operated furnace for processing. Thermal processing is divided into two stages: feed drying and mercury desorption. By staging the process in this manner, the process does not result in a water-mercury waste stream as water is maintained in vapor phase throughout the gas handling system. Metallic mercury is condensed from the carrier gas during the second stage of the process. All process air is filtered through a series of gas filtration columns containing sulfur-impregnated carbon.

Company Name/POC: Pittsburgh Mineral & Environmental Tech/William F. Sutton

Address : 700 Fifth Avenue/New Brighton, Pennsylvania 15066

Phone Number : 412 843-5000

Fax Number : 412 843-535

Technology Maturity : Field demo complete

Performance History : Three process products: Mercury-free solids (<1 ppm total Hg); Metallic Mercury (>99 percent total Hg); and Mercury-free process gas exhaust. Capable of recovering metallic mercury from numerous mercury compounds including oxides, sulfides, chlorides, etc. Treatability demonstrations has been performed on contaminated soils (sand, clays, carbonates) and wastes from chlor-alkali facilities (K106, D009).

Comments : Contaminant identified as : Mercury

No liquid process effluent stream; designated as recycling by numerous regulatory agencies; applicable to contaminated soils, sludges (K106), debris (D009); applicable to sandy, clayey, and loamy soil types; performance not dependent upon feed Hg content.

Although the process has been designated as recycling; it also meets the BDAT requirements for mercury contaminated wastes.

Source of Information : VISITT 3.0

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *High Temperature Thermal Desorption*

Technology Name : HT-6 Thermal Distillation

Application : On-site Ex-situ

Brief Description : HT-6 can operate up to 2,200 degrees Fahrenheit. The desired material temperature is reached gradually as it progresses through the system. In the first zone, most of the water is vaporized along with a portion of the light hydrocarbons; in the second zone the remainder of the light ends and water are vaporized along with a portion of the heavy hydrocarbons; in the third zone almost all of the remaining hydrocarbons are vaporized and the thermal desorption is complete. After passing through the third zone, the solid product leaves the HT-6 system through an exit port and is transported by the screw conveyor to a collection bin for ultimate disposal. The final product is inert, chemically stable and meets all federal, state, and local landban restriction criteria.

Company Name/POC: Seaview Thermal Systems/William Packer

Address : P.O. Box 3015/Blue Bell, Pennsylvania 19422

Phone Number : 215 654-9800

Fax Number : 215 654-9660

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

EPA has approved this technology as a recycling process when used for processing oil bearing hazardous wastes. In other words, it is exempt from RCRA Part B permit application requirements. It is the BDAT equivalent to incineration. The process has been demonstrated on a full-scale basis for the removal of all volatile and semivolatile organics and the subsequent recovery of these constituents. Pilot scale demonstrations on the degradation of PCB's have been completed and document DRE percentages of 99.9999 percent. A mobile PCB/chlorinated organic treatment unit will be available in the first quarter of 1994.

Comments :

The HT-6 process achieves treatment standards without oxidation, such as occurs in incineration. The resulting advantages are: 1) significant reduction in SO₂, NO_x, CO_x emissions; 2) no byproducts of combustion; 3) no dioxin precursors generated from processing and degrading PCBs; 4) no increase in leachability of metals; 5) no toxic metal particulate emissions; 6) simplified permitting; 7) modular, skid mounted, and transportable; 8) versatile on variations in waste (from liquids up to contaminated soils); and 9) no Btu limit or maximum. This technology, in and by itself, is not applicable to metal-only wastes, with the exception of mercury.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *High Temperature Thermal Desorption*

Technology Name : SAREX MX-1500 & MX-2000/2500 Thermal Processors

Application : On-site Ex-situ

Brief Description : The SAREX "Process Train" is a mobile, trailer mounted, modular system designed for on-site, on-line treatment of oil/water/solids matrix materials. It utilizes centrifuge action to separate the oil and the water from the solids and low and high temperatures to desorb the toxic constituents from the material. The centrifuge separates the oil, water and solids and discharges the solids to the MX-2000. The oil and water are discharged into settling tanks from which they can be reclaimed and recycled. A specially designed SAREX Vapor Recovery System (VRS) recovers and treats vapors generated during the "Process Train" operation. The vapors are collected in the unit's vapor domes and routed through collection pipes to the VRS. The VRS removes particulate matter, and condenses water and hydrocarbon into separate phases. The organics can be reclaimed and recycled to an appropriate end user for reuse. The water can also be reclaimed, recycled and reused.

Company Name/POC: Separation and Recovery Systems, Inc./Brad Miller

Address : 1762 McGaw Avenue/Irvine, California 92714-4962

Phone Number : 714 261-8860

Fax Number : 714 261-601

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

The MX-2500 has been on the marketplace for a number of years and is presently processing over 1,000 tons per month of refinery sludge at five different petroleum refineries around the U.S. The MX-1500 centrifuge system is also a proven technology, as it processed over 1,000,000 feed barrels of material in the last 10 years. The SRS treatment processes have been approved the New Jersey Department of Environmental Quality and the Bay Area and South Coast Air Quality Management Districts.

Comments : The system is limited to treating contaminants that have nominal boiling points that are less than 900 degrees Fahrenheit; the MX-2500 requires that the feed material must be dried to have less than 10 percent of moisture before entering the system. Therefore, in most situations, sludges must be centrifuged using the MX-1500 and dried using the MX-2000 before entering the MX-2500 BDAT system; the SAREX treatment train requires steam, fresh water, a small amount of nitrogen gas, and 400 amps of electricity for operation. Sometimes, these utilities are not readily available at abandoned sites to be remediated; if the material is sludge-like, additional fluids may need to be added (water, kerosene, or diesel) to improve separation in the centrifuge.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *High Temperature Thermal Desorption***Technology Name :** Soiltech ATP System**Application :**

On-site Ex-situ
Off-site

Brief Description :

The SoilTech ATP Sytem removes organic contaminants from feed material through thermal desorption in an indirectly fired rotary kiln. It can be used in conjunction with a dehalogenation process. The SoilTech ATP System is continuous and provides preheating of incoming feed material in the preheat zone and desorption of contaminants in the anoxic retort zone at temperatures over 1,000 degrees Fahrenheit. Oxidation of decontaminated coked products takes place in the combustion zone and process heat is efficiently reused through indirect heat transfer from hot treated solids in the cooling zone to the incoming feed material in the preheat zone. Ancillary systems condense the vapors desorbed from the retort zone. The resulting liquid products are water and oil and can be chemically decontaminated on site, recycled, or sent off site for treatment.

Company Name/POC: Soiltech ATP Systems, Inc./Dave Ettlers**Address :** 304 Inverness Way South/Suite 200/Englewood, Colorado 80112**Phone Number :** 303 790-1747**Fax Number :** 303 799-0186**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.

SoilTech has commercially treated PCB and phenol contaminated soils and successfully demonstrated treatment of a long list of other contaminants. These include: refinery wastes, coal tar wastes, wood treating wastes, dioxin/furan-impacted soils, VOC and SVOC contaminated material, and many more. In 1990 and 1991, the SoilTech ATP System was successfully applied to treat 42,000 tons of PCB-contaminated soil at the Wide Beach Superfund Site in Brant, New York. In June 1992, SoilTech completed work at the Waukegan Harbor Superfund Site in Waukegan, Illinois; 12,700 tons of PCB contaminated soil and sediments were treated. SoilTech is now remediating 12,000 tons of VOC, PAH, and pesticide contaminated soil at the Pristine Superfund Site in Reading, Ohio.

Comments :

The SoilTech ATP System is suitable for treatment of organic or oily waste in concentrations up to 25 percent by weight. Higher contaminant concentrations may require blending of feed material prior to treatment. High moisture content (greater than 20 percent) and/or high silt/clay content (greater than 20 to 30 percent) may reduce the process throughput and increase treatment costs.

Source of Information : VISITT 3.0

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Incineration*

Technology Name : Fully Integrated Hazardous Waste management Transportation, Treatment and Disposal

Application : Off-site Ex-situ

Brief Description : Company offers a total treatment service which includes: incineration, stabilization, solidification, and chemical neutralization

Company Name/POC: CHEM-SECURITY Alberta/Art Mathes

Address : #4 Manning Close N.E./Calgary, AB T2E 7N5, Canada

Phone Number : 403 235-8361

Fax Number : 403 248-343

Technology Maturity : Commercial use experience

Performance History : The following references relate to Mercury Stabilization Work:

Battelle Pacific N. W. Division
 Marine Research Lab
 Brenda LaSorsa, PhD
 439 W. Suquire Bay Rd.
 Sequia, WA 98362
 206 681-4151

Ratec Remdiations Tech. Inc.
 Hans. F. Stroo, PhD
 1011 S. W. Klickitat Way
 Suite 207
 Seattle, WA 98134
 206 624-9349

Comments : CHEM-SECURITY operates a fully integrated Special Waste System in Canada Including:
 Transport of waste
 Incineration (2 Rotary Kilns)

Roasting furnace for decontamination of PCB (and other) contaminated transformers and metals.
 Chemical neutralization and treatment of acid and basic waste liquids
 Stabilization and solidification using advanced state of the art processes and equipment
 Secure landfill
 Two laboratories which conduct characterization and analysis and compliance testing as well as stabilization and solidification technology development.

Affiliated companies provide a full range of environmental evaluation and risk analysis services and manufacture instrumentation for emission and environmental monitoring.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Incineration***Technology Name :** LLW Incineration**Application :**

On-site Ex-situ
Off-site

Brief Description : Technology results in volume and weight reduction by incineration of low level activity waste. The ashes are organically stable and safe for disposal in drums.

Company Name/POC: Studsvik RadWaste AB/Olof Andersson**Address :** S-611 82 NYKOPING/Sweden**Phone Number :** 46 155 22 15 20**Fax Number :** 46 155 26 31 17**Technology Maturity :** Commercial use experience

Performance History : Technology has been used in Studsvik since 1978; SEG, Ten., USA since 1989; CILVA site in Belgium since 1995.

Comments : None.**Source of Information :** International TechCon

PROCESS WASTES/SLUDGE

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Low Temperature Thermal Desorption*

Technology Name : Desorption and Vapor Extraction (DAVE) System

Application : On-site Ex-situ

Brief Description : RSI's low temperature, high volume Desorption and Vapor Extraction (DAVE) system separates toxic and hazardous waste from soil, sludge and sediments. The process is designed to separate and capture both volatile and semi-volatile organic contaminants from host materials. Nonvolatile inorganic contaminants (such as metals) in the waste feed do not inhibit the process, but are not removed. The clean processed soil (98 to 99 percent or more of incoming feed after rehydration) is returned to the excavation site or used for clean fill. The contaminants are captured and shipped off site for recycling or final disposal. This is accomplished in a closed process, with continuous, real time monitoring and numerous back-up systems.

Company Name/POC: Recycling Science International Inc./William C. Meenan

Address : 175 West Jackson Blvd./Suite A1910/Chicago, Illinois 60604

Phone Number : 312-663-4242

Fax Number : 312-663-426

Technology Maturity : Commercial use experience

Performance History : Tested - Numerous EPA, state and local government supervised tests of the DAVE System have verified treatment capabilities. The DAVE System can treat soils, sludges and sediments contaminated with PCB, PAHs pesticides, VOCs semivolatile organics such as tetraethyl lead and mercury. This process can operate at 40 percent - 60 percent below incineration costs. Treated products from the DAVE system include: water suitable for discharge, oil that may be recycled as fuel, and solids that can be returned to the site as backfill. The process can reduce the initial volume of contaminated material be more than 95 percent. The DAVE system can process 240 to 1,500 tons per day in a portable configuration. Capabilities of 5,000 tons per day can be achieved in a fixed site, non portable mode.

Comments : Materials which cannot be treated include tars, and substances which form tars at low temperatures and relatively short exposure times. Examples of the latter are some oxygenated petroleum products, polymer precursors, etc. Nonvolatile inorganic contaminants, such as metals, do not inhibit the process but are not removed. The DAVE System treatment process is most effective on matrices that are non-adsorptive and of low porosity.

Source of Information : VISITT 3.0

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☒ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Low Temperature Thermal Desorption***Technology Name :** Low Temperature Thermal Treatment

Application :

On-site Ex-situ

Off-site

Brief Description : The LT3 is a soil treatment system that indirectly heats the soil, causing volatilization of the organic compounds. The cleaned soil is then available for backfill or other treatment steps (i.e., stabilization). The organic vapors are vented to a condensation system that concentrates the organics into liquid for off-site disposal, recycling, or use as a waste fuel.

Company Name/POC: Roy F. Weston, Inc./Michael G. Cosmos**Address :** 1 Weston Way/West Chester, PA 19380**Phone Number :** 610 701-7423**Fax Number :** 610 701-5035**Technology Maturity :** Commercial use experience**Performance History :** Contact company representatives for Performance Data.

Comments : The technology is applicable to soil, sediments, and sludges that can be handled as a solid. Moisture content increases costs. The process will not affect heavy metals or inorganics. The LT3 is immediately implementable for full-scale use. The LT3 has been on four remediation projects. The system is trailer-mounted for transportability. Transportability has been demonstrated by using on-site power generation and propane fuel use.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Low Temperature Thermal Desorption*

Technology Name : Vacuum Assisted Thermal Desorption/Catalytic Oxidation

Application : On-site Ex-situ

Brief Description : Soil is heated to 250 degrees Celsius in a rotary kiln under vacuum. Water and volatiles are volatilized and carried downstream. The water/organic stream is run through a catalytic oxidizer. Organic and inorganic compounds are oxidized into innocuous compounds. Soil is processed in batches. Technology has been designed to be cost-effective at small facilities (200-2000 cubic meters), a large number of which exist at DOE sites. The VAC*TRAX is small, mobile, and requires minimal mobilization and demobilization activities. The vacuum reduces the required heating time.

Company Name/POC: Rust Remedial Services/John Westcott

Address : Clemson Technical Center/100 Technology Drive/Clemson Research Park/Anderson, SC 29625

Phone Number : 803 646 2413

Fax Number : 803 646-531

Technology Maturity : Pilot plant testing

Performance History : Successfully applied at bench-scale. Contact Carl Swanstrm 708/513-4500.

Comments : Best suited for volumes ranging from 200-2000 cubic meters of waste. Unit is easy to use, takes up minimal space, has minimal utility requirements, and requires 1-2 people of moderate technical ability to operate. Equipment for unit is available in the U.S. through Rust Remedial Services; however, Rust does not sell the equipment.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Low Temperature Thermal Desorption***Technology Name :** SAREX MX-1500 & MX-2000/2500 Thermal Processors**Application :** On-site Ex-situ**Brief Description :**

The SAREX "Process Train" is a mobile, trailer mounted, modular system designed for on-site, on-line treatment of oil/water/solids matrix materials. It utilizes centrifuge action to separate the oil and the water from the solids and low and high temperatures to desorb the toxic constituents from the material. The centrifuge separates the oil, water and solids and discharges the solids to the MX-2000. The oil and water are discharged into settling tanks from which they can be reclaimed and recycled. A specially designed SAREX Vapor Recovery System (VRS) recovers and treats vapors generated during the "Process Train" operation. The vapors are collected in the unit's vapor domes and routed through collection pipes to the VRS. The VRS removes particulate matter, and condenses water and hydrocarbon into separate phases. The organics can be reclaimed and recycled to an appropriate end user for reuse. The water can also be reclaimed, recycled and reused.

Company Name/POC: Separation and Recovery Systems, Inc./Brad Miller**Address :** 1762 McGaw Avenue/Irvine, California 92714-4962**Phone Number :** 714 261-8860**Fax Number :****Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.

The MX-2500 has been on the marketplace for a number of years and is presently processing over 1,000 tons per month of refinery sludge at five different petroleum refineries around the U.S. The MX-1500 centrifuge system is also a proven technology, as it processed over 1,000,000 feed barrels of material in the last 10 years. The SRS treatment processes have been approved the New Jersey Department of Environmental Quality and the Bay Area and South Coast Air Quality Management Districts.

Comments :

The system is limited to treating contaminants that have nominal boiling points that are less than 900 degrees Fahrenheit; the MX-2500 requires that the feed material must be dried to have less than 10 percent of moisture before entering the system. Therefore, in most situations, sludges must be centrifuged using the MX-1500 and dried using the MX-2000 before entering the MX-2500 BDAT system; the SAREX treatment train requires steam, fresh water, a small amount of nitrogen gas, and 400 amps of electricity for operation. Sometimes, these utilities are not readily available at abandoned sites to be remediated; if the material is sludge-like, additional fluids may need to be added (water, kerosene, or diesel) to improve separation in the centrifuge.

Source of Information : VISITT 3.0

PROCESS WASTES/SLUDGE**CONTAMINANTS :**

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : Low Temperature Thermal Desorption**Technology Name :** Mobile Solid Waste Desorption**Application :** On-site Ex-situ

Brief Description : Texarome's ex-situ continuous desorption process uses highly superheated steam (adjusted up to 900 degrees Fahrenheit) as a conveying and stripping gas in a pneumatic type conveying system to treat contaminated wastes, such as soils, sediments, sludges, and difficult emulsions containing volatile and semivolatile contaminants of any kind, together with water. An elaborate and proprietary way (patent pending) of running pipes within the conveying system allows for a true countercurrent flow, as well as multi-stage dispersion and separation of the gas phases and the solid phase, to make the efficient mass transfer separation task possible.

Company Name/POC: Texarome, Inc./Gueric R. Boucard**Address :** 1.5 Miles East Highway 337/P.O. Box 157/Leaky, Texas 78873**Phone Number :** 210 232-6079**Fax Number :** 210 232-5711**Technology Maturity :** Pilot plant testing**Performance History :** Performance data are available.

In 1982, a 4 ton per day pilot plant was set up in the Texas Hill Country to extract Cedarwood Oil from the native Texas Cedar. The project was moved to Leakey, Texas in 1984 and the pilot plant was scaled up to a 12 ton per day of commercial size plant. To date, this plant has been successfully operating around the clock. The EPA SITE demonstration unit tentatively scheduled for late Fall 1993 will be 25 ton per day unit improved and modified to operate between 340-900 degrees Fahrenheit and strip toxic solid waste.

Comments : The main limitations of this process is necessity of sifting debris, and reducing the particle size of the material to be treated to a uniform 35 mesh and under (less than 0.016 inches). Non porous solids such as sand could be treated in larger particle sizes of up to 10 mesh (less than 0.65 inches), because contaminants are easily flashed from the surface. Non-flowable solids, such as 100 percent putty-like clays, or gummy solids are also a problem. Such materials would have to be thoroughly mixed with dry sand into a semi-flowable solid with an angle of repose of at least 60 degrees before treatment.

Source of Information : VISITT 3.0

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Low Temperature Thermal Desorption***Technology Name :** RF Driven Thermal Processing**Application :**

On-site Ex-situ
Off-site

Brief Description : Thermal desorption unit can be used to dewater sludges and precipitates, and to remove organics by devolatilization.**Company Name/POC:** Westinghouse Communications/D.L. Keairns**Address :** 1310 Beulah Rd./Pittsburgh, Pennsylvania 15235**Phone Number :** 412 256 1954**Fax Number :** 412 256-1348**Technology Maturity :**

Field demo complete

Performance History : Has been used by Texaco for oil field enhancement; field demonstration planned at Savannah River.**Comments :** Mobile unit is self-contained. Water table may be problem for soils (minor). Low boiling point VOC may have cheaper routes such as soil vapor extraction.**Source of Information :** TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Pyrolysis***Technology Name :** Product control systems (PCS) Flash Pyrolysis**Application :** On-site Ex-situ
Off-site**Brief Description :** Indirect thermal decomposition (dry distillation, vacuum flash pyrolysis) of solid hazardous organic/inorganic waste in reductive environment. Main components: indirectly heated rotary reactor (operating up to 1500 F); indirectly cooled multi venturi scrubber.**Company Name/POC:** Product Control Ltd./G. Edward Someus**Address :** La Plaiderie/P.O. Box 79/St. Peter Port/Guernsey, C.I., United Kingdom**Phone Number :** 1481 726 426**Fax Number :** 1481 726 52**Technology Maturity :** Pilot plant testing**Performance History :** Contact Product Control Ltd. for performance history data.

Comments : A benchmark of a good safe treatment technology is a high DRE efficiency. Pilot-scale testing demonstrated that the PCS process was more than capable of this. No possibility of dioxin or furan formation and cost efficient technical solution for utilization of heavy metals based on the reductive thermal treatment. The small reactor size and the capability to recirculate process gas-vapors from the decomposition process makes the process equipment, especially the flue gas treatment unit, small, technically simple, and safer. The PCS process is suitable for many types of waste, sorted and unsorted, as well as, all those that are economically decomposable by dry distillation under any range of 1,000 C. The special patented feature of the PCS indirect heated rotary reactor and other vital apparatus components makes viable the process of continuous process control and monitoring of the destruction efficiency. The PCS technology is limited for: (1) treatment of liquids (water, flammable liquids and solvents) (2) treatment of solid material over 45 percent moisture content, (3) explosives and/or materials with highly oxidizing character under heat treatment, (4) materials which can not be decomposed by thermal treatment at 600 C (1,112 F), and (5) nuclear waste with high radioactivity. The PCS technology is at the full scale demonstration and commercialization phase of the development.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Pyrolysis*

Technology Name : Ion Exchange Resin Pyrolysis (Radflash)

Application :

On-site	Ex-situ
Off-site	

Brief Description : Radflash is a method and system for volume reducing radioactively contaminated ion exchange media (organic) by thermally decomposing the resin in the absence of oxygen. Volume reduction achieved is approximately 10:1, and radioactive contaminants are retained in the pyrolysed residue. The system is relatively small and energy efficient, with resin throughput on the order of 50 kg/h. The system is environmentally safe and can be configured for essentially zero emission in terms of radioactive release. Non-radiological releases are null, within US requirements.

Company Name/POC: Studsvik RadWaste AB/Olof Andersson

Address : S-611 82 NYKOPING/Sweden

Phone Number : 46 155 22 15 20

Fax Number : 46 155 26 31 17

Technology Maturity : Field demo complete

Performance History : Over the past 4 years the system and technology has been taken from bench scale to essentially commercial. Recent testing on 2,000 kg of contaminated resin produced less than 300 kg of residue, with follow-on testing of approximately 500 kg of reactor generated resins producing 100 kg of residue. Testing of resins and char indicates essentially all radionuclides retained in the pyrolysed residue along with the inerts (metals) and sulfides.

Comments : Powdered resin (input) less than 20 percent H₂O by weight is required. System is flexible and easily supplemented. Infrastructure requirements are dependent upon application.

Source of Information : International TechCon

PROCESS WASTES/SLUDGE

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Vitrification (Ex Situ)*

Technology Name : Plasma Torch

Application : ☒ On-site ☒ Ex-situ
☒ Off-site

Brief Description : Vitrification of materials using a Plasma Torch is used to treat materials such as fly ash, chlorinated wastes, asbestos, and hospital wastes.

Company Name/POC: Aerospatiale/Herve Saul

Address : P.O. BP2/78133 Les Mureaux Cedex, France

Phone Number : 33 1 34 92 39 00

Fax Number : 33 1 34 92 11 9

Technology Maturity : Commercial use experience

Performance History : More than 20 industrial plasma systems have been sold to clients like EDE, Nippon Steel, Rengeot, and Lorfont.

Comments : None.

Source of Information : International TechCon

CONTAMINANTS :

- ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Vitrification (Ex Situ)*

Technology Name : Waste Destruction Furnace

Application :

On-site Ex-situ
Off-site

Brief Description :

This dual frequency induction furnace uses a uniquely heated and stirred bath of molten iron for the destruction of waste materials and absorption of metallic constituents into the molten bath.

Company Name/POC: EA Technology Ltd./L. Smith

Address : Capenhurst, Chester, CH16ES UK

Phone Number : 151 347 2473

Fax Number : 151 347 2138

Technology Maturity :

Pilot plant testing

Performance History :

Current experience has been limited to development of the furnace system. Destruction of waste and waste injection has not yet been accomplished.

Comments :

Technique probably limited to dry feed materials. The Dual Frequency furnace at EA Technology was designed to use a 1200Hz 250kW medium frequency power supply for the heating function since this generates little metal flow but has good cold start characteristics. The metal flow is generated by a 50Hz power source and a unique design of power coil which produces a travelling field system. The test rig was built as a fixed, that is non-tilting, furnace in an existing structure which had a side tapping facility for pouring the molten metal. It is assumed, however, that any furnaces built for industrial use would be of the normal tilting design. The furnace capacity is one tonne iron and is lined with a typical dry vibrated silica refractory. It is believed the furnace can benefit a number of existing process applications where the ability to stir at a constant temperature is a requirement and metallurgical reactions are undertaken. The use of molten iron as a reaction media can provide an important tool for waste material processing such as arc furnace dusts, incinerator residues and special and hazardous wastes. An operating temperature in excess of 1300 degrees C is ideal for destruction of organic and inorganic materials producing either gaseous or molten reaction products. Any metals present in waste will enter solution in the melt.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Vitrification (Ex Situ)*

Technology Name : Vitrification

Application : On-site Ex-situ

Brief Description : Vitrification processes wastes into stable, non-degradable, chemically durable glass that is highly leach resistant. GTS Duratek joule heated Duramelter (TM) produces a waste form that reduces the volume of waste up to 75 percent. This vitrification process is designed for the treatment of the contaminated fraction left from soil washing. Vitrification replaces grouting with cement. Grouting increases the volume of the waste treated; vitrification, on the other hand, decreases the volume of the waste processed and produces a more stable waste form.

Company Name/POC: GTS Duretek, Inc./William Greenman

Address : 8955 Gillford Road/Suite 200/Columbia, Maryland 21046.

Phone Number : 410 312-5100

Fax Number : 301 621-821

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

GTS Duratek and its primary subcontractor, the Vitreous State Laboratory at the Catholic University of America, have performed numerous laboratory-scale research projects for both government and private industry. Some of these projects are: Construction of commercial units is being completed at both Barnwell, North Carolina, and the DOE Savannah River Site (SRS). Start up of the Barnwell unit is anticipated by the end of the 1995 calendar year. Testing is scheduled to begin at SRS in December 1995, with the start up of the unit scheduled for January 1996. Minimum Additive Waste Stabilization Program/Fernald-Phase 1/Fernald, Ohio/Dr. Mitchell Erickson CMT/Argonne National Laboratory/708 972 7772/FAX 708 252 5912. Vitrification Development Studies for OU1 Wastes/Fernald, Ohio/Rod Gimpel/513 738 6112/ FAX 513 738 6184. Development of a Combined Soil Wash/In-Furnace Vitrification System for Soil Remediation at DOE Sites/Weldon Spring, Oak Ridge/Dr. Mitchell Erickson, CMT/Argonne National Laboratory/708 972 7772/FAX 708 252 5912

Comments :

This technology is not applicable to metal-only wastes or to wastes that are predominately organic. Approximate minimum limits are at present about 5 weight percent metals or total organic carbon. In general, implementing this technology is straightforward. The melter design and operation are relatively constant as is the required training of personnel (melter operators, etc.). The offgas system is the only component of the vitrification process which may change appreciably from site to site. The biggest challenge in implementing this technology is understanding the waste-specific chemistry involved and applying it to the design of the offgas system (fluorides, sulfates, etc.). Secondary waste generation can also present a challenge. In the system currently operating, secondary waste is fed back into the melter. Another challenge is developing a glass composition for specific wastes that is capable of high waste loading which is also cost-effective (minimum additives), durable, and processable. The ideal glass is that which can be processed below 1200 degrees celsius and still meet all of the above requirements. If it cannot be processed below 1200 degrees celsius, the melter may require redesign incorporating exotic metals and high temperature electrodes. Construction of commercial units is being completed at both Barnwell, North Carolina, and the DOE Savannah River Site (SRS). Start up of the Barnwell unit is anticipated by the end of calendar year 1995. Testing is scheduled to begin at SRS in December 1995, with start up of the unit scheduled for January 1996.

Source of Information : TechCon

CONTAMINANTS :

- ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Vitrification (Ex Situ)***Technology Name :** McNeill Vitrification Process

Application :

On-site Ex-situ
Off-site

Brief Description : Waste material is mixed with glass-making raw materials and then fed (continuously) into an adapted glass furnace. Inorganic material is dissolved into the molten glass bath and organics fully combust. In commercial trials of 240 tonnes/day the technology has been proven to be completely successful in the destruction of wastes, both organic & nonorganic.

Company Name/POC: Vert LTD./Keith McNeill**Address :** Unit 7, Stadium Court/Parkgate, Rotherham S62 6EW, UK**Phone Number :** 1709 720651**Fax Number :** 1709 720851**Technology Maturity :** Commercial use experience

Performance History : The technology has been tested at all levels from bench top to 240 tonnes/day commercial trials. All environmental assessments were carried out by AEA technology's National Environmental Technology Centre (netcen) and the process has had HMIP approval. All trials were success. Problems tend to be that the technology is too early for the UK market where landfilling is cheap.

Comments : The process requires a constant feed, 24 hours a day, 7 days a week. The process can treat a multitude of wastes including the backend residues of other environmental processes, such as soil washing. Plants can be built to size requirements, in-situ, centralized (240T/day) or mobile (20T/day). It's a complete recycling technology with release from "duty of care". Works with fibers (e.g. asbestos), sands, phosphates, all types of ash. A static plant can process up to 240 tonnes/day.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Electrical Separation*

Technology Name : Direct Membrane Cleaning (DMC)

Application : Ex-situ

Brief Description : Electrochemical method for in-situ cleaning of membrane filters. Avoids the need for chemical reagents, and thus minimizes the volume of secondary waste produced needing controlled disposal. High flux rates maintained with minimal maintenance for all solid-liquid separations.

Company Name/POC: AEA Technology/Dr. Mark Neville

Address : Building 429/Harwell Laboratory/Near Didcot/Oxon, OX11 0RA, UK

Phone Number : 44 1235 432252

Fax Number : 44 1235 43227

Technology Maturity : Field demo complete

Performance History : Performance data are available.

Comments : The DMC technology is at the field demonstration stage in it's development cycle; therefore, permits have been obtained to operate pilot systems on nuclear sites on a case by case basis. As with all membrane/filtration technology the goal is to concentrate contaminants into a limited volume. Targets approaching 50 wt percent solids have been obtained. Immobilization of the concentrate is required. The DMC process requires the use of conductive filter media. Traditionally commercially available micro- or ultrafilters, conductive ceramics are used.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☒ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Bioreactors*

Technology Name : Bionergies, Biosmose, Biosurf

Application : In-situ (vadose zone) Off-site Ex-situ
In-situ (saturated zone)

Brief Description : Bioremediation of organic pollutions (in soils, water, effluents) by using: 1. exogenous specific bacterial consortium (non toxic, environment safe, European Federation of Biotechnology class I in order to control a full, complete and non selective biodegradation. 2. Biofixations (mineral natural support). 3. Biosurfactants (produced by selected bacteria) provide an effective, fast and secure alternative to common place bioremediation because Bionergies controls the biodegradation of the pollutant (and metabolites) by using specialized bacteria and feasibility tests (in labs, on the field).

Company Name/POC: Bionergies Laboratories, Biosurf/M. Jacques FAUDIN

Address : 59/100, rue des 4 termes/B.P. 1009/Z.I. des Paluds/13781 AUBAGNE Cedex, France

Phone Number : 33 42 84 30 07

Fax Number : 33 42 84 23 33

Technology Maturity : Commercial use experience

Performance History : Contact company for performance data.

Comments : Each case is analyzed in order to optimize the treatment and the on site materials and personnel. Bioenergies controls the bacterial action by using exogenous specific bacterial strains, biofixations and biosurfactants. None of the bacteria is genetically engineered. They are classified into class I (one) of the European Federation of Biotechnology, and produced under French and European Community regulations. The company is looking for join-ventures in U.S. in order to cover the environmental and industrial field.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Bioreactors*

Technology Name : Anaerobic Metal Removal Technology (AMR)

Application : ☒ On-site ☐ Ex-situ
☐ Off-site

Brief Description : The AMR process was developed to release, separate and remove toxic metal contaminants in solids (soils, sediments, sludges) and can simultaneously bioremediate organic pollutants. The AMR technology involves the use of indigenous anaerobic heterotrophic denitrifying microbial populations which are resistant to and will aid in the solubilization of metal sulfides in the presence of other organic pollutants. AMR technology operates in the absence of oxygen, thereby eliminating the need for aeration. The process produces no acid which eliminates the secondary pollution problems. The addition of a low-cost and readily available soluble alternate electron acceptor source (nitrate) allows the system to be operated at low cost.

Company Name/POC: Geo-Microbial Technologies, Inc./D.O. Hitzman

Address : P.O. Box 132, East Main Street/Ochelata, Oklahoma 74051

Phone Number : 918 535-2281

Fax Number : 918 535-256

Technology Maturity : Bench scale testing, only

Performance History : Development for removal of metals from spent coal liquification catalysts (DOE contracts).

Comments : The elimination of oxygen requirements allows broad usage. Microbial ecology would be easily manipulated by minimum alternate electron acceptor amendments. The system has broad potential applications with minimum requirements for implementation. The ease and flexibility of amendment addition and use of indigenous microflora expand the range of applications.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Bioreactors*

Technology Name : Biological Soil Treatment Plant

Application :

	On-site	Ex-situ
	Off-site	

Brief Description : The biological soil treatment plant consists of a bioreactor for treatment of oil and light tar contaminated soil for reduction of the pollution from 3% oil down to 0.01-0.1% with-in a few weeks. The plant can also be used for treatment of soil polluted with light organic compounds such as benzene, phenols and some pesticides. The technology is based on biological degradation of the pollutants.

Company Name/POC: Newcon A/S/J. Mollekilde

Address : Ternevey 20/DK-4000 Roskilde

Phone Number : 45 42353616

Fax Number : 45 42351548

Technology Maturity : Commercial use experience

Performance History : The biological soil treatment plant was developed in 1991. Newcon A/S treated 45,000 tons oil and tar contaminated soil with one plant. Newcon A/S has one plant in operation and is planning to increase capacity with two more plants in Denmark this year.

Comments : The plant is constructed so it can easily be moved from one place to another.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides☒ Heavy Metals☒ PCB☒ Explosives/Propellants☒ Petroleum Hydrocarbons☒ Radionuclides☒ SVOC☒ Other Contaminant☒ Nonhalogenated VOC☒ Halogenated VOC☒ N/ATECHNOLOGY TYPE : *Bioreactors*

Technology Name : BIO-WASH

Application :

On-site

Ex-situ

Brief Description :

W.E.S. Environmental Division has its own R&D group that has tested both vegetative and spore bacteria to break down various types of organic contaminants such as benzene, toluene, xylene, acetone and waste oil. Some tests have been conducted on radioactive nuclei, but are still under testing with W.E.S. The biological approach eliminates the need to dispose of a residue that is hazardous. Normal process allows end-user to dispose of process waste as non-hazardous material after the bacteria has digested the organics.

Company Name/POC: W.E.S. Environmental Division/Anthony DeLoach

Address : 6389 Tower Lane/Sarasota, Florida 34240

Phone Number : 941 371-7617

Fax Number : 941 378-521

Technology Maturity : Commercial use experience

Performance History : Bill DeLoach, DeLoach Industries 813 371-4995 - Acetone treatment

W.D. Howard, Chevron USA 404 984-3085 - hydrocarbon treatment

Comments :

High levels of chlorinated solvents will destroy bacteria growth. Contact time must be insured for proper treatment and acclimation. Once product has been acclimated to organic selection, the use of it is very simple and flexible.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Filtration***Technology Name :** Microfiltration**Application :** On-site Ex-situ**Brief Description :** Fine microfiltration of precipitated metals with tight, low-cost Tyvek (R) T-980 filtration media and patented Profix stabilization agent (to pass TCLP) in a fully-automatic Oberlin automatic pressure filter (APF).**Company Name/POC:** DuPont/Dr. Ernest Mayer**Address :** Engineering Dept. L1359/P.O. Box 6090/Newark, Delaware 19714///Oberlin. Filter Co./Mr. Mike Hughes/404 Pilot Court/Waukesha, WI 53188**Phone Number :** 302 774-1000**Fax Number :** 302 774-7321**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.

Demonstrations: Industrial partnerships/collaboration potential: participated in USEPA SITE program (w/Oberlin & Enviroguard Mfg. of Profix Stabilization Agent), John Martin, Cincinnati, Ohio; working w/SRS on various wastes; testing other hazardous waste (Oberlin/DuPont/Enviroguard).

Comments : Utilities required for the DuPont/Oberlin microfiltration technology demonstration included water, electricity and telephone service. Flow rates above about 250 gpm require multiple units. Easy to use and implement (6 installations that are operational and functioning well); minimal personnel skill required since simple.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : Filtration**Technology Name :** Liquid Radwaste Volume Minimization by Cross Flow Filtration

Application : On-site Ex-situ
 Off-site

Brief Description : Fairey Microfiltrex offers equipment to volume reduce sludges containing solid contaminants, returning clean liquid for re-use or onward treatment and making available a concentrated sludge that can be taken to disposal or onward treatment. The process enables the removal of particles above 0.5 micron and smaller.

Company Name/POC: Fairey Microfiltrex Ltd./Chris Chadwick**Address :** Fareham Industrial Park Unit 40/Fareham Hampshire/PO16 8XG, U.K.**Phone Number :** 1329 285616**Fax Number :** 1329 822 44**Technology Maturity :** Commercial use experience

Performance History : Using sintered metal fibre medium, Fairey Microfiltrex has improved the effectiveness of cleanable filtration with dramatically higher permeabilities and much finer filtration. Sintered metal fiber out performs all previous filter media in these applications. Contact company for performance data.

Comments : The technology is limited only by profoundly aggressive environments and required separation ratings below, perhaps 0.1 micron.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Filtration*

Technology Name : Colloid Filter Method

Application : On-site Ex-situ
Off-site

Brief Description : Secondary wastewater from soil washing; processing to volume minimize heavy metal and radionuclide (excluding tritium) pollutants via: (a) Solids vs. liquid separation; (b) Sorption/filtration concentration of metals and radionuclides; (c) Produce potable effluent for re-use, recycle, or environmental discharge; and (d) Stabilization or recovery of the concentrated metals, radioactive pollutants in a sludge material. The technology is highly efficient for removing metals, U, Sr, Pu, Am, Ce, Co pollutants from wastewater. Replaces ultrafiltration, ion exchange, reverse osmosis methods. The technology efficiently removes colloidal and/or ionic inorganic metallic water pollutants, achieves high volume reduction and concentrates without some of the limitations of filtration, resin bed problems, at a lower cost per 1,000 gallons processed.

Company Name/POC: Filter Flow Technology, Inc./Tod S. Johnson, Ph.D.

Address : 122 Texas Ave./League City, Texas 77573

Phone Number : 713 332-3438

Fax Number : 713 332-3644

Technology Maturity: Commercial use experience

Performance History : Performance data are available.

Numerous scientific bench tests have demonstrated utility of methodology for inorganic metallic removal from water; field tests (good test results for 8-10 sites, no major problems); demonstrations (EPA/DOE [in progress] contacts can be provided upon request); private industry and government projects are ongoing.

Comments : Small mobile wastewater processing trailer/skid - 20,000 lbs wt, capacity 50 gpm; large mobile/skid mounted equipment - 250,000 lbs wt or more, capacity 200-250 gpm wastewater processing. The Colloid Filter Method can remove trace metals and non-tritium radioculcide pollutants in primary and secondary wastewater down to ppb, ppt, but cannot process moderate or high TSS water (Requires pre-solids removal). This is a polishing filter method. The Colloid Filter Method has proved useful for removing a wide range of heavy metals, uranium, TRU and NORM radionuclide pollutants from water. The methodology is into commercial applications for industrial metal wastewater; textile industry dye and metals removal for strict compliance standards; environmental remediation projects for metals and radionuclide contaminated water, sludge, solid (secondary wastewater); and EPA, DOE RCRA and Superfund projects. Engineering and design phases for the equipment have been completed; Mobile and in-line equipment has been fabricated and tested. Special sorption/chemical complexing chemicals have been developed and tested; Bulk chemical blending and packaging capability has been established in South Texas. The technology is well into EPA, DOE testing for BAT (Best Available Technology).

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : Filtration

Technology Name : Filtering of Particles

Application : On-site Ex-situ
Off-site

Brief Description : Filtering of particles with size greater than 1 micron with ceramic totally inorganic filter. The filter has high capacity to collect all particles in this filtering range, and another feature of the filter allows drying of the filtered mass with underpressure.

Company Name/POC: IVO International Ltd./Jukka Rautakallio

Address : 871 Ethan Allen Hwy, Suite 104/Ridgefield, CT 06877

Phone Number: 203 894-1954

Fax Number : 203 431-029

Technology Maturity : Commercial use experience

Performance History : A filter with height of 640 mm and diameter 168.8 mm has been designed and tested to be used at JAERI in Japan. After pH control, 1.1 g/l of precipitated material will be collected from 275 liters into one filter. Filter will be vacuum dried.

Comments : Inorganic filter suitable for liquids where capillary action can be used; it can be modified almost to any size. The filter can be delivered either as single filter or as multiple filters including pumping systems and needed connections.

Source of Information : International TechCon

CONTAMINANTS :

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

■ Petroleum Hydrocarbons

Radionuclides

 SVOC

Other Contaminant

■ Nonhalogenated VOC

■ **Halogenated VOC**

☒ N/A

TECHNOLOGY TYPE : *Filtration*

Technology Name : Radioactive Waste Treatment - Slurry Dewatering

Application :	On-site	Ex-situ
	Off-site	

Brief Description : Slurry dewatering technology reduces water content of radioactive waste using cross flow filtration. Solids content is increased from 5 wt percent to typically 25 wt percent (50 wt percent for some waste types). 10-20 cubic meters of waste can be dewatered in one shift (8-10 hrs). Development work has shown that the technology works successfully on a wide range of wastes. The technology has been developed to accept a number of filter membrane. Enables higher waste loadings to be achieved where encapsulation is used for immobilizing radioactive waste. Process reduces quantity of packaged wastes.

Company Name/POC: Nuclear Electric plc/Dr. R. Clayton

Address : Littlebroom Manorway/Dartford Kent DA1 5PY. UK

Phone Number : 44 0 1322 282800

Fax Number : 44 0 1322 282819

Technology Maturity : Pilot plant testing

Performance History : After detailed review of available technology, crossflow filtration was chosen. Nuclear Electric (formerly C.E.G.B.) has carried out successful trials on a wide range of simulants and membranes. The membrane technology has been proven on manufacturer's test rigs and various Nuclear Electric's test rigs including a 1/3 scale test rig. A contract to construct a full size mobile plant will be in place by end of 1995.

Comments : Technology limited by availability of suitable membranes. Mobile plant has been designed for operation at Power Stations where decommissioning activities have commenced so that minimal site services are required.

Source of Information : International TechCon

CONTAMINANTS:

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: Ion Exchange

Technology Name: Forager (TM) Sponge for Heavy Metals

Application: In-situ (vadose zone) Off-site Ex-situ
 In-situ (saturated zone)

Brief Description: FORAGER (TM) Sponge selectively removes heavy metals from water. This is accomplished by virtue of a proprietary chelating resin deposited within small (1 cm) cubes of open cell cellulosic sponge. A multitude of the cubes is disposed within a vertical column through which water is passed. Flow rates of 0.1 bvm achieve 90+ percent removals. Because of the low cost and high absorption capacity of FORAGER (TM) Sponge, one-time-use and disposal is economically feasible. This product can be used on dirty or mixed-waste streams or sludges that would ruin conventional bead form resins.

Company Name/POC: Dynaphore, Inc./N. Rainer

Address: 2709 Willard Rd/Richmond, Virginia 23294

Phone Number: 804 288-7109

Fax Number: 804 282-132

Technology Maturity: Field demo complete

Performance History: FORAGER (TM) Sponge is currently being sold in 8 gal. modular drums for the treatment of small volume industrial effluents. Most of the users are either reluctant to talk about results obtained, or do not have accurate data concerning performance. A preliminary trial was run at an EPA Superfund (Groundwater) site in early 1993. 90 + percent removals were achieved for Cd, Cu, Pb, and V. 70 + percent removals were achieved for Cr, Hg, Zn, and Ni.

Comments: Will not remove Rb, Cs. Will remove Sr, Ba, and Ra only in the absence of Ca. A multi-column installation employing FORAGER (TM) Sponge involves no moving parts except for a pump. In those installations which include valves for staging or sequencing operations, manipulation of the valve is simple, and can be automated. A single semi-skilled operator can handle units having flow rates of 2-20 gallons/min. Because the system can be trailer mounted, it can easily service effluents in different locations.

Source of Information: TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Precipitation*

Technology Name : Potassium Ferrate/TRU Clear

Application : On-site Ex-situ

Brief Description : Potassium Ferrate (Iron VI) coagulant. Removes uranium, plutonium, americium, and priority pollutant metals from wastewater; pollutant removal through charge neutralization and precipitation; radionuclide and metals removal levels to below regulatory requirements; generates 2-10 times less dewaterable sludge that requires recovery, transportation, and final EPA restricted disposal.

Company Name/POC: Analytical Development Corporation/Gary Tye

Address : 4405 North Chestnut, Suite D/Colorado Springs, CO 80907

Phone Number : 719 260 1711

Fax Number : 719 260-0695

Technology Maturity : Commercial use experience

Performance History : Performance Data are available (below).

West Valley Nuclear Services: Process water, 6.6M gal/yr, reduced sludge 10x--Garret Smith 716/942-4325; Fernald Environmental Restoration Management Corp.: Process water, 8M gal/yr, reduced sludge 2.5x--Lyle Hampshire 513/738-6541; Fernald Environmental Restoration Management Corp.: Process water, 500M+ gal/yr being constructed--Joe Patton, 513/738-6555; Rocky Flats Plant, Bench demo-successful--Chuck Baldwin, 303/966-2919.

Comments : Uses current wastewater treatment equipment; mobile unit utilizes direct filtration or clarification; purple color indicator demonstrates reaction completion, user-friendly; normally no modification of EPA Part B operating permit required; technical service support for bench and plant demonstration; Potassium Ferrate (VI) also oxidizes organic pollutants.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Membrane Separation*

Technology Name : Spiral Wound Membrane Technology

Application : In-situ (saturated zone) Ex-situ

Brief Description : Spiral-wound membrane technology offers a cost-effective, energy-efficient method of making separations using the principles of osmosis. The technology used by Desalination Systems, Inc. allows for the recovery and reuse of waste stream constituents from acids to metals. SWMT needs no additional chemicals, making this technology environmentally friendly. A highly trained operator is unnecessary. There are no additional sludge costs with membrane technology. A membrane system is a small fraction of the cost of installing a Dissolved Air Flotation (DAF) device.

Company Name/POC: Desalination Systems, Inc./Bridgete Owens

Address : 760 Shadowridge Dr./Vista, California 92083

Phone Number : 619 598-3334

Fax Number : 619 598-333

Technology Maturity : Commercial use experience

Performance History : Performance data are available from the company.

Comments : SSWM systems are small compared to other technologies such as DAF. Membrane systems require electricity to run the motor and pump. SWM systems need little support services from an outside operator. These systems can also be located outdoors. A SWM system can be used easily. A technician can be trained in a few hours to take readings, if needed, and watch the system. The membrane system is flexible in that it can be installed inside or outside the facility, so no large infrastructures need to be built. The size of a membrane system is so small that it fits almost anywhere.

Source of Information : TechCon

CONTAMINANTS :

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

☒ Nonhalogenated VOC

☒ Halogenated VOC

■ N/A

TECHNOLOGY TYPE: *Electron Beam*

Technology Name : Electron Beam Hazardous Waste Treatment (E-Beam)

Application :	On-site	Ex-situ
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Brief Description : The process is based on aqueous radiation chemistry and it is non-selective in the destruction of organic chemicals because strongly reducing reactive species, and strongly oxidizing reactive species, are formed at the same time and in approximately the same concentration in solution. The reactive transients initiate thousands of chemical reactions capable of destroying hazardous compounds in aqueous solution, in most cases, mineralizing them to carbon dioxide, water, and salt. High energy electron beam treatment of hazardous waste can be used to replace UV/O₃, UV/H₂O₂, and other advanced oxidation processes (AOPs), and in some cases incineration.

Company Name/POC: High Voltage Environmental Applications, Inc./William J. Cooper, Pres., Mike Nickelsen

Address : 9562 Doral Boulevard/Miami, Florida 33178

Phone Number : 305 593-5330

Fax Number : 305 593-0071

Technology Maturity : Commercial use experience

Performance History : In addition to controlled (single solute) feasibility studies, feasibility studies on two multi-source hazardous waste leachates have been conducted which have shown that the process is economical for the ultimate destruction of hazardous waste leachates. HVEA waste treatment systems are part of the US EPA SITE Program, and are available for use on Superfund sites. HVEA's mobile systems were to be demonstrated on solvent contamination ground water under the SITE program in the fall '93 at Savannah River, South Carolina.

Comments : HVEA's electron beam treatment systems require (1) site location the size of a tractor trailer, (2) a mechanism for delivering the waste to the treatment system, i.e., well pumps, etc., (3) three phase electrical power, (4) 120 VAC electrical power, (5) effluent line and site. Soils, sediments, and sludges must be suspended in an aqueous matrix. The electron beam treatment systems are ineffective in treating heavy metals. HVEA electron beam treatment systems are available in different sizes, to effectively address any size problem. Units are modular in design; therefore, several systems can be interfaced to enhance treatment capability. Systems are completely automated and require only one technician per 8 hr shift. High initial capital cost.

Source of Information ; TechCon

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Other*

Technology Name: Wet-Oxidation Process Using Special Autoclave Equipment

Application: On-site Ex-situ
Off-site

Brief Description: This technology treats organic and inorganic waste water, sludge, and microdust by means of wet-oxidation processes under air-pressures up to 200 bars and temperatures up to 300 degrees C.

Company Name/POC: ABRA Fluid AG/Markus Frei

Address: Industrie Nollen/Birkenstr. 109/CH-9443 Widnau, Switzerland

Phone Number: 41 71 72 78 72

Fax Number: 41 71 72 78 7

Technology Maturity: Commercial use experience

Performance History: Contact company for performance history.

Comments: None.

Source of Information: International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides☒ Heavy Metals☒ PCB☒ Explosives/Propellants☒ Petroleum Hydrocarbons☒ Radionuclides☒ SVOC☒ Other Contaminant☒ Nonhalogenated VOC☒ Halogenated VOC☒ N/ATECHNOLOGY TYPE : *Other*

Technology Name : In-Situ Electro-Enhanced Remediation/Electrofrac

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : In situ electro-thermal treatment uses volatilization, pyrolysis and fusion to treat the soil. This technology replaces excavation of soil.

Company Name/POC: Bio-Electrics, Inc./E. Sarapu

Address : 1301 Woodswether/Kansas City, Missouri 64105

Phone Number : 816 474-4895

Fax Number : 816 842-1245

Technology Maturity : Pilot plant testing

Performance History : Refer to EPA's VISITT 3.0 Database.

Comments : Qualified engineering personnel required for problem evaluation. This technology was originally developed for in situ processing of mineral fuels. This technology cannot be used for under-water decontamination.

Source of Information : TechCon

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: Other**Technology Name:** Ex Situ Soil Remediation Equipment**Application:** Ex-situ

Brief Description: Portec/Construction Equipment Division (CED) offers predesigned ex situ soil remediation equipment and also offers to manufacture equipment for the soil remediation market. Preconditioning (including crushing and screening), soil washing, mixing, conveying, storage, and slurry makeup systems are readily available. Other types of specialized equipment can be engineered and manufactured under a variety of contract arrangements.

Company Name/POC: Portec, Inc./Jim Lincoln**Address:** 700 West 21st Street/P.O. Box 20/Yankton, South Dakota 57078-0220**Phone Number:** 605 665-8770**Fax Number:** 605 665-885**Technology Maturity:** Commercial use experience

Performance History: In 1992 a Model 53 portable pugmill plant was used, on site, to modify the physical properties of a wide variety of liquid hazardous wastes. Also in 1992 Portec Portable Blender has been used to incorporate a proprietary chemical mixture for the treatment of hydrocarbon contaminated soil. Again in 1992 another Model 53 unit was used to chemically precondition PCB contaminated wastes for final thermal treatment.

Comments: Portec/CED equipment is not a technology and therefore has no technical limitations. It is possible that equipment designed and manufactured by Portec/CED could be used for many remediation applications. However, the majority of equipment currently being offered is best suited for those technologies that require ex situ treatment.

Source of Information: VISITT 3.0

CONTAMINANTS :

- ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Other*

Technology Name : Molten Salt Oxidation

Application :

On-site Ex-situ
Off-site

Brief Description :

MSO is a combined chemical and thermal waste treatment technology which (1) feeds wastes and air into a ceramic-lined vessel containing a bed of molten salt at 900-1000C, (2) oxidizes organic wastes, (3) uses the heat of oxidation to keep the salt molten, (4) neutralizes acid gas precursors in the bed, and (5) discharges the salt for disposal or for processing and recycle. Radioactive wastes are trapped in the melt, organic wastes are removed to 99.9999% and acid gases are retained such that off-gas scrubbing is not required. MSO is a non-combustion alternative to incineration. MSO can treat 95% of the DOE wastes that are candidates for incineration either alone or in combination with thermal desorption pretreatment. The process does not require a flame to initiate or continue reaction; destruction and removal efficiencies exceed EPA requirements, off-gas treatment does not require acid gas scrubbing.

Company Name/POC: Rockwell International/Rich Gay

Address : Rocketdyne Division/6633 Canoga Ave./Canoga Park, California 91309-7922

Phone Number : 818 586-6110

Fax Number : 818 586-5877

Technology Maturity :

Pilot plant testing

Performance History :

Energy Technology Engineering Center (ETEC) Canoga Park CA, September 1992 prototype units were used to treat 5 gallons of mixed waste hydraulic oil (Cs and Sr) for organics and attained DRE's of 99.9999% with radioactive waste entrapped in melt, generated 12 lbs of spent salt mix. Chlorinated fraction not expelled as acid gas but neutralized in melt to NaCl. Bench-scale testing at ORNL, LLNL and LANL. Preconceptual design for 100-200 lbs/hr plant is underway. In the 1980's, extensive testing up to 150lbs/hr was performed on a large variety of mixed wastes, organics, explosives, and chemical warfare agents.

Comments :

Applicable to high heating value organic liquids (solvents, waste oils) and low heating value liquids (chlorinated organic liquids) with medium applicability to aqueous sludge with heavy metals and/or organics and low ash combustibles. Not applicable to soils, inorganic salts and dilute aqueous wastes. Wastes with Hg require pretreatment. Sludges must be diluted to facilitate pumping, but water use for dilution must be minimized. Solids must be sorted to remove most metal and size reduced to <1/4 inch to facilitate pumping. Applicable to several waste streams that are unique, e.g., graphite, sodium metal, and NaK. Extensive development work and scale-up has been documented on coal gasification and hazardous waste which forms a strong experience base for the MSO process. MSO operating systems may be constructed in relatively small units for small quantity generators. Relatively simple treatment process. System is tolerant of a wide range of feed-rate fluctuations. Additional research needed to determine optimal ash content, chlorine content, and volatile metal content for operation. Residuals management needs further evaluation in terms of reducing overall volume (e.g. by salt recycle) and also in terms of leach characteristics of final stabilized waste form for disposal. Material to eliminate or reduce concerns about corrosion need to be used for design of larger-scale facilities. Plugging of feeder by frozen salt must be addressed. Two independent peer reviews have concluded that MSO could be an important technology for DOE.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : Other**Technology Name :** Magnetic Separation

Application : In-situ (vadose zone) Off-site Ex-situ
In-situ (saturated zone)

Brief Description : The MAG SEP process uses specially designed particles to selectively absorb contaminants from water. The particles are composite particles with a magnetite core (to make the particle magnetic), a polymer coating (for durability), and selective adsorbers on the surface. Examples are amidoxime, clinoptilolite, zeolites, etc. The selective adsorbers can recover contaminants down to ppb levels without recovering nonhazardous ions. The particles (with contamination) are collected in a magnetic filter. The particles are regenerated for reuse. The regeneration solution can be treated for disposal or recovery of a recycleable material. The alternatives to this technology are precipitation, filtration, ion exchange and reverse osmosis. The advantage of the MAG SEP technology compared to all others is the reduced operating costs due to low pump head costs for magnetic filtration, and reduced waste disposal costs because the process is selective. This can reduce waste volumes by more than an order of magnitude when recovering low ppm or ppb levels of contamination from water containing several hundred ppm total dissolved solids.

Company Name/POC: Rust Remedial Services/John Westcott**Address :** Clemson Technical Center, 100 Technology Drive, Clemson Research Park/ Anderson SC 29625**Phone Number :** 803 648-2413**Fax Number :** 803 646-531**Technology Maturity :** Field demo complete

Performance History : Several successful pilot-scale demonstrations have been completed. Magnetic filters are standard commercial equipment. Currently the process is being demonstrated as part of the in-situ soil treatment demonstration, the in-situ groundwater project, and the Resource Recovery Project.

Comments : The only issue is the ability to selectively adsorb the contaminant of interest which must be determined by a treatability study. Easy to use, takes up minimal space, minimal utility requirements, and will generally require 2 people of moderate technical ability to operate. Equipment and service support is available worldwide.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Other***Technology Name :** Reduction of Mixed Wastes**Application :**

On-site Ex-situ
Off-site

Brief Description :

The process involves passing the wastes (mixed hazardous and/or radioactive) through a shower of molten aluminum. This is done in a sealed system. The material is reduced to carbon and hydrogen, aluminum salts, etc., with the off-gases contained in a trap system. This is a reductive process which generates combustible gases. Since air is excluded, it is unnecessary to heat large volumes of nitrogen. All products are trapped so that there is no loss to the environment. Process has destroyed PCBs, parathion and malathion; reduced plating plant waste sludges to metallic elements and aluminum salts. Hg, As, and Se vaporized from melt.

Company Name/POC: Schultz & Associates/Clifford G. Schultz**Address :** P.O. Box 7111-47719/1701 Glendale Avenue/Evansville, IN 47712**Phone Number :** 812 465-7721 x240**Fax Number :** 812 465-5746**Technology Maturity :**

Bench scale testing, only

Performance History : Contact Schultz & Associates for Performance History Data.**Comments :** New phone number after March 1996 (812) 422-5750.**Source of Information :** TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☒ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Other***Technology Name :** Ultrasound Particle Separation (SONOSEP)**Application :** ☐ On-site ☐ Ex-situ
☐ Off-site**Brief Description :** Particle separation technology that utilizes ultrasound to coagulate, flocculate and separate particles suspended in a liquid. The technology can separate solid or liquid particles (emulsions) from a liquid. Separation of up to 99 percent of suspended particles may be achieved.**Company Name/POC:** Triton Environmental Consultants/John Poppington**Address :** 120 - 13511 Commerce Parkway/Richmond, B.C., Canada V6V 2L1**Phone Number :** 604 279-2093**Fax Number :** 604 279-204**Technology Maturity :** ☐ Pilot plant testing**Performance History :** This technology is at early pilot-scale. Over 6 years of applied research has been performed. Equipment is available for batch and continuous-flow testing.**Comments :** Particles in suspension with a diameter less than 0.5 microns are difficult to flocculate. Flow through the acoustic treatment chamber must be close to laminar - this limits flow velocity. There is a maximum distance between transducer and reflector. This limits flow rates. The technology achieves flocculation at a higher rate than conventional systems without the use of chemical additives. The equipment is simple and maintenance free since there are no moving parts. The equipment is compact. Primary challenge is scale-up.**Source of Information :** International TechCon

CONTAMINANTS :

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

Petroleum Hydrocarbons

Radionuclides

Other Contaminant

Nonhalogenated VOC

☒ Halogenated VOC

■ **N/A**

TECHNOLOGY TYPE : *Recycle*

Technology Name : Catalytic Extraction Processing

Application :

On-site

Ex-situ

Off-site

Brief Description :

CEP uses the catalytic action of a molten metal bath to revert waste streams to their elemental constituents. Selective reactant addition allows controlled partitioning and the production of recovered resource streams, typically synthesis gas (CO and H₂), ferroalloys, and specialty inorganics. CEP is applicable to RCRA, TSCA, and radioactive wastes and process feeds of any physical form.

Company Name/POC: Molten Metal Technology, Inc./Dr. Victor Gatto

Address : 51 Sawyer Road/Waltham, Massachusetts 02154

Phone Number : 617 487-7642

Fax Number : 617 487-7870

Technology Maturity :

Field demo complete

Performance History :

Sandia: weapons components, bench scale, >99.99 percent DRE for organics.
International chemical manufacturer: biosludge, small commercial scale.
Major U.S. chemical manufacturer: polyaromatic hydrocarbons contaminated with metals; conversion to synthesis gas.
Over 10 successful customer demonstrations or feasibility analyses.

Comments :

Facility requirements for 4,200 tpy: 75' x 125' space; 40' height; liquid O2 and N2, natural gas; power, water: boiler feed, cooling, fresh, sewer; caustic for scrubber (feed component).
Radioactive components are contained in low-volume stable vitreous matrix suitable for final form disposal.

CEP is robust to a wide range of chemical and physical feeds.

Flexibility: organics and metals, all physical metal forms, all dimensions:

product Ease of Use: little up-front characterization required, minimal feed pretreatment/separation, generation;

generation;

Infrastructure: none required.

Destruction Removal Efficiencies (DREs) of RCRA wastes can exceed 99.9999 percent. Recovered products meet or surpass commercial specifications.

Key benefits of CEP for radioactive waste processing include: controlled partitioning of radionuclides; decontamination of products allowing recycle or reuse; minimal generation of secondary waste; containment of heavy radionuclides in a non-leachable vitreous matrix suitable for final form disposal; and ability to handle mixed waste.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Dust Control*

Technology Name : Long Duration Foam

Application : On-site Ex-situ

Brief Description : Rusmar Long Duration foam is applied over an emitting surface to control odors, VOC's, dust and other emissions. The foam creates a continuous barrier between the surface and the atmosphere. Rusmar Long Duration Foam Technology is very effective in controlling any emission. Long Duration Foam is utilized in place of soils, tarps and other cover materials to control odors, VOC's, dust, windblown emissions, etc. Long Duration Foam completely covers any surface to which it is applied and it will conform to irregular and vertical surfaces. Long Duration Foam can be applied quickly, easily and provides a superior barrier to emissions than soil or tarps. It is non-toxic, non-hazardous, non-flammable and biodegradable.

Company Name/POC: Rusmar Incorporated/Laura White

Address : 216 Garfield Avenue/West Chester, Pennsylvania 19380

Phone Number : 610 436-4314

Fax Number : 610 436-843

Technology Maturity : Commercial use experience

Performance History : Rusmar Long Duration Foam has been used throughout the United States and abroad for a variety of applications including: remediation projects, Superfund projects, lagoon and pond closures. It has been used as odor control on a liquid surface, for dust and VOC's suppression, emergency response, vapor and odor suppression in industrial applications and erosion control and to prevent surface water infiltration on stock piled soils. Additionally, Long Duration Foam has been used for in transit odor control on sludge filled containers and dust control during demolition of asbestos contaminated buildings.

Comments : Some of the Long Duration Foam products require water to dilute the product prior to use. The water must have less than 300 PPM of hardness. The smaller Pneumatic Foam Units are trailer mounted and require a piece of equipment to tow them around the site. During months of freezing weather, all Long Duration Foam products must be protected from freezing. The Pneumatic Foam Units are completely self contained and require no outside source of power. During freezing weather, a source of electricity is required to operate the freeze protection system on the larger Pneumatic Foam Units. There are no application temperature limitations on Long Duration Foam Products. Care must be exercised when applying AC-900 Series products with respect to weather, a heavy rain will not allow the membrane to form. After the first day, AC-900 Series products are unaffected by weather, i.e., rain, snow, wind, etc. Long Duration Foam is easily applied utilizing a Rusmar Incorporated Pneumatic Foam Unit. Long Duration Foam is a single component material requiring non chemical mixing and no post application cleanup. The Pnuematic Foam Units are simple and easy to operate; they require no special training. Long Duration Foam is available with durations ranging from a few hours to six months. The Pnuematic Foam Units are available in a variety of sizes ranging from a small skid mounted unit to a large self propelled track mounted unit. These units are available for purchase or rental. Long Duration Foam and Pnuematic Foam Units have been in use in the field for the past nine years. They do not face any general challenges. Long Duration Foam can be applied at a rate of 500 square feet per minute and requires only one operator.

Source of Information : TechCon

Sediments in Surface Water

Treatment

Sediments in Surface Water

Treatment

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : Bionergies, Biosmose, Biosurf

Application : In-situ (vadose zone) Off-site Ex-situ
In-situ (saturated zone)

Brief Description : Bioremediation of organic pollutions (in soils, water, effluents) by using: 1. exogenous specific bacterial consortium (non toxic, environment safe, European Federation of Biotechnology class I in order to control a full, complete and non selective biodegradation. 2. Biofixations (mineral natural support). 3. Biosurfactants (produced by selected bacteria) provide an effective, fast and secure alternative to common place bioremediation because Bionergies controls the biodegradation of the pollutant (and metabolites) by using specialized bacteria and feasibility tests (in labs, on the field).

Company Name/POC: Bionergies Laboratories, Biosurf/M. Jacques FAUDIN

Address : 59/100, rue des 4 termes/B.P. 1009/Z.I. des Paluds/13781 AUBAGNE Cedex, France

Phone Number : 33 42 84 30 07

Fax Number : 33 42 84 23 33

Technology Maturity : Commercial use experience

Performance History : Contact company for performance data.

Comments : Each case is analyzed in order to optimize the treatment and the on site materials and personnel. Bioenergies controls the bacterial action by using exogenous specific bacterial strains, biofixations and biosurfactants. None of the bacteria is genetically engineered. They are classified into class I (one) of the European Federation of Biotechnology, and produced under French and European Community regulations. The company is looking for join-ventures in U.S. in order to cover the environmental and industrial field.

Source of Information : International TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS: ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE: *Biodegradation (In Situ)*

Technology Name: Biocatalytic Contaminant Degradation (BCD)

Application: In-situ (vadose zone) Ex-situ
In-situ (saturated zone)

Brief Description: ECO-TEC, Inc. (ETI), utilizes "Enviomech Gold", (EMG), a proprietary biocatalyst to dramatically accelerate the biodegradation of petroleum hydrocarbons and other biodegradable contaminants. The biocatalytic contaminant degradation (BCD) process can be applied to soil or groundwater, ex situ or in situ. A pH-balanced microbial inoculum (BMI) consisting of water, EMG, indigenous microbes, contaminant specific microbes (if needed) and all trace minerals and nutrients required for microbial proliferation is created.

Company Name/POC: ECO-TEC, Inc./Ecology Technology, Inc./Herbert R. Pearse

Address: P.O. Box 1113/Issaquah, Washington 98027-1113

Phone Number: 206 392-0304

Fax Number: 206 392-057

Technology Maturity: Commercial use experience

Performance History: The Biocatalytic contaminant degradation, (BCD), technology has been successfully demonstrated many times on full-scale remediation projects in Washington State.

Comments: Generally, BCD technology can be applied to various sites and media, and can be implemented utilizing equipment that is readily available. Since many variable parameters exist between sites, no one BMI or application technology is best suited to all situations. The BCD process will be modified to meet site-specific criteria. The Biocatalytic contaminant degradation, (BCD), process is not the one cure for all remediation problems, although it can be utilized in conjunction with other remediation technologies. The BCD process is limited by the availability of oxygen, range of temperature and the availability of moisture. All of these limiting factors can be controlled in modern site remediation operations.

Source of Information: VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : Anaerobic Metal Removal Technology (AMR)

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : The AMR process was developed to release, separate and remove toxic metal contaminants in solids (soils, sediments, sludges) and can simultaneously bioremediate organic pollutants. The AMR technology involves the use of indigenous anaerobic heterotrophic denitrifying microbial populations which are resistant to and will aid in the solubilization of metal sulfides in the presence of other organic pollutants. AMR technology operates in the absence of oxygen, thereby eliminating the need for aeration. The process produces no acid which eliminates the secondary pollution problems. The addition of a low-cost and readily available soluble alternate electron acceptor source (nitrate) allows the system to be operated at low cost.

Company Name/POC: Geo-Microbial Technologies, Inc./D.O. Hitzman

Address : P.O. Box 132, East Main Street/Ochelata, Oklahoma 74051

Phone Number : 918 535-2281

Fax Number : 918 535-2564

Technology Maturity :

Bench scale testing, only

Performance History : Development for removal of metals from spent coal liquification catalysts (DOE contracts).

Comments : The elimination of oxygen requirements allows broad usage. Microbial ecology would be easily manipulated by minimum alternate electron acceptor amendments. The system has broad potential applications with minimum requirements for implementation. The ease and flexibility of amendment addition and use of indigenous microflora expand the range of applications.

Source of Information : TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Biodegradation (In Situ)*

Technology Name: Phytostabilized Bioremediation

Application: In-situ (vadose zone)
In-situ (saturated zone)

Brief Description: Uses enhanced biotechnology to degrade organics - e.g., phenol, PCB, dioxin and inorganics - nitrate, ammonia etc. The technology can be used in a soil matrix to treat flowing groundwater/effluent or by direct planting into soil. Non-stabilized bioremediated and many types of conventional water treatment. Microorganisms (fungi and bacteria) which develop in the planted soil are responsible for most of the treatment. The root and rhizone systems of the reeds bring air into the soil surrounding them while further away the environment is anaerobic creating a unique mosaic of treatment spheres which facilitates the impressive ability of reed beds to remove complex and previously intractable pollutants. The majority of treatment is by soil microbes but certain contaminants (such as heavy metals, sulphur and phosphorous) are removed via soil processes.

Company Name/POC: OEEL Ltd/ESU Ltd/ Lucian S. Gill

Address: 4 Cumberland House/Greenide Land/Lidget Green/Bradford W. Yorkshire BD89TF England

Phone Number: 1274 480033

Fax Number: 1274 48300

Technology Maturity: Commercial use experience

Performance History: Over 500 applications worldwide including PCB, Pesticide, Dioxins, Organics - including solvents, phenolics, PAH's, ammonia, nitrates, cyanide etc., sewage, farm slurries, metal, entrapment/extraction.

Comments: Requires adaptation and monitoring over the first 3 years to maturity but then continues in some cases with little or no attention. Requires larger land areas than conventional "packaged" systems. Requires three years adaption period. Once adapted is extremely flexible and will readapt to changes in input. The technique involves genetics selection of plant types to withstand toxic material. The plant/soil/bacterial matrix is then adapted to the site conditions and once stabilized - continues to treat the toxic material indefinitely. Effluent/groundwater is fed into a basin containing the PL/SO/BAC matrix. Plants are allowed to develop and penetrate their rhizomes into the toxic soil. Because each site has a unique problem, no hard rule for system costs can be given. Smallest system - 10 sq. meters, largest 20 hectares; volume 1 m(cubed) per day to 5000 m(cubed) per day.

Source of Information: International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☒ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : Bioremediation

Application :
In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : SBP Technologies, Inc. (SBP) has compiled a unique collection of patented microorganisms for use in bioremediation applications. The integrated use of these microorganisms together with in situ bioreactor technologies promise to yield an effective and cost-efficient remedial solution for soil, sediment and groundwater contaminated by a great number of organic compounds. The in situ bioreactor is an encapsulated cell designed to be inserted into a well. The bioreactor can be inserted to treat the vadose zone or groundwater.

Company Name/POC: SBP Technologies, Inc./Dr. James Mueller, Ph.D.

Address : One Sabine Island Drive/Gulf Breeze, Florida 32561-3999

Phone Number : 904 934-9282

Fax Number : 904 934-9201

Technology Maturity : Pilot plant testing

Performance History : Specially selected microorganisms have been patented for the treatment of soil (and water) containing organic wood preservatives, namely creosote and PCP, and chlorinated solvents, especially TCE. Application strategies using in situ bioreactors and encapsulated cells are designed on a site-specific basis.

Comments : Time constraints often limit in situ applications. All conventional limitations to biological processes apply (e.g., high metal concentrations, temperature, pH, nutrient status, oxygen potential, bioavailability, etc.). Physical/hydrogeological constraints are also relevant.

Source of Information : VISITT 3.0

SEDIMENTS IN SURFACE WATER

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : Enhanced Bioremediation

Application : In-situ (vadose zone)

Brief Description : Enhanced biological degradation/destruction of contaminants in soils/sediments: improved microbial growth for contaminant mineralization to innocuous end-products, excellent destruction for organic contaminants.

Company Name/POC: Wastewater Technology Centre/Kevin Hosler

Address : 867 Lakeshore Road/P.O. Box 5068/Burlington, Ontario, Canada L7R 4L7

Phone Number : 905 336-6021

Fax Number : 905 336-476

Technology Maturity :

Field demo complete

Performance History : Technology is presently licensed to S. R. Grace Ltd.

Comments : Best success achieved for medium-to-coarse-textured soils. Easy to use; irrigation/moisture control system required.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *White Rot Fungus*

Technology Name : White Rot Fungi For the Treatment of Recalcitrant Organics in Soil

Application : On-site Ex-situ

Brief Description : White rot fungi are able to degrade many recalcitrant organic pollutants. Biotol Ltd. have scaled the process up successfully for the treatment of chlorinated phenols. Current activities are laboratory and field work with PCB's and dioxins.

Company Name/POC: Biotol LTD./Dr. Philip Caunt

Address : 5 Chiltern Close/Cardiff Industrial Park, Cardiff Glanorgan South Wales/CF4 5DL, UK

Phone Number : 1222 766716

Fax Number : 1222 766945

Technology Maturity : Commercial use experience

Performance History : 10,000 metric tons of chlorophenol contaminated soil successfully treated in Finland. Levels reduced from 200 ppm to <10 ppm in 12 months. Further details available on request. Currently working at field scale on polyaromatic hydrocarbons following successful laboratory trials. Laboratory and small scale field programs for PCBs and dioxins.

Comments : Beds approx 2m deep. An area of one square meter is required for each two cubic meters of soil to be treated. Power is required for aeration fans ; passive aeration under development beds formed using standard site machinery. (front end loader, drum screen tub grinder) No plant requirements during treatment period. Only suitable for organic contamination. Skills required for handling of fungus (Biotol will provide). For PCB's and dioxins, the question is how low can contamination be reduced and will it reach acceptable targets. High concentration may require some dilution to reach treatment target. PCB & dioxin program initiated in March 1994. Laboratory work scheduled to run March 94 - March 95. Field scale work scheduled for January 95 - September 95 work is supported by D.T.I. under SPUR (Support for Products Under Research Program).

Source of Information : International TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Solidification/Stabilization (In Situ)*

Technology Name: Stabilization/Solidification

Application: In-situ (vadose zone)

In-situ (saturated zone)

Brief Description: STC Omega specializes in the development and application of technologies for the treatment of organic and inorganic contaminated soils, sludges and wastewaters. STC Omega's chemical fixation and solidification technologies have been utilized successfully to treat over 500,000 cubic yards of contaminated soils and sludges on >30 full-scale hazardous waste remediation projects across the U.S. and in Italy. STC Omega's technologies have been applied to industrial in-process treatment, hazardous waste site remediation projects, RCRA Landban treatment in a Part B permitted hazardous waste landfill facility, and organic and inorganic industrial wastewater treatment systems. Technology allows treatment to be performed in-situ. Full-scale treatment performance can be determined effectively on a laboratory- and pilot-scale basis before full scale.

Company Name/POC: STC Omega, Inc./Greg Maupin

Address: 7650 E. Redfield Road/Suite D5/Scottsdale, Arizona 85260

Phone Number: 602 948-7100

Fax Number: 602 991-317

Technology Maturity: Commercial use experience

Performance History: Performance Data are Available.

Comments: This technology is quite versatile. It has been used inside buildings, in rural areas with minimal access to power, and normal construction sites. Soil matrix such as stiff clay can reduce the treatment rate production. STC Omega has been successful in treating all types of soil matrices. STC Omega treatment can be provided with standard rental construction equipment. Main attribute after treatment is significantly reducing the leachability and mobilization of contaminants. This reduction can be determined with such tests as the EPA TCLP and American Nuclear Society ANS 16-1.

Source of Information: TechCon

CONTAMINANTS :

Pesticides/Herbicides

Heavy Metals

Explosives/Propellants

■ Petroleum Hydrocarbons

■ Radionuclides

SVOC

Other Contaminant _____

■ **Nonhalogenated VOC**

Halogenated VOC

N/A

TECHNOLOGY TYPE: *Composting*

Technology Name : Bioremediation

Application :

On-site

Ex-situ

Brief Description :

The initial steps of this technology consist of excavating contaminated soil/sediment or collection of contaminated waters for treatment. The contaminated material is then mixed with composting materials as a mixture formulated to yield the desired carbon to nitrogen ratio to result in optimal composting conditions. Air is circulated through the compost via perforated pipe in the compost bed. Temperature is controlled by the rate of air flow through the compost and pH is monitored regularly to ensure optimal composting conditions. Moisture is added as required to maintain a nominal 60% moisture in the compost and mixing is carried out on a weekly basis. Composting of energetic materials (explosives and propellants) is completed within a 4- to 6-week time period.

Company Name/POC: Arctech, Inc./Dr. Daman Walia

Address : 14100 Park Meadow Drive/Chantilly, Virginia 22021

Phone Number : 703 222-0280

Fax Number : 703 222-0299

Technology Maturity : Commercial use experience

Performance History : Arctech has recently demonstrated its composting technology on radioactive energetics (explosives and propellants).

Comments :

This technology is not applicable to volatile organics, solvents or inorganic metal contaminants due to the release of volatiles as a result of the heat generated during composting and/or due to the activity of the microorganisms in creating volatile organics, for example methyl mercury.

Source of Information : VISITT 3.0

SEDIMENTS IN SURFACE WATER

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Composting*

Technology Name : Terra Ferm

Application :

On-site Ex-situ
Off-site

Brief Description : Biodegradation of contaminated soil hydrocarbons, PAH's, PCB's, chlorinated hydrocarbons. Composting technology with enhanced native organisms; product (clean soil) sold as potting soil in Germany.

Company Name/POC: Umweltschutz Nord GmbH/Dr. Kurt Lissner

Address : Industrie Park 6, 27767 Ganderkesee/ Germany

Phone Number : 49 4222 47 106

Fax Number : 49 4222 47 142

Technology Maturity : Commercial use experience

Performance History : Numerous sites remediated in Germany. Some problems with PCBS. Contact in US: Bioremediation Service; P O Box 2010 Lake Oswego, OR 97035; 800-775-9464 or 503-626-9464.

Comments : Company provides all equipment, analysis, and service. Can be used in U.S. through subsidiaries in Texas and Oregon or through J.A. Jones Construction. Company uses a high-tech composting approach with extensive pre- and post-treatment monitoring. Takes ownership of contaminated soil. On-site or remote treatment.

Source of Information : International TechCon.

CONTAMINANTS :

☒ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Solid Phase Biological Treatment*

Technology Name : Biocatalytic Contaminant Degradation (BCD)

Application : On-site Ex-situ

Brief Description : ECO-TEC, Inc. (ETI), utilizes "Enviromech Gold", (EMG), a proprietary biocatalyst to dramatically accelerate the biodegradation of petroleum hydrocarbons and other biodegradable contaminants. The biocatalytic contaminant degradation (BCD) process can be applied to soil or groundwater, ex situ or in situ. A pH-balanced microbial inoculum (BMI) consisting of water, EMG, indigenous microbes, contaminant specific microbes (if needed) and all trace minerals and nutrients required for microbial proliferation is created.

Company Name/POC: ECO-TEC, Inc./Ecology Technology, Inc./Herbert R. Pearse

Address : P.O. Box 1113/Issaquah, Washington 98027-1113

Phone Number : 206 392-0304

Fax Number : 206 392-0575

Technology Maturity : Commercial use experience

Performance History : The Biocatalytic contaminant degradation, (BCD), technology has been successfully demonstrated many times on full-scale remediation projects in Washington State.

Comments : Generally, BCD technology can be applied to various sites and media, and can be implemented utilizing equipment that is readily available. Since many variable parameters exist between sites, no one BMI or application technology is best suited to all situations. The BCD process will be modified to meet site-specific criteria. The Biocatalytic contaminant degradation, (BCD), process is not the one cure for all remediation problems, although it can be utilized in conjunction with other remediation technologies. The BCD process is limited by the availability of oxygen, range of temperature and the availability of moisture. All of these limiting factors can be controlled in modern site remediation operations.

Source of Information : VISITT 3.0

SEDIMENTS IN SURFACE WATER

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Solid Phase Biological Treatment*

Technology Name : CNP-Plus Bioremediation

Application : On-site Ex-situ

Brief Description : The CNP-Plus is a speciality belended biological activator that stimulates indigenous microbial growth when applied to soils containing organic contaminants. The stimulating characteristics of CNP-Plus causes extensive proliferation in the indigenous microbial population to the point where the organic contaminants become their basic food source and biodegradation takes place.

Company Name/POC: Etus, Inc./Mark Wernhoff

Address : 1511 Kastner Place/Sanford, Florida 32771

Phone Number : 407 321-7910

Fax Number : 407 321-309

Technology Maturity : Commercial use experience

Performance History : Full-scale process installations have been used to reduce organic hydrocarbon contaminant loadings in soils to within the established parameters of the State and local regulatory agencies. Pilot-scale demonstrations have been performed at sites to treat soils and sludges contaminated with diesel fuels, TPHs, and PCBs.

Comments : The treatment process may be applied both in situ or ex situ, while the ex situ process is greatly accelerated by the optimization of all the factors relevant to microbial proliferation. The main limiting factor of the process is sustained ambient air temperature below 50 degrees Fahrenheit but this can be overcome with the use of mechanical devices. The use of the enhanced bioremediation technology for organic hydrocarbon contaminants will achieve up to 90 percent reduction in concentration levels within 60 to 180 days.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Solid Phase Biological Treatment*

Technology Name : Biofast

Application : On-site Ex-situ

Brief Description : The most typical application is related to leaking underground storage tanks where excavated soil must be treated. The BIOFAST system is installed in the pit generated during tank removal; a liner is placed in the pit to prevent further contaminant migration. Excavated soil is treated with nutrients, lime and moisture as recommended by a simple bench-scale assessment. Layers of soil and air exchange conduits are placed in the lined pit until the pit is refilled. The pit is then typically covered with an asphalt cap.

Company Name/POC: IT Corporation/Duane Graves

Address : 312 Directors Drive/Knoxville, Tennessee 37923

Phone Number : 615 690-3211

Fax Number : 615 690-3626

Technology Maturity : Commercial use experience

Performance History : The BIOFAST system has been successfully deployed at full scale. Full-scale systems have been employed to treat gasoline and diesel impacted soil at service stations and at a trucking terminal.

Comments : The BIOFAST system provides an unobtrusive soil treatment alternative which is well suited for the treatment of contaminated soils associated with underground storage tanks and other remedial activities which involve the excavation of contaminated soil. The system is space efficient and generally does not interfere with site operations. The system has the capability to treat a variety of soil types and will accommodate almost any volume of soil. A subsurface BIOFAST system will support heavy ground traffic if properly compacted.

Source of Information : VISITT 3.0

SEDIMENTS IN SURFACE WATER

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Solid Phase Biological Treatment*

Technology Name : Solid Phase - Bioremediation

Application : Ex-situ

Brief Description : Solid phase bioremediation involves the cleaning of soil contaminated with petroleum hydrocarbons and some low-level PAHs. The contaminated soil is processed through a specially designed machine which shreds the soil, adds a compost material, nutrients, and water. The finished product is a fluffy, well blended mixture of soil and organic substrate that has achieved the proper moisture level (70 percent field capacity) and inorganic nutrient level for optimum bioremediation.

Company Name/POC: SBP Technologies, Inc./Dr. James Mueller, Ph.D.

Address : One Sabine Island Drive/Gulf Breeze, Florida 32561

Phone Number : 904 934-9282

Fax Number : 904 934-920

Technology Maturity : Commercial use experience

Performance History : Contact company for performance data.

Comments : The technique is most effective with petroleum hydrocarbons and low molecular weight PAHs. This technology is not effective for inorganic contaminants, (i.e. heavy metals). Based on site specific cases, may need control of volatile emissions during excavation and treatment.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : Bionergies, Biosmose, Biosurf

Application : In-situ (vadose zone) Off-site Ex-situ
In-situ (saturated zone)

Brief Description : Bioremediation of organic pollutions (in soils, water, effluents) by using: 1. exogenous specific bacterial consortium (non toxic, environment safe, European Federation of Biotechnology class I in order to control a full, complete and non selective biodegradation. 2. Biofixations (mineral natural support). 3. Biosurfactants (produced by selected bacteria) provide an effective, fast and secure alternative to common place bioremediation because Bionergies controls the biodegradation of the pollutant (and metabolites) by using specialized bacteria and feasibility tests (in labs, on the field).

Company Name/POC: Bionergies Laboratories, Biosurf/M. Jacques FAUDIN

Address : 59/100, rue des 4 termes/B.P. 1009/Z.I. des Paluds/13781 AUBAGNE Cedex, France

Phone Number : 33 42 84 30 07

Fax Number : 33 42 84 23 33

Technology Maturity : Commercial use experience

Performance History : Contact company for performance data.

Comments : Each case is analyzed in order to optimize the treatment and the on site materials and personnel. Bioenergies controls the bacterial action by using exogenous specific bacterial strains, biofixations and biosurfactants. None of the bacteria is genetically engineered. They are classified into class I (one) of the European Federation of Biotechnology, and produced under French and European Community regulations. The company is looking for join-ventures in U.S. in order to cover the environmental and industrial field.

Source of Information : International TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : Slurry Phase Bioremediation

Application : ☐ On-site ☐ Ex-situ

Brief Description : Slurry-Phase Bioreactors - Bioslurry reactors combine excavated contaminated soils, sludges, or sediments with water and nutrients in above-ground agitated tanks to create a slurry. Mechanical agitation not only introduces oxygen but maximizes the availability of nutrients to the indigenous microorganisms capable of degrading the target compounds. Following treatment, the cleaned soils is separated from the slurry and is replaced on-site. Bioslurry reactors are particularly effective for a site where seasonal climatic changes are unfavorable for solid-phase treatment. Anaerobic slurry reactors can be utilized for the remediation of recalcitrant compounds such as chlorinated aliphatics and substituted aromatics.

Company Name/POC: COGNIS, Inc./Ron Wilson

Address : 2331 Circadian Way/Santa Rosa, California 95407

Phone Number : 707 575-7155

Fax Number : 707 575-783

Technology Maturity :

Bench scale testing, only

Performance History : This remediation technology is being developed rapidly and was to have completed pilot plant testing by early 1993. Capability to remediate chlorinated organics within this system will be developed.

Comments : May be coupled with acid extraction to address soils contaminated with metals and organics. Metals which adversely affect bioremediation are removed before the bioreactor step.

Source of Information : VISITT 3.0

CONTAMINANTS :

- ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment***Technology Name :** Biotechnology/Bioremediation**Application :** On-site Ex-situ

Brief Description : Biological decontamination of soil/wastewater using bioadapted micro-organisms. Microbes use hazardous organic substances as food sources thereby degrading them to nonhazardous end products like CO₂ and H₂O. Achieves a high level of decontamination in a short time; inexpensive.

Company Name/POC: KAM Biotechnology Ltd./Mongi Ferchichi**Address :** 9710 187th St., #101/Surrey B.C. V4N 3N6**Phone Number :** 604 888-4336**Fax Number :** 604 888-6623**Technology Maturity :** Commercial use experience**Performance History :** Successfully completed decontamination of soils, wastewaters, sludges, transformer oils etc.

Comments : Bacteria cannot degrade all compounds and some are in fact inhibitory to their growth. Equipment easily transported. Minimal infrastructure required. Most bacterial additives are "not controlled" plus not "hazardous."

Source of Information : International TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : Biological Sulfate and Metal Removal

Application : On-site Ex-situ

Brief Description : Biologically reduce sulfate to sulfide. Remove metals as insoluble metal sulfide, remove excess sulfide as elemental sulfide. Metal removals >99.1%; Sulfate removals >90.1%.

Company Name/POC: Paques, Inc./Andre de Vegt

Address : 486 Thomas Jones Way/Suite 100/Exton, PA 19341 USA

Phone Number : 610 363-9564

Fax Number : 610 363-955

Technology Maturity : Commercial use experience

Performance History : One full scale plant in operation at Zinc Production Facility in the Netherlands. Good operation since start-up in May 1992

Comments : Electron donor required for sulfate reducing bacteria (can be ethanol, hydrogen gas, organic wastes). Highly automated operation possible. Parent company is located in town of Balk, Netherlands.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : Slurry Phase Bioremediation

Application :

Ex-situ

Brief Description : SBP Technologies, Inc., (SBP) has established a unique collection of patented microorganisms for use in bioremediation applications. Based on the nature of the impacted matrix and the site-specific cleanup goals, various bioremediation strategies have been developed for the practical application of these technologies. These strategies include: 1) fixed-film bioreactors for water treatment and 2) soil slurry bioreactors.

Company Name/POC: SBP Technologies, Inc./Dr. James Mueller, Ph.D.

Address : One Sabine Island Drive/Gulf Breeze, Florida 32561-3999

Phone Number : 904 934-9282

Fax Number : 904 934-9201

Technology Maturity :

Pilot plant testing

Performance History : The SBP biotreatment strategy has been shown to: 1) effectively and extensively biodegrade (mineralize) high-molecular-weight PAHs, and 2) remove the toxicity and teratogenicity associated with effluent from the treatment train. This result was demonstrated at the American Creosote Works Superfund site, Pensacola, Florida, where system effluent was acceptable for direct discharge off site.

Comments : For soils, soil texture and structure can significantly influence treatment efficacy. All conventional limitations to biological processes apply (e.g., high metal concentrations, temperature, pH nutrient status, oxygen potential, bioavailability, etc.). However, treatment systems that integrate physical separation technologies (e.g., soil washing and filtration) can be designed to handle organic/inorganic waste streams.

Source of Information : VISITT 3.0

SEDIMENTS IN SURFACE WATER

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : Biolift Reactor

Application : On-site Ex-situ

Brief Description : The reactor uses a rake/thickener mechanism to control settled solid particles by raking them to either a central airlift or multiple airlifts at the tank periphery. Internal or external airlifts will affect the recirculation of solids. Airlift(s) effect(s) internal (external) recirculation of solids. Flexible membrane tube diffusers are provided in a stacked arrangement rotating on the rake arms to effect aeration of the slurry. Depending on the application, one or several mixers are provided. The reactor is gas-sealed and volatile emissions are controlled through gas recirculation allowing for their eventual biodegradation.

Company Name/POC: Tekno Associates/Gunter Brox

Address : 3466 South Westwood Drive/Salt Lake City, Utah 84109

Phone Number : 801 272-2288

Fax Number : 801 272-228

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Equipment was evaluated during the demonstration of Biotrol, Inc.'s soil washer under EPA's SITE Program. The Biolift Reactor has treated creosote contaminated soil for an EPA BDAT study project executed by ECOVA Corporation and for the SBP Site demonstration project at American Creosote Works in Florida. The reactor has also treated BTEX and TPH contaminated soils from the Ninth Avenue Superfund Site.

Comments : Contaminants have to be biodegradable. High metal concentration may be inhibitory. Soil has to be processed into a uniform slurry by applying mineral processing techniques. The reactor does not provide enough kinetic energy to affect slurrying of freshly "as is" excavated soil.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : Auto-Heating Thermophilic Aerobic Reactor (ATAR)

Application : On-site Ex-situ

Brief Description : A-TAR is a self-heating slurry-phase bioreactor operating in the thermophilic temperature range (45-65 degrees Centigrade) with no external heating support and no nutrient addition. This technology is being developed for accelerated bioremediation soils, sediments and sludges contaminated with biodegradable hazardous organics. The aerobic bioreactor degrades complex organic substrates and the energy released in exothermic reactions is captured to maintain the reactor temperature. Significant biological destruction of polycyclic aromatic hydrocarbon is achieved over a 5-10-day treatment time.

Company Name/POC: Wastewater Technology Centre/Deonarine Phagoo

Address : 867 Lakeshore Road/P.O. Box 5068/Burlington, Ontario, Canada L7R 4L7

Phone Number : 905 336-6478

Fax Number : 905 336-4765

Technology Maturity : Pilot plant testing

Performance History : Bench-scale treatability study on contaminated soils from a manufactured gas plant site. These trials have demonstrated over 90% removals of PAHs at a 5-day retention time for contaminated soil in the feed of up to 10% by weight. Pilot scale experiments were conducted using a 1000 L slurry bioreactor for treating contaminated sediments from Hamilton Harbour and the results demonstrated over 95% removal of total PAHs, about 80% removal of total petroleum hydrocarbon (TPH), and about 70% removal of oil and grease (O&G) over an 8-day reactor retention time, without external heating support.

Comments : Requires high oxygen transfer efficiency and good mixing. Primary applicable for the treatment of contaminated fines in soils, sediment and sludges.

Source of Information : International TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Slurry Phase Biological Treatment*

Technology Name : Slurry-Phase Bioremediation

Application : On-site Ex-situ

Brief Description : Engineered bioreactor for slurry-phase remediation of contaminated soils, sediments, and or sludges at higher treatment rates than conventional solid phase bioremediation:

Company Name/POC: Wastewater Technology Centre/Kevin Hosler

Address : 867 Lakeshore Road/P.O. Box 5068/Burlington, Ontario, Canada L7R 4L7

Phone Number : 905 336-6021

Fax Number : 905 336-476

Technology Maturity :

Bench scale testing, only

Performance History : Contact company for performance data.

Comments : Limited to biologically-degradable contaminants. Will be easy to use at full-scale; available as a transportable unit, fully automated. Scale-up considerations have not yet been fully addressed.

Source of Information : International TechCon

CONTAMINANTS:

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

■ Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

Halogenated VOC

N/A

TECHNOLOGY TYPE: *Chemical Reduction/Oxidation*

Technology Name : Light Activated Reduction of Chemicals (LARC)

Application :	On-site	Ex-situ
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Brief Description : LARC is a patented photochemical process (U.S. Patent No. 4, 144, 152) which uses ultraviolet light and an optimized reducing environment to dehalogenate chlorinated, brominated, and iodinated organic compounds. The photochemical conditions supplied by the LARC reactor lead to a rapid, highly controllable reaction which yields only biphenyl and sodium chloride as the final products from PCBs. No oxygenated derivatives, chlorinated dibenzofurans, or chlorinated dioxins have ever been observed in gas chromatographs or mass spectra of the intermediates or products in the LARC degradation of chlorinated organics.

Company Name/POC: Arctech, Inc./Dr. Daman Walia

Address : 14100 Park Meadow Drive/Chantilly, Virginia 22021

Phone Number : 703 222-0280

Fax Number : 703 222-0299

Technology Maturity : Pilot plant testing

Performance History : LARC is extremely cost-competitive with the existing technologies for treatment of PCBs (significantly lower in cost than incineration). Samples containing in excess of 1,000 ppm of PCBs have been successfully decontaminated to meet federal, state, and local clean-up levels. In a pilot-test study, Arochlor 1260 was reduced from 3,000 ppm to 20 ppm, when treated by the LARC technology.

Comments : The LARC technology is not useful for treatment of metals-only or radioactive wastes. The process is designed specifically for treatment of halogen containing materials. Inorganic materials present in wastes do not interfere with the efficiency of the process.

Source of Information : VISITT 3.0

SEDIMENTS IN SURFACE WATER

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Chemical Reduction/Oxidation

Technology Name : Gas Phase Chemical Reduction

Application : On-site Ex-situ

Brief Description : The ECO LOGIC Process involves the gas-phase reduction of hazardous organic contaminants. The system is capable of treating any form of organic contamination at any concentration with proven destruction and removal efficiencies (DREs) of at least 99.9999 percent. Contaminants entrained in liquids, soils and bulk solids can be destroyed without the formation of hazardous organic residuals. The system has been verified by various government agencies worldwide including the US EPA through the Superfund Innovative Technology Evaluation program. The ECO LOGIC Process is currently offered as a commercial-scale system for on-site treatment. The closed-loop destruction process ensures that no uncontrolled emissions result while the use of a reducing atmosphere ensures that dioxins and furans are not formed as byproducts. The system is mobile and may be utilized for on-site destruction.

Company Name/POC: ELI Eco Logic International Inc./Jim Nash

Address : 143 Dennis Street/Rockwood, Ontario, Canada NOB2K0

Phone Number : 519 856-9591

Fax Number : 519 856-923

Technology Maturity : Commercial use experience

Performance History : Development of the technology began in 1986 and proceeded through the bench-scale and laboratory-scale. In 1991, a pilot-scale unit was constructed and tested extensively at Hamilton Harbour, Ontario, Canada. Demonstrations on sediment contaminated with 300,000 ppm PAH and 400 ppm PCBs confirmed DREs of 99.9999 percent. The pilot-scale unit was tested in Bay City, Michigan, the following year for the US EPA and PCB contaminated oil (25 percent PCBs), water and soil. Once again DREs of at least 99.9999 percent were confirmed. Following the Bay City demonstration further modifications were made to the front-end preprocessing units as well as scaling up the technology to a commercial-scale. At the time of this writing, (May 1995) the first commercial-scale unit was operating in Australia on pesticide residuals and PCB contaminated electrical equipment. The second and third commercial-scale units are presently being constructed and will be utilized by General Motors of Canada Ltd. and the steel manufacturing firm Dofasco Inc.

Comments : The ECO LOGIC Process treats only the organic portion of the waste stream. Any inorganic co-contaminants will remain in the treated soil or be separated in the grit and scrubber as metal hydrides, depending on their physical characteristics. Additionally, the radioactive component of a mixed low level waste stream would be captured at various specific locations in the Process. With the ECO LOGIC Process, a mixed waste stream would undergo significant volume reduction and separate the radioactive component into a form that is more amenable to traditional methods of disposal. The ECO LOGIC Process is mobile and mounted on several drop-deck highway trailers. It may be transported to the waste site and set-up within four weeks. Once the on-site waste has been destroyed, the system is simply moved to the next site. The mobility and closed-loop destruction process have garnered significant public acceptance for the technology while being offered at a competitive cost. The ECO LOGIC Process is at an advanced state of development for an alternative remediation technology and is presently offered at a commercial-scale.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Chemical Reduction/Oxidation*

Technology Name : Fenton's Chemistry (Fe catalyzed H₂O₂)

Application :	On-site	Ex-situ
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Brief Description : Organic chemicals, i.e., aromatics, chlorohydrocarbons, alcohols, acids, aldehydes and amines react completely with OH to form CO₂ and H₂O. Hydroxyl radical is generated by Fe catalyzed hydrogen peroxide in water at atmospheric pressure and temperature. Reaction is controlled by ORP, pH, time temperature and concentration.

Company Name/POC: Technotreat Corporation/Richard J. Bigda

Address: 6216 S. Lewis/Suite 106/Tulsa, Oklahoma 74136

Phone Number : 918 445-0966

Fax Number : 918 445-0994

Technology Maturity : Commercial use experience

Performance History : Six Technotreat Fenton's Reactors have been put into service for the treatment of paint stripper waste water containing phenol, formic acid, chrome, methylene chloride, benzene and toluene. References and contacts:

Aero Corporation: 904-752-7911, Joe Bonds
KC Aviation: 214-902-7511, Clyde Phillips
TAP Air Portugal: 011-351-1-841-6022, Abrantes Machado

Comments : Units are skid mounted. 5000 gal/batch capacity system requires about 9' x 20' by 12'h area, requires 12-20 KVA power supply, and compressed air at 69 to 90 psi. Temperatures below 60 degrees Fahrenheit inhibit initiation of reaction. Automated, computer controlled system with proprietary software drives the unit through 55 steps with minimum operator's input or knowledge of chemistry. Various safety shut down devices protect against harm and run-away reactions. Interlocks prevent accidental spills and discharges to environment. Double containment can be incorporated. The system operates at atmospheric pressure and low temp. (100-140 degrees Fahrenheit)

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Soil Washing

Technology Name : Physical Separation (Soil Washing)

Application : On-site Ex-situ

Brief Description : Physical processing to reduce the amount of contaminated material requiring downstream treatment or disposal (volume reduction). The process uses readily available equipment from the mineral processing industry. The circuit configuration is tailored to the exploitable physical differences between contaminated and noncontaminated particles that are identified and quantified in a series of characterizing laboratory tests. The tests and subsequent treatment are based on differences in grain size, abrasion, settling velocity, specific gravity, surface chemical properties, magnetic susceptibility and solubility/leachability. The advantage of AEA's approach is that it uses the most appropriate readily available, mineral processing equipment in a configuration that is matched to the exploitable attributes of the contaminants and the "soil" components.

Company Name/POC: AEA Technology/Dr. Mark Neville

Address : Building 429/Harwell Laboratory/Near Didcot/Oxon, OX11 0RA, UK

Phone Number : 44 1235 432252

Fax Number : 44 1235 43227

Technology Maturity : Pilot plant testing

Performance History : (1) UK Department of the Environment: Contact: Judith Denner Tel: 44 71 276-8348. Research programs over years 1990-1994 into the physical separation of contaminants from a number (8) of contaminated soils. (2) US Environmental Protection Agency: Contact: Norma Lewis Tel: (513) 569-7665, Mary Stinson Tel: (908) 321-6683. Research program 1991-1994 using techniques from the mineral processing industry for the treatment of soil from a former gasworks. Contaminants included heavy metals, PAH and cyanide. (3) European Commission: Reprocessing of Beralit Mineral Tailings. (4) Other projects: are commercially in confidence but include work with contaminated soils and dredged harbour sediment.

Comments : The process is a volume reduction process based on separating a relatively "clean" bulk from contaminated particles. Not all contaminated soils can be treated in this manner, as the contamination may be dispersed over all the particles such that a separated bulk cannot reach the desired "cleanup" targets. The ability to reach the cleanup targets however can be ascertained in the preliminary laboratory characterizing tests. As a volume reduction process, it is therefore limited by the costs associated with disposal or downstream treatment of the contaminated concentrates. The downstream processes, however, can be cost effective as they only apply to the relatively low volume of contaminant concentrates rather than the total soil. The equipment used is readily available mineral processing equipment which could be leased from a number of manufacturers. It can operate on a treatment pad in the open but environmental controls may necessitate erection of a surrounding frame and fabric cover for containment. Operator training is required. The number of operators will depend on the throughput requirements and the degree of control automation required. The organizational structure would involve an overall plant manager, excavation and transport personnel, 2-3 operators, maintenance engineers and support administrative and analytical staff. The tests and the subsequent pilot designs have been developed by adapting techniques that AEA has developed over the last 30 years for the assessment and separation of mineral ores.

Source of Information : International TechCon

CONTAMINANTS :☒ Pesticides/Herbicides☒ Heavy Metals☒ PCB☒ Explosives/Propellants☒ Petroleum Hydrocarbons☒ Radionuclides☒ SVOC☒ Other Contaminant☒ Nonhalogenated VOC☒ Halogenated VOC☒ N/A**TECHNOLOGY TYPE :** *Soil Washing***Technology Name :** High Pressure Water Jet**Application :**

On-site Ex-situ

Brief Description :

This technology is an aqueous soil-washing system with a capacity of 100 tons/hr. and uses cyclonic water jets. Treatment capabilities include the removal of heavy metals (Pb 600 to <75ppm; PAHS 450 to <20 ppm; and chlorinated HC's 130 to <0.09ppm).

Company Name/POC: Bodem Sanering B.V./Mr. Bilsma or Mr. Olive**Address :** BSN Wetering #2/6002 SM Weert/Netherlands**Phone Number :** 011 31 49 504 3035**Fax Number :** 011 31 49554 3035**Technology Maturity :** Commercial use experience**Performance History :** Used in Duesseldorf for treating 300,000 tons of contaminated soil**Comments :**

The normal soil wash limitations exist for this technology: rocks, high clay content. Technology used by Klockner Oecotec but now owned (after patent dispute) by BSN.

Source of Information : International TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Soil Washing

Technology Name : Cacitox Soil Washing Process

Application : Ex-situ

Brief Description : The process uses a proprietary reagent "Cacitox" to dissolve actinides and certain heavy metals from soils. Feedstock may be LLW, TRU, or mixed waste contaminated soil. Treated material should be at or below limits for LLW. Process residues are suitable for immobilization; e.g., by cementation. Current experience includes the dissolution of Pu, U, Am, Th, Cs, Sr, Cr, Ni, Cu, Zn, As, Cd, and Pb.

Company Name/POC: British Nuclear Fuels plc/Janet Jackson

Address : Risley, Warrington WA3 6AS Cheshire, England

Phone Number : 1925 832735

Fax Number : 1925 83572

Technology Maturity :

Bench scale testing, only

Performance History : Contact company for performance data.

Comments : Process is not designed to remove organic contaminants but can be used after an organics treatment process. Plant uses proven, commercially available equipment. Skills required are those normally associated with HLW/TRU waste handling. BNFL has extensive expertise in this area. Cost advantage over conventional soil washing (classification) in-situ specific. Advantage increases as throughput and fines content increase. Equipment can be operated with high clay/silt content soils which are unsuitable for treatment by classification. Process does not rely on large particle size fraction or feedstock being relatively uncontaminated in order to achieve required product specification.

Source of Information : International TechCon

CONTAMINANTS :

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

■ Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

■ Nonhalogenated VOC

Halogenated VOC

N/A

TECHNOLOGY TYPE: Soil Washing

Technology Name : Soil Washing-TERRAMET

Application :

On-site

Ex-situ

Brief Description :

Soil washing/leaching is a combination of physical and chemical remedial techniques whose goal is to clean contaminated soil and remove and recover the contaminants. In some cases all the soil components can be cleaned, while in others the contaminant can be restricted to a very small fraction. Soil washing/leaching is specifically tailored to a site utilizing the relevant techniques, e.g. particle size separation, attrition, density separation, magnetic separation, flotation and selective leaching. Soil washing/leaching has been shown to be very effective, and cleanup standards as exacting as background residual values can be met.

Company Name/POC: COGNIS, Inc./Dr. William E. Fristad

Address : 2331 Circadian Way/Santa Rosa, California 95407

Phone Number : 707 576-6235

Fax Number : 707 575-7833

Technology Maturity : Commercial use experience

Performance History : One full-scale cleanup has been successfully completed, ~15,000 tons of soil at the Twin Cities Army Ammunition Plant (TCAAP). The soil was contaminated by ordnance plus eight heavy metals, primarily Pb, Cu and Hg. The cleanup criteria involved removing all ordnance and the metals-to-background concentrations. Meeting this stringent cleanup criteria meant providing a combined physical and chemical treatment plant operating at high efficiency. The recovered heavy metals were recycled through a secondary lead smelter. Contacts: Darryl Terho, Federal Cartridge Co. (612 633 2301) and Marty McCleery, TCAAP (612 622 2301 extension 651).

Comments :

Soil washing is generally most cost effective for sandy soils. Fines can be treated by leaching, but the throughput is slower. If contaminants are spread throughout all soil particle size fractions, and are completely insoluble and chemically difficult to alter in solubility, soil washing/leaching will be difficult; however, this combination of factors is not common. Residuals treatment depends on the contaminants. COGNIS has removed heavy metals from soil and been able to recycle 100 percent of the recovered metal from soil through a secondary smelter. After treatment, the soil was returned on site with no monitoring required and no deed restriction on the property. Recovered radioactive contaminants would require disposal rather than recycle.

Source of Information : TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Soil Washing

Technology Name : Mercury Removal

Application : Ex-situ

Brief Description : Contaminant identified as Mercury.

A hydrometallurgical approach has been devised and tested for the removal of mercury-containing solids. In this process, additives are added to water in order to extract the mercury contaminants. This extracting solution selectively reacts with mercury, leaving the solid media unaffected. As a result of the reaction, the mercury is complexed and converted to a high water soluble species; mercury solubility in the extractant can be as high as 25,000 ppm. The additives were selected for their high affinity for mercury relative to indigenous metals (calcium magnesium, iron, etc.). Following extraction, the solids and the extracting solution are physically separated. The used extracting solution is treated to produce elemental mercury. The solution is then regenerated and recycled back into the process.

Company Name/POC: General Electric, Corp. R&D/Mark Sneeringer

Address : P.O. Box 8, K1-3C3, Schenectady, New York 12301

Phone Number : 518 387-5334

Fax Number : 518 387-761

Technology Maturity :

Bench scale testing, only

Performance History : Scale up and testing of process is being accomplished jointly with Metcalf and Eddy, Inc. of Waverfield, Massachusetts. Fabrication and assembly of a mobile pilot scale system is being completed and design of a full scale system (5 to 10 tons/hour capacity) is in progress. Field demonstration of the full scale system is anticipated to begin in 1996. Point of contact at Metcalf and Eddy is Dr. Edward Cichon at (617) 224-6232, Fax (617) 224-6543.

An extracting system has been successfully tested at General Electric's Corporate Research and Development Center on a variety of mercury-containing solids including soils, concrete, brick, plastics, and phosphors from fluorescent lamps. The studies have also shown that a variety of forms of mercury including elemental, organo-, mercurous, and mercuric derivatives can be removed from soils. The mercuric compounds may be in the form of oxides, sulfides, chlorides, or phosphates. Mercury levels ranging from 100 ppm to 10,000 ppm in soil have been reduced to 1 to 25 ppm following treatment. Treated samples pass simulated TCLP tests.

Comments : None.

Source of Information : TechCon

CONTAMINANTS :

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

☒ Halogenated VOC

N/A

TECHNOLOGY TYPE: *Soil Washing*

Technology Name : Hydraulic Soil Washing (HYDROSEP)

Application :	On-site	Ex-situ
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Brief Description : HYDROSEP is a series of water-based hydraulic separation systems for contaminated soils and sediments. HYDROSEP systems isolate fine-grained soil and sediment fraction, thereby concentrating contaminants. HYDROSEP may be used alone or in conjunction with METALEX and ORGANOEX extraction technologies. Oversize, clean soil and sediments may be returned to the site. HYDROSEP systems either reduce the volume of soil/sediment requiring ultimate treatment or eliminate the need for treatment.

Company Name/POC: Metcalf and Eddy, Inc./Pier Mantovani

Address : 30 Harvard Mill Square/Wakefield, MA 01880

Phone Number : 617 246-5200

Fax Number : 617 245-6293

Technology Maturity : Commercial use experience

Performance History : HYDROSEP utilized on over 10 jobs with soil or sediment volumes ranging from 2,000 to over 200,000 cu yds. Effective treatability studies and selection of the appropriate HYDROSEP system have avoided significant field problems.

Comments : A high clay content (>50 percent) in the intended feed soil may result in higher unit costs than alternative remedial techniques. HYDROSEP systems run with a combination of chemical process engineers, analytical chemists, and skilled equipment operators and mechanics. The HYDROSEP systems have been designed to accommodate a wide range of site conditions through use of modular unit operations. Clean, oversize materials are generally returned to the site. HYDROSEP systems are configured to maximize the volume of clean, oversize material. Water used in the separation process is treated on-site and recycled to the extent practical. Fine materials containing the target contaminants are managed according to prescribed methods when configuring the HYDROSEP system. Such methods include: METALEX, ORGANOEX, biodegradation, thermal desorption, stabilization/fixation/vitrification.

Source of Information : International TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Soil Washing*

Technology Name : Optimizing Separation

Application : On-site Ex-situ

Brief Description : What: Optimizing the separation of clean vs non-clean soil through optimizing the performance of hydrocyclones for the specific soil and the contamination present by changing the shape and the operation of the hydrocyclones.
How: Run tests with plant (300-500 ton) for the different locations. Make information available for large scale operation (process data, efficiency, quantities clean and non-clean).
How well: Because of full-scale operation and "large" quantities, reliable answers are generated. The advantage of this technology is that the performance of existing soil cleaning technologies can be optimized.

Company Name/POC: Promeco B.V./ A.J. M. Broeders

Address : P.O. Box 94/574 OAB/Beek En Donk, The Netherlands

Phone Number : 31 492963903

Fax Number : 31 49246502

Technology Maturity : Commercial use experience

Performance History : Contact Promeco for list of references.

Comments : Contaminants that stick to coarse material cannot be concentrated in the fines. Reduction of waste volumes are accomplished by optimization of the separation. In cooperation with KEMA hydrocyclones are very often used as part of a wet cleaning operation for contaminated soils. The efficiency of hydrocyclones is a very important part of the total efficiency of wet soil cleaning. The requirements for the most efficient removal of the contaminations must be met by looking for the desired cut point in the particles size separation. Particle size-distributions vary by site and distribution of the contaminants. Choosing the cut point of the separation is a strategic decision for the cleaning strategy for each project. Searching the right cut point can only be done at a processing scale of 1:1, with relative high quantities. Once the optimum is found, the performance of hydrocyclones can be changed easily to meet the requirements of separation.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Soil Washing*

Technology Name : Ranator Detoxification Process (RDP)

Application :	On-site	Ex-situ
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Brief Description : On-site and non-destructive remediation, by separation of chemical substance such as PCB's, creosote, dioxins, oil and other petroleum products from soil, sludge, sediments and other contaminated material, by taking advantage of the very special physical and chemical properties of the substances in a three-step process with process chemicals recirculated in closed systems. The contaminating substances are recovered as a concentrate.

Company Name/POC: Ranator AB/Torgny A. Mellin

Address : Roslagsvagen 101, hus/15, S - 104 05/ Stockholm, Sweden

Phone Number : 46 8 153880

Fax Number : 46 8 159717

Technology Maturity : Pilot plant testing

Performance History : RDP was successfully tested on a pilot plant test scale (50-100 kg/hr) in 1994, supported by the Swedish EPA. Presently a full-scale RDP test plant is in the final construction phase, scheduled for operations in June - August 1995 on a creosote contaminated, first reference object in Sweden. The test with the full scale RDP plant will provide data relevant to several of the questions in this form; during fall 1995 more details of RDP performance will be available. The project results show that the contaminant separation from the material easily may be regulated during treatment; thus, the degree of decontamination can reach as close to 100% as is required.

Comments : RDP is not capable of heavy metal decontamination, with a possible exception of mercury (R&D in progress); fine-grained material with very high organic content reduces the RDP efficiency. An industrial RDP plant is mobile and designed according to the module principle, in order to permit transport to any contaminated area, in suitable size and productivity, for on-site decontamination operations.

Source of Information : International TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Soil Washing

Technology Name : Soil Washing

Application : ☐ On-site ☐ Ex-situ
☐ Off-site

Brief Description : This technology achieves soil, sediment, and sludge treatment for volume reduction or recycle. Treatment removes hydrocarbons, heavy metals, and radionuclides from contaminated media. It utilizes a patented system with countercurrent augers augmented by high pressure, heated water and co-surfactants as needed according to requirements as determined by treatability tests in the company's in-house lab. Full-scale performance with the technology has achieved state and federal cleanup standards at competitive prices. Advantages include limited or no emissions, volume reduction, low water usage, 60' x 60' footprint, and simultaneous hydrocarbon/metals treatment.

Company Name/POC: TVIES, Inc./W. R. (Randy) Hall

Address : 2835 Holmes Road/Houston, Texas 77051

Phone Number : 713 799-5243

Fax Number : 713 799-554

Technology Maturity : Commercial use experience

Performance History : Performance Data are Available.

HYDROCARBONS: (3, 500-15,000 tons) successfully achieved cleanup requirements in all cases. Problems included consistency in contamination level and soil/media particle size of feed, and water treatment/recycle if large swings in contamination level are experienced.
NORM: (3, 2-500 bbls) treated to <5pCi/gm with volume reduction of 70-95 percent.
HEAVY METALS: (2, 100-800 tons) achieved state cleanup standard.

Comments : Process is modular and as such, it is very flexible. Most functions are automated and labor intensity is not high. Equipment is not complex and tolerances are not high. Operation/maintenance and supplies/equipment are readily available and easy to install. Current feed rates are 10-40 tons/hr. Could achieve higher rates with added modules. Higher capacity or greater efficiency equates to lower cost. Considered BDAT for heavy metals and low-level radionuclides.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Soil Washing***Technology Name :** Soil Washing**Application :**

On-site Ex-situ

Brief Description :

The process uses well known mineral-handling technology to separate the contaminated material into two or more fractions. The fractions are cleaned, using physical (e.g., scrubbing heat, pressure jets) and chemical steps (e.g., pH adjustment, oxidation). The washing fluid may be water or water with chelating agents or surfactants, acids or bases, depending on the contaminant to be cleaned. The equipment is mobile and operates continuously. The process works best on particles greater than 270 mesh (approximately 0.05 mm).

Company Name/POC: West PAC Environmental, Inc./Mark McCullough**Address :** P.O. Box 80743 (zipcode 98108)/54 South Dawson Street/Seattle, Washington 98134**Phone Number :** 206 762-1190**Fax Number :** 206 762-9362**Technology Maturity :** Commercial use experience

Performance History : Metals such as lead and arsenic have been treated with up to 95 percent reduction. TPHs have been treated, reducing levels from over 50,000 ppm to 300 ppm. West PAC has pilot-, treatability-, and production-level equipment on hand. Over the last five years, West PAC has conducted research and development work on soil washing for total petroleum hydrocarbons (TPH) and metal removal.

Comments :

Efficient cleaning of the finer or clay fractions (<270 mesh) has required a combination of soil washing with another technology, such as solidification, bioremediation, or simply disposal of the fine fraction. Complex waste mixtures make fluid formulation of the washing fluid difficult. Based on tests, to date, the mixture of metals with organics has been identified as problematic.

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Soil Washing*

Technology Name : Westinghouse Soil Washing System

Application : ☒ On-site ☒ Ex-situ

Brief Description : The Westinghouse Soil Washing Process (WSWP) can treat soils contaminated with organics, heavy metals, radionuclides, and combinations of contaminants. The full-scale units are integrated process trains which use equipment originally developed for the mining industry. The process is arranged to form three functional units: an initial screening and wash of coarse materials; breakup of the remaining solids followed by a thorough wash; a high intensity leaching and separation of the contaminated fines from the clean soil.

Company Name/POC: Westinghouse Remediation Services, Inc./William E. Norton, P.E.

Address : 675 Park North Boulevard/Building F/Suite 100/Clarkston, Georgia 30021

Phone Number : 404 299-4736

Fax Number : 404 296-975

Technology Maturity : Commercial use experience

Performance History : Westinghouse has completed a major soil washing project which involved remediation of 16,000 cubic yards of material contaminated with metals at a site near Bruni, Texas. In addition, Westinghouse has completed bench- and full-scale pilot testing for the remediation of a wood treating site. Westinghouse has also successfully performed numerous bench-, and pilot-scale treatability studies.

Comments : Westinghouse maintains two full-scale soil washing units. Both process a continuous feed of soil, the larger unit at 20 tons per hour, and the smaller one from 2 to 4 tons per hour. Both units are trailer-mounted and can be easily mobilized. This technology has been proven effective in handling soils that are difficult to wash, such as clays. Aqueous-based, biodegradable leachates are used so that soil washing residuals will not pose future contamination problems.

Source of Information : VISITT 3.0

CONTAMINANTS :

☐ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☒ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Solidification/Stabilization (Ex Situ)*

Technology Name : Customized Grout Applications for Waste Management

Application :

On-site	Ex-situ
Off-site	

Brief Description : The company offers design and specification of customized grout formulations and mobile and fixed mixing plants to carry out void filling of drums containing solid wastes, plastics, etc. End products are large containers of decommissioned waste from soil stabilization or hydraulic cut-offs that sensibly meet the present regulations.

Company Name/POC: A-Z WASTE TEK Ltd./David J. Brown

Address : 32A Pooch Rd/Upton Poole/Dorset England BH16 5JB

Phone Number : 01144 1202 624985

Fax Number : 01144 1202 625177

Technology Maturity : Commercial use experience

Performance History : DJ Brown/A-Z is the originator of designs of many of the acceptable cement based grout. Currently used in the UK nuclear industry. A-Z has extended designs/specifications into a second generation of high performance grouting systems that have greater flexibility, longer working times and better end product performances.

Comments : Technology uses readily available equipment. Organic wastes can be a problem. A-Z can demonstrate the acceptability to grout containers with solid or decommissioned wastes from 200 liters to large ISO freight sizes. In its own laboratories A-Z have designed and demonstrated novel grouts and grouting systems to handle:

- Thickened slurries
- Solid simulated asbestos waste
- To produce special absorbents
- Synergized performance grouts

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Solidification/Stabilization (Ex Situ)*

Technology Name : Polymerization of Heavy Metal Ions

Application : On-site Ex-situ
Off-site

Brief Description : Process uses a polymerized sulfide agent to chemically and physically stabilize heavy metal ions. The final waste product meets U.S. EPA leaching criteria. Stabilized product is low in volume and is chemically inert.

Company Name/POC: ADTECHS, Inc. (a wholly owned subsidiary of JGC Corp.)/Ken Sauda

Address : 2411 Dulles Corner Park/Suite 520/Herndon, Virginia 22071

Phone Number : 703 713-9000

Fax Number : 703 713-910

Technology Maturity : Commercial use experience

Performance History : This process has been in use for 10 years for chemically binding heavy metals in municipal incinerator effluent streams. It is now also being used for processing electronics and electroplating manufacturing wastes. This process has been used for 10 years in Japan to fix heavy metal ions in process waste streams. It will work with radioactive or non-radioactive metal ions. Full scale, operational systems have been in service for several years.

Comments : Materials handling and processing equipment are required, depending on the through-put rates and material form. May require soil washing and crushing equipment. Does require tanks for precipitation of waste dissolved water. Heavy metal ions must be wetted or in solution to react with the polymer. The basic challenge is the handling of the contaminated material.

Source of Information : TechCon

CONTAMINANTS :

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

Halogenated VOC

N/A

TECHNOLOGY TYPE: Solidification/Stabilization (Ex Situ)

Technology Name : Heitkamp Process of Solidification

Application :

On-site

Ex-situ

Off-site

Brief Description :

The Heitkamp Process is a patented solidification process for hazardous organics, metals, and radionuclides in soil, sediments, and sludges.

Company Name/POC: Heitkamp Umwelttechnik Gmb H

Address :

Heinrichstr 67/44805 Bochum, Germany

Phone Number :

49 234 87905 236

Fax Number : 49 234 87905 115

Technology Maturity : Commercial use experience

Performance History :

The Heitkamp Process - Immobilization of contaminants by solidification was developed in 1986. The year of issue of the patent grant was 1989. From 1987 to 1995 22 projects were carried out with hazardous organics and heavy metals contaminated soils and sludges. In 1994 tests with radioactive contaminated overburden of uranium mines were performed. The result of these experiments was a reduction of the mobile radioactive components down to 3 percent.

Comments :

The mobile equipment is easy to handle, highly flexible and requires only short mobilization (1 week). No fixed installed infrastructure needed for the mobile equipment. The capacity depends on size and type of equipment (mobile around 250 t/d, portable 1,000 t/d, field erected more than 1,000 t/d).

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Solidification/Stabilization (Ex Situ)*

Technology Name : Phoenix Ash Technology (P.A.T.)

Application : On-site Ex-situ

Brief Description : This is a mobile or fixed-based ex-situ treatment technology that can be designed and built in a variety of capacities. The technology employs well established pozzolanic reaction chemistry to encapsulate a wide variety of potential waste streams. The P.A.T. technology uses C-grade fly ash from coal-fired power plants to encapsulate wastes into a fly-ash matrix in a form the size of standard construction bricks. Fly ash and waste are mixed and compressed into waste/ash bricks. The product shows significant leach resistance, low permeability, high compressive strength, resistance to spalling and cracking, and low thermal conductivity. The final waste form produced has been shown to pass the TCLP test and to have potential recycling applications in a variety of construction formats. The produced brick has potential application in construction of on site vaults for long term storage of bricks containing waste. The process is relatively inexpensive, operates at ambient temperatures, has a high loading rate, uses abundant and cheap fly ash, and produces a block configuration with high leach resistance and structural strength. The bricks have short cure times of approximately 15 minutes and have an advantage in not requiring special containers for storage.

Company Name/POC: Informatice Inc./John Theis/Mike Riddle

Address : 1900 Randolph Road, SE/Suite A/Albuquerque, New Mexico 87106

Phone Number : 505.248-1191

Fax Number : 505.248-119

Technology Maturity : Commercial use experience

Performance History : Performance Data are Available.

Commercial application - 900 tons of mine tailings at the Shiny Rock Mining Co site near Salem Oregon mine site in October 1992. Testing conducted at ORNL during 1993; shows TCLP results for metals similar to cement-based solidification/stabilization, Roger Spence (MMES ORNL 615-574-6782. Testing conducted at LANL in 1993, Karl Standhammer, 505-667-9333. Bruce King (Dr.) NETAC, 412-826-5511 wrote study for EPA on the results of stabilizing sodium salts into final waste forms.

Comments : The feed material to the process requires reactive grade Class C fly ash. The waste stream is restricted to a maximum of 20 percent moisture. Higher levels of moisture content can be pre-treated using additional fly ash which is an inert material. Additional data is needed to fully define the range of materials that can be treated using this technology. In addition, the current level of regulatory acceptance associated with the technology needs to be more fully defined. In particular, the final waste form has the technical potential to be utilized in construction of on-site vaults for long term repositories. Another alternative that should be explored more fully is the use of the bricks containing waste in recycling or resource recovery applications. This technology is based on the use of pozzolanic reactions in stabilization/solidification. These reactions are a well established process in construction applications going back in history more than 2,000 years and are noted for their long term stability. The Phoenix Ash Technology [PAT] employs these reactions but is a newly developed technology with a very limited track record. It can frequently be considered as similar to cementitious reactions which are frequently rejected because of the containment strategy, volume growth, limited long term stability, and long cure times. The PAT technology provides rapid cure times, volume reduction potential and very long term stability. The technology has been used to remediate a small lead-mill-tailings site in Oregon using a mobile treatment configuration with a capacity of 40 tons/day [8 hour shift]. An 80 ton/day [8 hour shift] unit has been built and is currently available from TIDE to be used in providing field services.

Source of Information : TechCon

Pesticides/Herbicides

Heavy Metals

Explosives/Propellants

Radionuclides

Other Contaminant

■ Halogenated VOC

N/A

TECHNOLOGY TYPE: Solidification/Stabilization (Ex Situ)

Technology Name : Radwaste Cementation and Process Control

Application :	On-site	Ex-situ
1. .	Off-site	

Brief Description : The quality of cemented waste has to be proven. Process control is preferable to end control. The advantage of process control is that during operation the system can be improved. Various on-line measuring techniques have been developed to check the mechanical, chemical and radiological properties during the cementation process.

Company Name/POC: KEMA Nederland B.V./H.A.W. Cornelissen

Address : P.O. Box 9035, NL-6800 ET/ARNHEM, The Netherlands

Phone Number : 31 2635 63370

Technology Maturity :	Field demo complete
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Performance History : During a four year European project, measurement techniques and procedures were developed and validated at a radwaste campaign at a BWR power plant.

Comments : None.

Source of Information : International TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Solidification/Stabilization (Ex Situ)*

Technology Name : Molecular Bonding System

Application : On-site ☐ Ex-situ ☐

Brief Description : The Molecular Bonding System (MBS) is a patented process that stabilizes heavy metals in soils, sludges and ash. The MBS process chemically renders leachable metal ions inert by bonding them to non-leachable molecules. MBS powder is added to excavated soil or sludge in a pug-mill operation. Moisture is added to enhance mixing. Curing is immediate and the soil is conveyed to a retention bin where, once dried, it is either returned to the site or disposed of off-site at subtitle "D" landfills.

Company Name/POC: Solucorp Inc./Michael DeLuca

Address : 520 Victor Street/Saddle Brook, New Jersey 07663

Phone Number : 201 368-7902

Fax Number : 201 368-852

Technology Maturity : Commercial use experience

Performance History : MBS has been performed on bench-scale, pilot, and commercial projects and in all cases has successfully reduced contaminated levels to non-detectable or well below EPA acceptable limits. Depending on the size of the equipment, the system can treat between 20-100 tons/hr. Curing time is immediate.

Comments : The total system is ~75 feet long, 10 feet high except for the silo, which is 33 feet high and 16 feet wide. This equipment is powered by a diesel generator. As 15-20 percent moisture is required, a water source is necessary. Two workers and one supervisor are required to operate machinery. The MBS technology is not suitable for treating contaminated liquids. Treated material can be returned to the site in basically the same form. Material is easily transported since the handling characteristics are not changed. Curing time is immediate.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Solidification/Stabilization (Ex Situ)*

Technology Name : Stabilization/Solidification

Application : Off-site Ex-situ

Brief Description : STC Omega specializes in the development and application of technologies for the treatment of organic and inorganic contaminated soils, sludges and wastewaters. STC Omega's chemical fixation and solidification technologies have been utilized successfully to treat over 500,000 cubic yards of contaminated soils and sludges on >30 full-scale hazardous waste remediation projects across the U. S. and in Italy. STC Omega's technologies have been applied to industrial in-process treatment, hazardous waste site remediation projects, RCRA Landban treatment in a Part B permitted hazardous waste landfill facility, and organic and inorganic industrial wastewater treatment systems. Technology allows treatment to be performed in-situ. Full-scale treatment performance can be determined effectively on a laboratory- and pilot-scale basis before full scale.

Company Name/POC: STC Omega, Inc./Greg Maupin

Address : 7650 E. Redfield Road/Suite D5/Scottsdale, Arizona 85260

Phone Number : 602 948-7100

Fax Number : 602 991-3173

Technology Maturity : Commercial use experience

Performance History : Performance Data are Available.

Comments : This technology is quite versatile. It has been used inside buildings, in rural areas with minimal access to power, and normal construction sites. Soil matrix such as stiff clay can reduce the treatment rate production. STC Omega has been successful in treating all types of soil matrices. STC Omega treatment can be provided with standard rental construction equipment. Main attribute after treatment is significantly reducing the leachability and mobilization of contaminants. This reduction can be determined with such tests as the EPA TCLP and American Nuclear Society ANS 16-1.

Source of Information : TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS:

☐ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Solidification/Stabilization (Ex Situ)*

Technology Name : Stabilization/Solidification

Application : On-site Ex-situ

Brief Description : Use of generic low-cost cementing additives to produce monolithic stabilized waste forms of residual leachability.

Company Name/POC: Wastewater Technology Centre/Rockcliffe Research Management/Julia Stegemann

Address : 867 Lakeshore Rd./P.O. Box 5068/Burlington, Ontario, L7R 4L7, Canada

Phone Number : 905 336-4738

Fax Number : 905 336-476

Technology Maturity : Commercial use experience

Performance History : Considerable body of work conducted in support of Ontario Waste Management Corporation Facility design 1985-1992. Call contact for additional references.

Comments : WTC/RRM has extensive information development capability. Would need to work with contractor for full-scale application.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☐ Heavy Metals	☒ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☒ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Chemical Extraction*

Technology Name : Low Energy Extraction Process (LEEP)

Application : On-site Ex-situ

Brief Description : LEEP (Low Energy Extraction Process), a patented process, uses common organic solvents to extract and concentrate organic pollutants from soil, sediments, and sludges. After a pre-treatment step, the solid matrix is washed using a unique dual solvent approach. A combination of proprietary hydrophilic and hydrophobic solvents guarantees the efficient removal of the contaminants. The extracted pollutants are concentrated in a sacrificial solvent by liquid-liquid extraction or by distillation and are removed from the process for off-site disposal or recycling. The leaching solvents are internally recycled and the treated soil can be used as clean fill at the site.

Company Name/POC: Art International, Inc./Werner Steiner, Genya Mallach

Address : 100 Ford Road/Denville, New Jersey 07834

Phone Number : 201 627-7601

Fax Number : 201 627-6524

Technology Maturity : Pilot plant testing

Performance History : Performance data are available.

LEEP was accepted into the SITE Emerging Technologies Program, and has been successfully demonstrated at bench- and pilot-scales. Bench-scale treatability studies are routinely conducted for government and private clients. Treatment of tar contaminated soil from manufactured gas plant sites containing up to 5 percent tar has been successfully demonstrated in pilot-plant tests. A 200-pound per hour pilot plant has been used in the test program for scaling-up the commercial size plant. Operating permits have been obtained under TSCA, and RCRA. This removal efficiency of organic contaminants is as high as 99 percent and the volume reduction of the original waste is over 90 percent.

Comments : LEEP is a high efficiency mobile process for removal of virtually any organic pollutants from soil, sediments, and sludges. The matrix can contain particle sizes down to the submicron range and water concentration from a few percent up to 90 percent. This process can remediate organic pollutants and is not applicable for inorganics such as heavy metals. The process is designed for zero air emissions.

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Chemical Extraction*

Technology Name : Carver-Greenfield Process

Application : Ex-situ

Brief Description : The Carver-Greenfield (C-G) Process can be used to treat sludges, soils, and other water-bearing wastes containing hazardous compounds, including polychlorinated biphenyls (PCB), polycyclic aromatics (PNA), and dioxins. This unique process efficiently separates hazardous solid/liquid feed materials into three product streams convenient for disposal: (1) a clean, dry solid, (2) a water product virtually free of solids and oils, and (3) a concentrated mixture of the extracted compounds. The recovered solvent is reused in the process. The full-scale system is normally continuous, but can be operated in a batch or semicontinuous mode depending on the particular process/capacity requirements.

Company Name/POC: Dehydro-Tech Corp./Theodore D. Trowbridge

Address : 6 Great Meadow Lane/East Hanover, New Jersey 07936

Phone Number : 201 887-2182

Fax Number : 201 887-254

Technology Maturity : Pilot plant testing

Performance History : Performance data are available.

The successful pilot plant demonstration under the SITE Program was carried out in summer 1991 to separate oily drilling muds into their constituent oil, water, and solid phases. Other soil remediation tests have also been carried out.

Comments : Feeds to the process must include solids (5 to 95 percent), water (5 to 95 percent) and oil soluble contaminants (percentage level to over 75 percent) to maximize its capability. Note that the technology separates and concentrates feeds into solids, water and oil-soluble streams but does not destroy them. In the last 30 years, over 80 commercial C-G Process facilities have been licensed in a dozen countries to solve waste disposal problems in a wide variety of fields.

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Chemical Extraction*

Technology Name : GRS Solvent Extraction

Application : On-site Ex-situ
Off-site

Brief Description : GRS Solvent Extraction treats soils and sediments contaminated with heavy organics, in a mobile plant. An organic solvent extracts the contaminants in a solid-liquid contactor. The soil is then rinsed and dried at low temperature. The solvent is recycled on site. The concentrated contaminants are incinerated off site. Extraction efficiency is 98-99 percent.

Company Name/POC: GRS/G. Pottecher

Address : 13 Villa Croix Nivert/75015 Paris, France

Phone Number : 33 1 53 69 61 80

Fax Number : 33 4734 6855

Technology Maturity : Field demo complete

Performance History : More than 15 pilot scale studies have been completed. One commercial job for GAZ de France (100 t at 20g/kg PAH) Contact: Mr. Vercamer 33 1 49 22 52 39. Efficiency has been demonstrated with PAH, PCB, motor oil, heavy fuel. The process potentially applies to pesticides, dioxins and most heavy organics.

Comments : Effectiveness, feed rate and operation cost are impacted by the amount of fine particles and water in the soil. A treatability study enables GRS to quantify the process performance. The process generates no effluent. Treated soil or sediment can be returned to the site. In France they can also be recycled, e.g., as vegetal soil or fill material. Grain size is reduced to below 4 mm.

Source of Information : International TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS:

☐ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE: Chemical Extraction

Technology Name: Metals Extraction (METALEX)

Application: On-site Ex-situ
Off-site

Brief Description: METALEX is a series of extraction technologies for metal-contaminated soils and sediments. Each technology represents a formulation specific to the type and mixture of metal contaminants. METALEX may be used alone or in conjunction with HYDROSEP soil washing systems.

Company Name/POC: Metcalf and Eddy, Inc./Pier Mantovani

Address: 30 Harvard Mill Square/Wakefield, MA 01880

Phone Number: 617 246-5200

Fax Number: 617 245-629

Technology Maturity: Field demo complete

Performance History: METALEX is being used on jobs with soil or sediment volumes ranging from 2,000 to 200,000 cu yds. All jobs are initiated with treatability tests to select the optimum METALEX formulation.

Comments: Design requirements which impact use include the length and number of transfer units (extraction, stages), and initial type and mixture of metal contaminants. METALEX systems run with a combination of chemical/process engineers, analytical chemists, and skilled equipment operators and mechanics. With adequate treatability testing and site characterization the METALEX technology is relatively easy to use. Solids subjected to METALEX and meeting site specific criteria are returned to the site. METALEX solutions are treated to isolate target metals for recovery and further treatment by stabilization/fixation/vitrification. METALEX solutions are recycled to the head of the process to the maximum extent practical.

Source of Information: International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☐ Heavy Metals	☒ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☒ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE: *Chemical Extraction*

Technology Name : RCC Solvent Extraction

Application :	On-site	Ex-situ
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Brief Description : This technology extracts PCBs, pesticides and PAHs from soils, sludges, and sediments; produces water suitable for discharge; reduces waste volumes 90 - 99 percent+; treated solids can be returned to the site; and reduces the organic concentrations below TCLP limits. No air emissions.

Company Name/POC: Resource Conservation Company (a Halliburton Company)/Lanny Weimer

Address : 3006 Northup Way/Bellevue, Washington 98004

Phone Number : 301 596-6066

Fax Number: 410 465-2887

Technology Maturity :	Field demo complete
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Performance History : RCC has designed, constructed and operated three pilot plants and one commercial-scale unit (70 tons/day). The commercial scale unit is designed to process only pumpable sludges and sediments. The current pilot plant and future commercial-scale units will be configured to treat pumpable and non-pumpable (soils and filter cake) wastes.

Comments : Modular systems designed to be suitable for meeting a variety of site area and utility conditions. Typically, a 75-100 ton/day will require a 75 x 100-foot area and 400 amp electrical service. System operates at ambient pressure and moderate temperatures; bench scale treatability testing required for all applications. Can process soil, sludge and sediment containing clay and silt without increased difficulty. Process operates at near ambient pressures and moderate temperatures (up to 212 degrees Fahrenheit). Operation is stable and does not require specialized skills. Waste volume reduction (removing water and organics) can be 90 - 99 percent in sludges and soils.

Source of Information : TechCon

SEDIMENTS IN SURFACE WATER**CONTAMINANTS :**☒ Pesticides/Herbicides☒ Heavy Metals☒ PCB☒ Explosives/Propellants☒ Petroleum Hydrocarbons☒ Radionuclides☒ SVOC☒ Other Contaminant☒ Nonhalogenated VOC☒ Halogenated VOC☒ N/A**TECHNOLOGY TYPE : Chemical Extraction****Technology Name :** Terra-Kleen**Application :**

On-site

Ex-situ

Brief Description :

The Terra-Kleen unit is a mobile batch processing system which removes undesired organics from soil, sediment and debris. Soil is typically dewatered prior to processing. After dewatering, the soil is mixed with solvent to dissolve organic contaminants. The solvent is then removed from the soil which removes the organics. This process is repeated until target contaminant levels are reached. The process results in a concentrated organic waste stream which is drummed for off-site disposal, a treated soil stream which may be reused at the site or sent for further processing, and a clean solvent stream which is recycled in the Terra-Kleen Unit. This system can be used to remove semi-volatile and nonvolatile organic contaminants from soil. Current technologies that this system could replace are incineration and thermal desorption. Most significant advantage is lower cost. Another advantage is that oversized material does not have to be separated from the soil matrix.

Company Name/POC: Terra-Kleen Corporation/Alan Cash**Address :** 7321 North Hammond Avenue/Oklahoma City, Oklahoma 73132**Phone Number :** 619 792-2985**Fax Number :****Technology Maturity :** Commercial use experience**Performance History :** Completed 1 Superfund site, currently working on NPL site in Maine; have also worked for industry.

Reference: Mark Meckus, 513-569-7676 (USEPA SITE Program, Risk Reduction Engineering Laboratory)

Reference: Scott Engle, 513-241-0149 (PRL Environmental Management)

Comments :

The technology has problems with clay and high water content.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *High Temperature Thermal Desorption*

Technology Name : Thermal Desorption System

Application : On-site Ex-situ

Brief Description : Use of two stage process to remove a wide variety of contaminants from soils, sediments, and sludges. System components consist of rotary kiln, soil discharge/dust suppression system, cyclone, quench tower, baghouse, ID fan and stack. In the rotary kiln, heat volatilizes contaminants from the soils at temperatures ranging from 600 to 1000 degrees Fahrenheit. The volatilized contaminants are then destroyed in a high efficiency afterburner. Off-gases are cooled and filtered prior to discharge. Clean soils can be re-used as backfill. The system is suitable for a wide range of feed characteristics, from dry gravel to high moisture tars to clays.

Company Name/POC: Maxymillian Technologies, Inc./Neal Maxymillian (Boston)/John Anthony (HQ)

Address : 1801 East St./Pittsfield, Massachusetts 01201

Phone Number : 413 499-3050

Fax Number : 413 443-0511

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

The system has processed over 250,000 tons of petroleum contaminated soils, many with heavy clays and high moisture content. The system is currently processing PAH contaminated soils at a coal tar site. The system processes soil with high tar content.

Comments : The system can be limited by the BTU value of the feed. Additionally, certain contaminants, such as metals, limit throughput if scrubbing technology is not employed.

Boston contact number: 617-557-6077

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *High Temperature Thermal Desorption***Technology Name :** Soiltech ATP System**Application :** On-site Ex-situ
Off-site

Brief Description : The SoilTech ATP Sytem removes organic contaminants from feed material through thermal desorption in an indirectly fired rotary kiln. It can be used in conjunction with a dehalogenation process. The SoilTech ATP System is continuous and provides preheating of incoming feed material in the preheat zone and desorption of contaminants in the anoxic retort zone at temperatures over 1,000 degrees Fahrenheit. Oxidation of decontaminated coked products takes place in the combustion zone and process heat is efficiently reused through indirect heat transfer from hot treated solids in the cooling zone to the incoming feed material in the preheat zone. Ancillary systems condense the vapors desorbed from the retort zone. The resulting liquid products are water and oil and can be chemically decontaminated on site, recycled, or sent off site for treatment.

Company Name/POC: Soiltech ATP Systems, Inc./Dave Ettlers**Address :** 304 Inverness Way South/Suite 200/Englewood, Colorado 80112**Phone Number :** 303 790-1747**Fax Number :** 303 799-018**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.

SoilTech has commercially treated PCB and phenol contaminated soils and successfully demonstrated treatment of a long list of other contaminants. These include: refinery wastes, coal tar wastes, wood treating wastes, dioxin/furan-impacted soils, VOC and SVOC contaminated material, and many more. In 1990 and 1991, the SoilTech ATP System was successfully applied to treat 42,000 tons of PCB-contaminated soil at the Wide Beach Superfund Site in Brant, New York. In June 1992, SoilTech completed work at the Waukegan Harbor Superfund Site in Waukegan, Illinois; 12,700 tons of PCB contaminated soil and sediments were treated. SoilTech is now remediating 12,000 tons of VOC, PAH, and pesticide contaminated soil at the Pristine Superfund Site in Reading, Ohio.

Comments : The SoilTech ATP System is suitable for treatment of organic or oily waste in concentrations up to 25 percent by weight. Higher contaminant concentrations may require blending of feed material prior to treatment. High moisture content (greater than 20 percent) and/or high silt/clay content (greater than 20 to 30 percent) may reduce the process throughput and increase treatment costs.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Low Temperature Thermal Desorption*

Technology Name : Desorption and Vapor Extraction (DAVE) System

Application : On-site Ex-situ

Brief Description : RSI's low temperature, high volume Desorption and Vapor Extraction (DAVE) system separates toxic and hazardous waste from soil, sludge and sediments. The process is designed to separate and capture both volatile and semi-volatile organic contaminants from host materials. Nonvolatile inorganic contaminants (such as metals) in the waste feed do not inhibit the process, but are not removed. The clean processed soil (98 to 99 percent or more of incoming feed after rehydration) is returned to the excavation site or used for clean fill. The contaminants are captured and shipped off site for recycling or final disposal. This is accomplished in a closed process, with continuous, real time monitoring and numerous back-up systems.

Company Name/POC: Recycling Science International Inc./William C. Meenan

Address : 175 West Jackson Blvd./Suite A1910/Chicago, Illinois 60604

Phone Number : 312 663-4242

Fax Number : 312 663-4269

Technology Maturity : Commercial use experience

Performance History : Tested - Numerous EPA, state and local government supervised tests of the DAVE System have verified treatment capabilities. The DAVE System can treat soils, sludges and sediments contaminated with PCB, PAHs pesticides, VOCs semivolatile organics such as tetraethyl lead and mercury. This process can operate at 40 percent - 60 percent below incineration costs. Treated products from the DAVE system include: water suitable for discharge, oil that may be recycled as fuel, and solids that can be returned to the site as backfill. The process can reduce the initial volume of contaminated material by more than 95 percent. The DAVE system can process 240 to 1,500 tons per day in a portable configuration. Capabilities of 5,000 tons per day can be achieved in a fixed site, non portable mode.

Comments : Materials which cannot be treated include tars, and substances which form tars at low temperatures and relatively short exposure times. Examples of the latter are some oxygenated petroleum products, polymer precursors, etc. Nonvolatile inorganic contaminants, such as metals, do not inhibit the process but are not removed. The DAVE System treatment process is most effective on matrices that are non-adsorptive and of low porosity.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Low Temperature Thermal Desorption

Technology Name : Low Temperature Thermal Treatment

Application : On-site Ex-situ
 Off-site

Brief Description : The LT3 is a soil treatment system that indirectly heats the soil, causing volatilization of the organic compounds. The cleaned soil is then available for backfill or other treatment steps (i.e., stabilization). The organic vapors are vented to a condensation system that concentrates the organics into liquid for off-site disposal, recycling, or use as a waste fuel.

Company Name/POC: Roy F. Weston, Inc./Michael G. Cosmos

Address : 1 Weston Way/West Chester, PA 19380

Phone Number : 610 701-7423

Fax Number : 610 701-503

Technology Maturity : Commercial use experience

Performance History : Contact company representatives for Performance Data.

Comments : The technology is applicable to soil, sediments, and sludges that can be handled as a solid. Moisture content increases costs. The process will not affect heavy metals or inorganics. The LT3 is immediately implementable for full-scale use. The LT3 has been on four remediation projects. The system is trailer-mounted for transportability. Transportability has been demonstrated by using on-site power generation and propane fuel use.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Low Temperature Thermal Desorption*

Technology Name : Vacuum Assisted Thermal Desorption/Catalytic Oxidation

Application : On-site Ex-situ

Brief Description : Soil is heated to 250 degrees Celsius in a rotary kiln under vacuum. Water and volatiles are volatilized and carried downstream. The water/organic stream is run through a catalytic oxidizer. Organic and inorganic compounds are oxidized into innocuous compounds. Soil is processed in batches. Technology has been designed to be cost-effective at small facilities (200-2000 cubic meters), a large number of which exist at DOE sites. The VAC*TRAX is small, mobile, and requires minimal mobilization and demobilization activities. The vacuum reduces the required heating time.

Company Name/POC: Rust Remedial Services/John Westcott

Address : Clemson Technical Center/100 Technology Drive/Clemson Research Park/Anderson, SC 29625

Phone Number : 803 646 2413

Fax Number : 803 646-5311

Technology Maturity : Pilot plant testing

Performance History : Successfully applied at bench-scale. Contact Carl Swanstrm 708/513-4500.

Comments : Best suited for volumes ranging from 200-2000 cubic meters of waste. Unit is easy to use, takes up minimal space, has minimal utility requirements, and requires 1-2 people of moderate technical ability to operate. Equipment for unit is available in the U.S. through Rust Remedial Services; however, Rust does not sell the equipment.

Source of Information : TechCon

CONTAMINANTS:

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE: *Low Temperature Thermal Desorption*

Technology Name: Mobile Solid Waste Desorption

Application: On-site Ex-situ

Brief Description: Texarome's ex-situ continuous desorption process uses highly superheated steam (adjusted up to 900 degrees Fahrenheit) as a conveying and stripping gas in a pneumatic type conveying system to treat contaminated wastes, such as soils, sediments, sludges, and difficult emulsions containing volatile and semivolatile contaminants of any kind, together with water. An elaborate and proprietary way (patent pending) of running pipes within the conveying system allows for a true countercurrent flow, as well as multi-stage dispersion and separation of the gas phases and the solid phase, to make the efficient mass transfer separation task possible.

Company Name/POC: Texarome, Inc./Gueric R. Boucard

Address: 1.5 Miles East Highway 337/P.O. Box 157/Leakey, Texas 78873

Phone Number: 210 232-6079

Fax Number: 210 232-571

Technology Maturity: Pilot plant testing

Performance History: Performance data are available.

In 1982, a 4 ton per day pilot plant was set up in the Texas Hill Country to extract Cedarwood Oil from the native Texas Cedar. The project was moved to Leakey, Texas in 1984 and the pilot plant was scaled up to a 12 ton per day of commercial size plant. To date, this plant has been successfully operating around the clock. The EPA SITE demonstration unit tentatively scheduled for late Fall 1993 will be 25-ton per day unit improved and modified to operate between 340-900 degrees Fahrenheit and strip toxic solid waste.

Comments: The main limitations of this process is necessity of sifting debris, and reducing the particle size of the material to be treated to a uniform 35 mesh and under (less than 0.016 inches). Non porous solids such as sand could be treated in larger particle sizes of up to 10 mesh (less than 0.65 inches), because contaminants are easily flashed from the surface. Non-flowable solids, such as 100 percent putty-like clays, or gummy solids are also a problem. Such materials would have to be thoroughly mixed with dry sand into a semi-flowable solid with an angle of repose of at least 60 degrees before treatment.

Source of Information: VISITT 3.0

CONTAMINANTS.:

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE: *Low Temperature Thermal Desorption*

Technology Name : RF Driven Thermal Processing

Application :	On-site	Ex-situ
	Off-site	

Brief Description : Thermal desorption unit can be used to dewater sludges and precipitates, and to remove organics by devolatilization.

Company Name/POC: Westinghouse Communications/D.L. Keairns

Address : 1310 Beulah Rd./Pittsburgh, Pennsylvania 15235

Phone Number : 412 256 1954

Fax Number : 412 256-1348

Technology Maturity : Field demo complete

Performance History : Has been used by Texaco for oil field enhancement; field demonstration planned at Savannah River.

Comments : Mobile unit is self-contained. Water table may be problem for soils (minor). Low boiling point VOC may have cheaper routes such as soil vapor extraction.

Source of Information : TechCon

SEDIMENTS IN SURFACE WATER**CONTAMINANTS :**

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : Pyrolysis**Technology Name :** Product control systems (PCS) Flash Pyrolysis**Application :** On-site Ex-situ
Off-site**Brief Description :** Indirect thermal decomposition (dry distillation, vacuum flash pyrolysis) of solid hazardous organic/inorganic waste in reductive environment. Main components: indirectly heated rotary reactor (operating up to 1500 F); indirectly cooled multi venturi scrubber:**Company Name/POC:** Product Control Ltd./G. Edward Someus**Address :** La Plaiderie/P.O. Box 79/St. Peter Port/Guernsey, C.I., United Kingdom**Phone Number :** 1481 726 426**Fax Number :** 1481 726 52**Technology Maturity :** Pilot plant testing**Performance History :** Contact Product Control Ltd. for performance history data.

Comments : A benchmark of a good safe treatment technology is a high DRE efficiency. Pilot-scale testing demonstrated that the PCS process was more than capable of this. No possibility of dioxin or furan formation and cost efficient technical solution for utilization of heavy metals based on the reductive thermal treatment. The small reactor size and the capability to recirculate process gas-vapors from the decomposition process makes the process equipment, especially the flue gas treatment unit, small, technically simple, and safer. The PCS process is suitable for many types of waste, sorted and unsorted, as well as, all those that are economically decomposable by dry distillation under any range of 1,000 C. The special patented feature of the PCS indirect heated rotary reactor and other vital apparatus components makes viable the process of continuous process control and monitoring of the destruction efficiency. The PCS technology is limited for: (1) treatment of liquids (water, flammable liquids and solvents) (2) treatment of solid material over 45 percent moisture content, (3) explosives and/or materials with highly oxidizing character under heat treatment, (4) materials which can not be decomposed by thermal treatment at 600 C (1,112 F), and (5) nuclear waste with high radioactivity. The PCS technology is at the full scale demonstration and commercialization phase of the development.

Source of Information : International TechCon

CONTAMINANTS:

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE: *Vitrification (Ex Situ)*

Technology Name : Vitrification

Application :	On-site	Ex-situ
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Brief Description : Vittrification processes wastes into stable, non-degradable, chemically durable glass that is highly leach resistant. GTS Duratek joule heated Duramelter (TM) produces a waste form that reduces the volume of waste up to 75 percent. This vittrification process is designed for the treatment of the contaminated fraction left from soil washing. Vittrification replaces grouting with cement. Grouting increases the volume of the waste treated; vittrification, on the other hand, decreases the volume of the waste processed and produces a more stable waste form.

Company Name/POC: GTS Duretek, Inc./William Greenman

Address : 8955 Gillford Road/Suite 200/Columbia, Maryland 21046

Phone Number : 410 312-5100

Fax Number: 301 621-8211

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

GTS Duratek and its primary subcontractor, the Vitreous State Laboratory at the Catholic University of America, have performed numerous laboratory-scale research projects for both government and private industry. Some of these projects are highlighted below:

Construction of commercial units is being completed at both Barnwell, North Carolina, and the DOE Savannah River Site (SRS). Start up of the Barnwell unit is anticipated by the end of the 1995

calendar year. Testing is scheduled to begin at SRS in December 1995, with the start up of the unit scheduled for January 1996.

Minimum Additive Waste Stabilization Program/Fernald-Phase 1/Fernald, Ohio/Dr. Mitchell Erickson
CMT/Argonne National Laboratory/708 972 7772/FAX 708 252 5912

Vitrification Development Studies for OU1 Wastes/Fernald, Ohio/Rod Gimpel/513 738 6112/
FAX 513 738 6184

Development of a Combined Soil Wash/In-Furnace Vitrification System for Soil Remediation at DOE Sites/Weldon Spring, Oak Ridge/Dr. Mitchell Erickson, CMT/Argonne National Laboratory/
708 972 7772/FAX 708 252 5912

Comments : This technology is not applicable to metal-only wastes or to wastes that are predominately organic. Approximate minimum limits are at present about 5 weight percent metals or total organic carbon. In general, implementing this technology is straightforward. The melter design and operation are relatively constant as is the required training of personnel (melter operators, etc.). The offgas system is the only component of the vitrification process which may change appreciably from site to site. The biggest challenge in implementing this technology is understanding the waste-specific chemistry involved and applying it to the design of the offgas system (fluorides, sulfates, etc.). Secondary waste generation can also present a challenge. In the system currently operating, secondary waste is fed back into the melter. Another challenge is developing a glass composition for specific wastes that is capable of high waste loading which is also cost-effective (minimum additives), durable, and processable. The ideal glass is that which can be processed below 1200 degrees celsius and still meet all of the above requirements. If it cannot be processed below 1200 degrees celsius, the melter may require redesign incorporating exotic metals and high temperature electrodes. Construction of commercial units is being completed at both Barnwell, North Carolina, and the DOE Savannah River Site (SRS). Start up of the Barnwell unit is anticipated by the end of calendar year 1995. Testing is scheduled to begin at SRS in December 1995, with start up of the unit scheduled for January 1996.

Source of Information : TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Electrical Separation*

Technology Name : Electrokinetics

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : When direct current is passed through a low permeability soil, the aqueous phase is observed to move from the positive electrode to the negative electrode. This is commonly referred to as electroosmosis. Soil contaminants such as heavy metals (Cs, Sr, Zn, Cd, U, etc.) and organic materials (gasoline, TCE, benzene, etc.) may be removed along with the aqueous phase as it is "pumped" through the soil. Electrokinetic permeabilities for aqueous systems in clays have been demonstrated to be up to one thousand times over normal hydraulic permeabilities.

Company Name/POC: Electro-Petroleum, Inc./Dr. J. Kenneth Wittle

Address : 996 Old Eagle School Road/Suite 1118/Wayne, Pennsylvania 19087

Phone Number : 610 687-9070

Fax Number : 610 964-857

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Comments : Field experience in oil field application for oil recovery, mud pit dewatering.
Applicable to contaminated soils and usable to depths of several hundred feet. Works best in soil with >10 percent clay.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Bioreactors*

Technology Name : Bionergies, Biosmose, Biosurf

Application : In-situ (vadose zone) Off-site Ex-situ
 In-situ (saturated zone)

Brief Description : Bioremediation of organic pollutions (in soils, water, effluents) by using: 1. exogenous specific bacterial consortium (non toxic, environment safe, European Federation of Biotechnology class I in order to control a full, complete and non selective biodegradation. 2. Biofixations (mineral natural support). 3. Biosurfactants (produced by selected bacteria) provide an effective, fast and secure alternative to common place bioremediation because Bionergies controls the biodegradation of the pollutant (and metabolites) by using specialized bacteria and feasibility tests (in labs, on the field).

Company Name/POC: Bionergies Laboratories, Biosurf/M. Jacques FAUDIN

Address : 59/100, rue des 4 termes/B.P. 1009/Z.I. des Paluds/13781 AUBAGNE Cedex, France

Phone Number : 33 42 84 30 07

Fax Number : 33 42 84 23 33

Technology Maturity : Commercial use experience

Performance History : Contact company for performance data.

Comments : Each case is analyzed in order to optimize the treatment and the on site materials and personnel. Bioenergies controls the bacterial action by using exogenous specific bacterial strains, biofixations and biosurfactants. None of the bacteria is genetically engineered. They are classified into class I (one) of the European Federation of Biotechnology, and produced under French and European Community regulations. The company is looking for join-ventures in U.S. in order to cover the environmental and industrial field.

Source of Information : International TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Bioreactors*

Technology Name : Anaerobic Metal Removal Technology (AMR)

Application : On-site Ex-situ
Off-site

Brief Description : The AMR process was developed to release, separate and remove toxic metal contaminants in solids (soils, sediments, sludges) and can simultaneously bioremediate organic pollutants. The AMR technology involves the use of indigenous anaerobic heterotrophic denitrifying microbial populations which are resistant to and will aid in the solubilization of metal sulfides in the presence of other organic pollutants. AMR technology operates in the absence of oxygen, thereby eliminating the need for aeration. The process produces no acid which eliminates the secondary pollution problems. The addition of a low-cost and readily available soluble alternate electron acceptor source (nitrate) allows the system to be operated at low cost.

Company Name/POC: Geo-Microbial Technologies, Inc./D.O. Hitzman

Address : P.O. Box 132, East Main Street/Ochelata, Oklahoma 74051

Phone Number : 918 535-2281

Fax Number : 918 535-256

Technology Maturity : Bench scale testing, only

Performance History : Development for removal of metals from spent coal liquification catalysts (DOE contracts).

Comments : The elimination of oxygen requirements allows broad usage. Microbial ecology would be easily manipulated by minimum alternate electron acceptor amendments. The system has broad potential applications with minimum requirements for implementation. The ease and flexibility of amendment addition and use of indigenous microflora expand the range of applications.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Bioreactors***Technology Name :** Biological Soil Treatment Plant

Application :

On-site Ex-situ

Off-site

Brief Description : The biological soil treatment plant consists of a bioreactor for treatment of oil and light tar contaminated soil for reduction of the pollution from 3% oil down to 0.01-0.1% with-in a few weeks. The plant can also be used for treatment of soil polluted with light organic compounds such as benzene, phenols and some pesticides. The technology is based on biological degradation of the pollutants.

Company Name/POC: Newcon A/S/J. Mollekilde**Address :** Ternevey 20/DK-4000 Roskilde**Phone Number :** 45 42353616**Fax Number :** 45 42351548**Technology Maturity :** Commercial use experience

Performance History : The biological soil treatment plant was developed in 1991. Newcon A/S treated 45,000 tons oil and tar contaminated soil with one plant. Newcon A/S has one plant in operation and is planning to increase capacity with two more plants in Denmark this year.

Comments : The plant is constructed so it can easily be moved from one place to another.

Source of Information : International TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☐ SVOC	☐ Other Contaminant
☒ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Filtration*

Technology Name : Microfiltration

Application : On-site Ex-situ

Brief Description : Fine microfiltration of precipitated metals with tight, low-cost Tyvek (R) T-980 filtration media and patented Profix stabilization agent (to pass TCLP) in a fully-automatic Oberlin automatic pressure filter (APF).

Company Name/POC: DuPont/Dr. Ernest Mayer

Address : Engineering Dept. L1359/P.O. Box 6090/Newark, Delaware 19714///Oberlin. Filter Co./Mr. Mike Hughs/404 Pilot Court/Waukesha, WI 53188

Phone Number : 302 774-1000

Fax Number : 302 774-732

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Demonstrations: Industrial partnerships/collaboration potential: participated in USEPA SITE program (w/Oberlin & Enviroguard Mfg. of Profix Stabilization Agent), John Martin, Cincinnati, Ohio; working w/SRS on various wastes; testing other hazardous waste (Oberlin/DuPont/Enviroguard).

Comments : Utilities required for the DuPont/Oberlin microfiltration technology demonstration included water, electricity and telephone service. Flow rates above about 250 gpm require multiple units. Easy to use and implement (6 installations that are operational and functioning well); minimal personnel skill required since simple.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Ion Exchange*

Technology Name : Forager (TM) Sponge for Heavy Metals

Application : In-situ (vadose zone) Off-site Ex-situ
In-situ (saturated zone)

Brief Description : FORAGER (TM) Sponge selectively removes heavy metals from water. This is accomplished by virtue of a proprietary chelating resin deposited within small (1 cm) cubes of open cell cellulosic sponge. A multitude of the cubes is disposed within a vertical column through which water is passed. Flow rates of 0.1 bvm achieve 90+percent removals. Because of the low cost and high absorption capacity of FORAGER (TM) Sponge, one-time-use and disposal is economically feasible. This product can be used on dirty or mixed-waste streams or sludges that would ruin conventional bead form resins.

Company Name/POC: Dynaphore, Inc./N. Rainer

Address : 2709 Willard Rd/Richmond, Virginia 23294

Phone Number : 804 288-7109

Fax Number : 804 282-1325

Technology Maturity : Field demo complete

Performance History : FORAGER (TM) Sponge is currently being sold in 8 gal. modular drums for the treatment of small volume industrial effluents. Most of the users are either reluctant to talk about results obtained, or do not have accurate data concerning performance. A preliminary trial was run at an EPA Superfund (Groundwater) site in early 1993. 90 + percent removals were achieved for Cd, Cu, Pb, and V. 70 + percent removals were achieved for Cr, Hg, Zn, and Ni.

Comments : Will not remove Rb, Cs. Will remove Sr, Ba, and Ra only in the absence of Ca. A multi-column installation employing FORAGER (TM) Sponge involves no moving parts except for a pump. In those installations which include valves for staging or sequencing operations, manipulation of the valve is simple, and can be automated. A single semi-skilled operator can handle units having flow rates of 2-20 gallons/min. Because the system can be trailer mounted, it can easily service effluents in different locations.

Source of Information : TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS :

☐ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☐ Other Contaminant
☒ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Membrane Separation*

Technology Name : Spiral Wound Membrane Technology

Application : In-situ (saturated zone) Ex-situ

Brief Description : Spiral-wound membrane technology offers a cost-effective, energy-efficient method of making separations using the principles of osmosis. The technology used by Desalination Systems, Inc. allows for the recovery and reuse of waste stream constituents from acids to metals. SWMT needs no additional chemicals, making this technology environmentally friendly. A highly trained operator is unnecessary. There are no additional sludge costs with membrane technology. A membrane system is a small fraction of the cost of installing a Dissolved Air Flotation (DAF) device.

Company Name/POC: Desalination Systems, Inc./Bridgete Owens

Address : 760 Shadowridge Dr./Vista, California 92083

Phone Number : 619 598-3334

Fax Number : 619 598-3333

Technology Maturity : Commercial use experience

Performance History : Performance data are available from the company.

Comments : SSWM systems are small compared to other technologies such as DAF. Membrane systems require electricity to run the motor and pump. SWM systems need little support services from an outside operator. These systems can also be located outdoors. A SWM system can be used easily. A technician can be trained in a few hours to take readings, if needed, and watch the system. The membrane system is flexible in that it can be installed inside or outside the facility, so no large infrastructures need to be built. The size of a membrane system is so small that it fits almost anywhere.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Electron Beam*

Technology Name : Electron Beam Hazardous Waste Treatment (E-Beam)

Application : On-site Ex-situ

Brief Description : The process is based on aqueous radiation chemistry and it is non-selective in the destruction of organic chemicals because strongly reducing reactive species, and strongly oxidizing reactive species, are formed at the same time and in approximately the same concentration in solution. The reactive transients initiate thousands of chemical reactions capable of destroying hazardous compounds in aqueous solution, in most cases, mineralizing them to carbon dioxide, water, and salt. High energy electron beam treatment of hazardous waste can be used to replace UV/O₃, UV/H₂O₂, and other advanced oxidation processes (AOPs), and in some cases incineration.

Company Name/POC: High Voltage Environmental Applications, Inc./William J. Cooper, Pres., Mike Nickelsen

Address : 9562 Doral Boulevard/Miami, Florida 33178

Phone Number : 305 593-5330

Fax Number : 305 593-0071

Technology Maturity : Commercial use experience

Performance History : In addition to controlled (single solute) feasibility studies, feasibility studies on two multi-source hazardous waste leachates have been conducted which have shown that the process is economical for the ultimate destruction of hazardous waste leachates. HVEA waste treatment systems are part of the US EPA SITE Program, and are available for use on Superfund sites. HVEA's mobile systems were to be demonstrated on solvent contamination ground water under the SITE program in the fall '93 at Savannah River, South Carolina.

Comments : HVEA's electron beam treatment systems require (1) site location the size of a tractor trailer, (2) a mechanism for delivering the waste to the treatment system, i.e., well pumps, etc., (3) three phase electrical power, (4) 120 VAC electrical power, (5) effluent line and site. Soils, sediments, and sludges must be suspended in an aqueous matrix. The electron beam treatment systems are ineffective in treating heavy metals. HVEA electron beam treatment systems are available in different sizes, to effectively address any size problem. Units are modular in design; therefore, several systems can be interfaced to enhance treatment capability. Systems are completely automated and require only one technician per 8 hr shift. High initial capital cost.

Source of Information : TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS : ☐ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : Other

Technology Name : In-Situ Electro-Enhanced Remediation/Electrofrac

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : In situ electro-thermal treatment uses volatilization, pyrolysis and fusion to treat the soil. This technology replaces excavation of soil.

Company Name/POC: Bio-Electrics, Inc./E. Sarapuu

Address : 1301 Woodswether/Kansas City, Missouri 64105

Phone Number : 816 474-4895

Fax Number : 816 842-124

Technology Maturity : Pilot plant testing

Performance History : Refer to EPA's VISITT 3.0 Database.

Comments : Qualified engineering personnel required for problem evaluation. This technology was originally developed for in situ processing of mineral fuels. This technology cannot be used for under-water decontamination.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Other*

Technology Name : Soil Extraction

Application : Ex-situ

Brief Description : Chemical extraction of radionuclides in soil; carbonate and magnetic separation to <35 pCi/g uranium and 25 pCi/pg plutonium.

Company Name/POC: Bradtec, LTD/Philip Tucker (UK)

Address : University of the West of England/Cold Harbour Lane/Bristol BS 16 1QY, United Kingdom

Phone Number : 0272 763937

Fax Number : 44 117 976 3892

Technology Maturity : Pilot plant testing

Performance History : Rust Remedation Inc. has introduced technology at Hanford. Relatively new and unproven; however, it is a promising technology.

Comments : Uses standard equipment. Field testing, and proof of efficiency on clay soils is needed. Actively being marketed in U.S. by Rust International Inc.

Source of Information : International TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Dust Control*

Technology Name : Long Duration Foam

Application : On-site Ex-situ

Brief Description : Rusmar Long Duration foam is applied over an emitting surface to control odors, VOC's, dust and other emissions. The foam creates a continuous barrier between the surface and the atmosphere. Rusmar Long Duration Foam Technology is very effective in controlling any emission. Long Duration Foam is utilized in place of soils, tarps and other cover materials to control odors, VOC's, dust, windblown emissions, etc. Long Duration Foam completely covers any surface to which it is applied and it will conform to irregular and vertical surfaces. Long Duration Foam can be applied quickly, easily and provides a superior barrier to emissions than soil or tarps. It is non-toxic, non-hazardous, non-flammable and biodegradable.

Company Name/POC: Rusmar Incorporated/Laura White

Address : 216 Garfield Avenue/West Chester, Pennsylvania 19380

Phone Number : 610 436-4314

Fax Number : 610 436-843

Technology Maturity : Commercial use experience

Performance History : Rusmar Long Duration Foam has been used throughout the United States and abroad for a variety of applications including: remediation projects, Superfund projects, lagoon and pond closures. It has been used as odor control on a liquid surface, for dust and VOC's suppression, emergency response, vapor and odor suppression in industrial applications and erosion control and to prevent surface water infiltration on stock piled soils. Additionally, Long Duration Foam has been used for in transit odor control on sludge filled containers and dust control during demolition of asbestos contaminated buildings.

Comments : Some of the Long Duration Foam products require water to dilute the product prior to use. The water must have less than 300 PPM of hardness. The smaller Pneumatic Foam Units are trailer mounted and require a piece of equipment to tow them around the site. During months of freezing weather, all Long Duration Foam products must be protected from freezing. The Pneumatic Foam Units are completely self contained and require no outside source of power. During freezing weather, a source of electricity is required to operate the freeze protection system on the larger Pneumatic Foam Units. There are no application temperature limitations on Long Duration Foam Products. Care must be exercised when applying AC-900 Series products with respect to weather, a heavy rain will not allow the membrane to form. After the first day, AC-900 Series products are unaffected by weather, i.e., rain, snow, wind, etc. Long Duration Foam is easily applied utilizing a Rusmar Incorporated Pneumatic Foam Unit. Long Duration Foam is a single component material requiring non chemical mixing and no post application cleanup. The Pnuematic Foam Units are simple and easy to operate; they require no special training. Long Duration Foam is available with durations ranging from a few hours to six months. The Pnuematic Foam Units are available in a variety of sizes ranging from a small skid mounted unit to a large self propelled track mounted unit. These units are available for purchase or rental. Long Duration Foam and Pnuematic Foam Units have been in use in the field for the past nine years. They do not face any general challenges. Long Duration Foam can be applied at a rate of 500 square feet per minute and requires only one operator.

Source of Information : TechCon

Construction Materials/Debris

Treatment

Construction Materials/Debris

Treatment

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : Biocatalytic Contaminant Degradation (BCD)

Application : In-situ (vadose zone) Ex-situ
In-situ (saturated zone)

Brief Description : ECO-TEC, Inc. (ETI), utilizes "Enviromech Gold", (EMG), a proprietary biocatalyst to dramatically accelerate the biodegradation of petroleum hydrocarbons and other biodegradable contaminants. The biocatalytic contaminant degradation (BCD) process can be applied to soil or groundwater, ex situ or in situ. A pH-balanced microbial inoculum (BMI) consisting of water, EMG, indigenous microbes, contaminant specific microbes (if needed) and all trace minerals and nutrients required for microbial proliferation is created.

Company Name/POC: ECO-TEC, Inc./Ecology Technology, Inc./Herbert R. Pearce

Address : P.O. Box 1113/Issaquah, Washington 98027-1113

Phone Number : 206 392-0304

Fax Number : 206 392-0575

Technology Maturity : Commercial use experience

Performance History : The Biocatalytic contaminant degradation, (BCD), technology has been successfully demonstrated many times on full-scale remediation projects in Washington State.

Comments : Generally, BCD technology can be applied to various sites and media, and can be implemented utilizing equipment that is readily available. Since many variable parameters exist between sites, no one BMI or application technology is best suited to all situations. The BCD process will be modified to meet site-specific criteria. The Biocatalytic contaminant degradation, (BCD), process is not the one cure for all remediation problems, although it can be utilized in conjunction with other remediation technologies. The BCD process is limited by the availability of oxygen, range of temperature and the availability of moisture. All of these limiting factors can be controlled in modern site remediation operations.

Source of Information : VISITT 3.0

CONSTRUCTION MATERIALS/DEBRIS

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Solidification/Stabilization (In Situ)*

Technology Name : The ABCOV Method of asbestos abatement and conversion to a non-toxic material

Application : On-site Ex-situ

Brief Description : The ABCOV Method is a patented, simple and economical, chemical and mixing approach for friable asbestos-containing material (ACM) that renders it harmless within a period of two hours. The ABCOV Method provides a safe, efficient, and cost-effective method for abating asbestos; alleviates the environmental impact and long-term liability associated with the practice of dumping ACM in landfills, and eliminates the "cradle-to-grave" liability.

Company Name/POC: ABCOV, Inc./ Tony Nocito

Address : 214 Sullivan Street/ New York, NY 10012

Phone Number : 212 505-5558

Fax Number : 212 505-566

Technology Maturity : Commercial use experience

Performance History : Griffiss AFB, Ralph LaLonde (315 330-2205); ConEdison, Glen Newell (212 460-2367); Radian Corp. (EPRI), Dave Daniels (512 454-4797); State of Virginia, Dept. of General Services, Sharon Gay (804 371-2799); FERMCO, Wayne Johns (513 738-9115); Aberdeen Proving Ground.

Comments : The ABCOV Method converts friable asbestos to a non-toxic material. Although it also treats transite board, at this time the ABCOV Method would be unsuitable for other non-friable asbestos-containing material (e.g., tile, roofing material). The patents and technology related to the ABCOV Method are in the field of ordinary ACM and asbestos waste that is mixed with other toxic or radioactive materials. In both fields, the hygienists, designers, contractors, supervisors, and mixers must be trained, certified, and licensed in the use of the ABCOV method. Austen-Chase Industries, Inc. has licensed its technology to DSI Industries Consolidated, Inc. which in turn provides licenses and chemicals and coordinates training in the use of the ABCOV Method.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Solid Phase Biological Treatment*

Technology Name : Biocatalytic Contaminant Degradation (BCD)

Application : On-site Ex-situ

Brief Description : ECO-TEC, Inc. (ETI), utilizes "Enviromech Gold", (EMG), a proprietary biocatalyst to dramatically accelerate the biodegradation of petroleum hydrocarbons and other biodegradable contaminants. The biocatalytic contaminant degradation (BCD) process can be applied to soil or groundwater, ex situ or in situ. A pH-balanced microbial inoculum (BMI) consisting of water, EMG, indigenous microbes, contaminant specific microbes (if needed) and all trace minerals and nutrients required for microbial proliferation is created.

Company Name/POC: ECO-TEC, Inc./Ecology Technology, Inc./Herbert R. Pearce

Address : P.O. Box 1113/Issaquah, Washington 98027-1113

Phone Number : 206 392-0304

Fax Number : 206 392-0575

Technology Maturity : Commercial use experience

Performance History : The Biocatalytic contaminant degradation, (BCD), technology has been successfully demonstrated many times on full-scale remediation projects in Washington State.

Comments : Generally, BCD technology can be applied to various sites and media, and can be implemented utilizing equipment that is readily available. Since many variable parameters exist between sites, no one BMI or application technology is best suited to all situations. The BCD process will be modified to meet site-specific criteria. The Biocatalytic contaminant degradation, (BCD), process is not the one cure for all remediation problems, although it can be utilized in conjunction with other remediation technologies. The BCD process is limited by the availability of oxygen, range of temperature and the availability of moisture. All of these limiting factors can be controlled in modern site remediation operations.

Source of Information : VISITT 3.0

CONSTRUCTION MATERIALS/DEBRIS

CONTAMINANTS : ☒ Pesticides/Herbicides ☐ Heavy Metals ☒ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : Chemical Reduction/Oxidation

Technology Name : Gas Phase Chemical Reduction

Application : On-site Ex-situ

Brief Description : The ECO LOGIC Process involves the gas-phase reduction of hazardous organic contaminants. The system is capable of treating any form of organic contamination at any concentration with proven destruction and removal efficiencies (DREs) of at least 99.9999 percent. Contaminants entrained in liquids, soils and bulk solids can be destroyed without the formation of hazardous organic residuals. The system has been verified by various government agencies worldwide including the US EPA through the Superfund Innovative Technology Evaluation program. The ECO LOGIC Process is currently offered as a commercial-scale system for on-site treatment. The closed-loop destruction process ensures that no uncontrolled emissions result while the use of a reducing atmosphere ensures that dioxins and furans are not formed as byproducts. The system is mobile and may be utilized for on-site destruction.

Company Name/POC: ELI Eco Logic International Inc./Jim Nash

Address : 143 Dennis Street/Rockwood, Ontario, Canada NOB2KO

Phone Number : 519 856-9591

Fax Number : 519 856-923

Technology Maturity : Commercial use experience

Performance History : Development of the technology began in 1986 and proceeded through the bench-scale and laboratory-scale. In 1991, a pilot-scale unit was constructed and tested extensively at Hamilton Harbour, Ontario, Canada. Demonstrations on sediment contaminated with 300,000 ppm PAH and 400 ppm PCBs confirmed DREs of 99.9999 percent. The pilot-scale unit was tested in Bay City, Michigan, the following year for the US EPA and PCB contaminated oil (25 percent PCBs), water and soil. Once again DREs of at least 99.9999 percent were confirmed. Following the Bay City demonstration further modifications were made to the front-end preprocessing units as well as scaling up the technology to a commercial-scale. At the time of this writing, (May 1995) the first commercial-scale unit was operating in Australia on pesticide residuals and PCB contaminated electrical equipment. The second and third commercial-scale units are presently being constructed and will be utilized by General Motors of Canada Ltd. and the steel manufacturing firm Dofasco Inc.

Comments : The ECO LOGIC Process treats only the organic portion of the waste stream. Any inorganic co-contaminants will remain in the treated soil or be separated in the grit and scrubber as metal hydrides, depending on their physical characteristics. Additionally, the radioactive component of a mixed low level waste stream would be captured at various specific locations in the Process. With the ECO LOGIC Process, a mixed waste stream would undergo significant volume reduction and separate the radioactive component into a form that is more amenable to traditional methods of disposal. The ECO LOGIC Process is mobile and mounted on several drop-deck highway trailers. It may be transported to the waste site and set-up within four weeks. Once the on-site waste has been destroyed, the system is simply moved to the next site. The mobility and closed-loop destruction process have garnered significant public acceptance for the technology while being offered at a competitive cost. The ECO LOGIC Process is at an advanced state of development for an alternative remediation technology and is presently offered at a commercial-scale.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Soil Washing*

Technology Name : Mercury Removal

Application :

Ex-situ

Brief Description : Contaminant identified as Mercury.

A hydrometallurgical approach has been devised and tested for the removal of mercury-containing solids. In this process, additives are added to water in order to extract the mercury contaminants. This extracting solution selectively reacts with mercury, leaving the solid media unaffected. As a result of the reaction, the mercury is complexed and converted to a high water soluble species; mercury solubility in the extractant can be as high as 25,000 ppm. The additives were selected for their high affinity for mercury relative to indigenous metals (calcium magnesium, iron, etc.). Following extraction, the solids and the extracting solution are physically separated. The used extracting solution is treated to produce elemental mercury. The solution is then regenerated and recycled back into the process.

Company Name/POC: General Electric, Corp. R&D/Mark Sneeringer

Address : P.O. Box 8, K1-3C3, Schenectady, New York 12301

Phone Number : 518 387-5334

Fax Number : 518 387-7611

Technology Maturity :

Bench scale testing, only.

Performance History : Scale up and testing of process is being accomplished jointly with Metcalf and Eddy, Inc. of Waverfield, Massachusetts. Fabrication and assembly of a mobile pilot scale system is being completed and design of a full scale system (5 to 10 tons/hour capacity) is in progress. Field demonstration of the full scale system is anticipated to begin in 1996. Point of contact at Metcalf and Eddy is Dr. Edward Cichon at (617) 224-6232, Fax (617) 224-6543.

An extracting system has been successfully tested at General Electric's Corporate Research and Development Center on a variety of mercury-containing solids including soils, concrete, brick, plastics, and phosphors from fluorescent lamps. The studies have also shown that a variety of forms of mercury including elemental, organo-, mercurous, and mercuric derivatives can be removed from soils. The mercuric compounds may be in the form of oxides, sulfides, chlorides, or phosphates. Mercury levels ranging from 100 ppm to 10,000 ppm in soil have been reduced to 1 to 25 ppm following treatment. Treated samples pass simulated TCLP tests.

Comments :

None.

Source of Information : TechCon

CONSTRUCTION MATERIALS/DEBRIS

CONTAMINANTS : ☐ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Chemical Extraction*

Technology Name : Corpex Technology

Application : On-site Ex-situ
Off-site

Brief Description : Corpex Technologies Inc. has developed and acquired patents on certain innovative chelation chemicals with unique capabilities for control and recovery of radioactive and other types of hazardous metal ions from soils, concrete, steel, and other materials. Corpex Technologies Inc. products can be applied in a soil wash process that can be targeted specifically to complex and remove undesirable and toxic ions or radionuclides and permit the soil to be returned clean to its site. The process is either batch or semicontinuous and takes place, typically above ground. Corpex Technologies Inc. patented formulations can remove such contaminants, usually at neutral pH, without the use of acids or caustics, and are effective over a wide range of temperatures. The chemicals can be oxidized after the cleaning process and no undesirable residues are left -- only water, carbon dioxide, carbon monoxide, and nitrogen.

Company Name/POC: Corpex Technologies, Inc./John K. Pirotte

Address : 5400 S. Miami Boulevard/Suite 154/Morrisville, North Carolina 27560

Phone Number : 919 941-0847

Fax Number : 919 941-065

Technology Maturity :

Bench scale testing, only

Performance History : The effectiveness of Corpex Technologies Inc. chemicals has been proven in a variety of difficult industrial and environmental situations; however, full-scale field application systems will require engineering development. Corpex Technologies Inc. has studied a variety of approaches to scaling up its processes and believes existing field application technology can be modified relatively easily to accommodate them.

Comments : There are no currently known alternative chemical means to selectively dissolve radioactive contaminants in soils. Corpex Technologies Inc. chemicals, however, have demonstrated the ability to dissolve both deposits of radioactive metals as well as other toxic heavy metals locked in compounds. Solutions used in the decontamination process can be destroyed, resulting in greater than 99.99 percent destruction of all organics present. The destruction process results in precipitation of contaminants, which can then be removed by filtration and ion exchange, for further processing.

Source of Information : VISITT 3.0

CONTAMINANTS:

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

Petroleum Hydrocarbons

■ Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

Halogenated VOC

■ **N/A**

TECHNOLOGY TYPE: *Chemical Extraction*

Technology Name : Terra-Kleen

Application :

On-site	Ex-situ
<p>1. Preparation of the sample</p> <p>2. Measurement of the sample</p> <p>3. Analysis of the sample</p> <p>4. Interpretation of the results</p> <p>5. Reporting of the results</p>	<p>1. Preparation of the sample</p> <p>2. Measurement of the sample</p> <p>3. Analysis of the sample</p> <p>4. Interpretation of the results</p> <p>5. Reporting of the results</p>

Brief Description :

The Terra-Kleen unit is a mobile batch processing system which removes undesired organics from soil, sediment and debris. Soil is typically dewatered prior to processing. After dewatering, the soil is mixed with solvent to dissolve organic contaminants. The solvent is then removed from the soil which removes the organics. This process is repeated until target contaminant levels are reached. The process results in a concentrated organic waste stream which is drummed for off-site disposal, a treated soil stream which may be reused at the site or sent for further processing, and a clean solvent stream which is recycled in the Terra-Kleen Unit. This system can be used to remove semi-volatile and nonvolatile organic contaminants from soil. Current technologies that this system could replace are incineration and thermal desorption. Most significant advantage is lower cost. Another advantage is that oversized material does not have to be separated from the soil matrix.

Company Name/POC: Terra-Kleen Corporation/Alan Cash

Address : 7321 North Hammond Avenue/Oklahoma City, Oklahoma 73132

Phone Number : 619 792-2985

Fax Number :

Technology Maturity : Commercial use experience

Performance History : Completed 1 Superfund site, currently working on NPL site in Maine; have also worked for industry.

Reference: Mark Meckus, 513-569-7676 (USEPA SITE Program, Risk Reduction Engineering Laboratory)

Reference: Scott Engle, 513-241-0149 (PRL Environmental Management)

Comments :

The technology has problems with clay and high water content.

Source of Information : TechCon

CONSTRUCTION MATERIALS/DEBRIS

CONTAMINANTS: ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☒ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE: *High Temperature Thermal Desorption*

Technology Name: Mercury Recovery Services (MRS)

Application: On-site Ex-situ

Brief Description: In this process, the contaminated feed is blended with a proprietary additive which promotes decomposition of stable mercury compounds and loaded into a batch-operated furnace for processing. Thermal processing is divided into two stages: feed drying and mercury desorption. By staging the process in this manner, the process does not result in a water-mercury waste stream as water is maintained in vapor phase throughout the gas handling system. Metallic mercury is condensed from the carrier gas during the second stage of the process. All process air is filtered through a series of gas filtration columns containing sulfur-impregnated carbon.

Company Name/POC: Pittsburgh Mineral & Environmental Tech/William F. Sutton

Address: 700 Fifth Avenue/New Brighton, Pennsylvania 15066

Phone Number: 412 843-5000

Fax Number: 412 843-535

Technology Maturity:

Field demo complete

Performance History: Three process products: Mercury-free solids (<1 ppm total Hg); Metallic Mercury (>99 percent total Hg); and Mercury-free process gas exhaust. Capable of recovering metallic mercury from numerous mercury compounds including oxides, sulfides, chlorides, etc. Treatability demonstrations has been performed on contaminated soils (sand, clays, carbonates) and wastes from chlor-alkali facilities (K106, D009).

Comments: Contaminant identified as: Mercury

No liquid process effluent stream; designated as recycling by numerous regulatory agencies; applicable to contaminated soils, sludges (K106), debris (D009); applicable to sandy, clayey, and loamy soil types; performance not dependent upon feed Hg content.

Although the process has been designated as recycling; it also meets the BDAT requirements for mercury contaminated wastes.

Source of Information: VISITT 3.0

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Vitrification (Ex Situ)*

Technology Name : Plasma Torch

Application :

On-site Ex-situ
Off-site

Brief Description : Vitrification of materials using a Plasma Torch is used to treat materials such as fly ash, chlorinated wastes, asbestos, and hospital wastes.

Company Name/POC: Aerospatiale/Herve Saul

Address : P.O. BP2/78133 Les Mureaux Cedex, France

Phone Number : 33 1 34 92 39 00

Fax Number : 33 1 34 92 11 92

Technology Maturity : Commercial use experience

Performance History : More than 20 industrial plasma systems have been sold to clients like EDE, Nippon Steel, Rengeot, and Lorfont.

Comments : None.

Source of Information : International TechCon

CONSTRUCTION MATERIALS/DEBRIS

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Vitrification (Ex Situ)*

Technology Name : DC Graphite Arc

Application : Ex-situ

Brief Description : DC Graphite Arc technology is a high-temperature graphite-arc-based technology which is used to destroy organic materials, and melt ceramics and metal at temperatures >1600 degrees Celcius. The system operates in a sealed furnace. Volume reduction and stabilization of products are realized. Applicable to soils and mixed waste.

Company Name/POC: Electro-Pyrolysis, Inc./Charles H. Titus

Address : 996 Old Eagle School Road/Suite 1118/Wayne, Pennsylvania 19087

Phone Number : 610 687-9070

Fax Number : 610.964-857

Technology Maturity : Pilot plant testing

Performance History : Performance data are available.

A 3000 pound/hour unit has been built; Prototype 100 pound/hour in operation at MIT; Prototype 500 pound/hour in construction.

Comments : Useful for all types of solid waste. However, a cost penalty is paid for energy for high water content waste.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Electrical Separation*

Technology Name : Electrochemical Decontamination Tank

Application : On-site Ex-situ
Off-site

Brief Description : Stainless steel items are decontaminated by packing them in a titanium basket, which is immersed in nitric acid electrolyte, in a stainless steel tank. The items in the basket are electrodeplated at a controlled rate down to levels for re-use or recycle. This process removes contaminated metal surfaces at a controlled rate using only dilute nitric acid in place of phosphoric acid electrolytes or aggressive chemical reagents, which generate less manageable effluents. Contaminants typically fixed include alpha/beta/gamma from reprocessing, e.g., ingrained uranium and mixed fission products (Cs, Sr, Ce). Major material treated is unwetted stainless steel. Heavily oxidized steel from reactors is also treatable.

Company Name/POC: British Nuclear Fuels plc/Janet Jackson

Address : Risley, Warrington WA3 6AS Cheshire, England

Phone Number : 1925 832735

Fax Number : 1925 835722

Technology Maturity : Commercial use experience

Performance History : The electro decontamination process is based upon 40 years of general decontamination experience and 2 years of specific process development, which included full-scale non-active and active trials. Operational experience has been gained on decontamination of AGR skips and Magnox fuel slitherheads. The process is installed in the THORP decontamination centre currently undergoing decommissioning at Sellafield.

Comments : Main operating limitation is tank size and throughput. Packing of titanium basket to maximize throughput is required. Protective coatings or grease need to be removed prior to treatment as the process treats base metal surfaces only. Small bore pipework may need to be cut into short lengths for effective decontamination of the internals. The process is designed for remote operation in a shielded cell. An in-cell hoist or crane is required to operate the system. The tanks can be used as simple decontamination tanks using chemical reagents, for additional flexibility if required. Treatment time is 2-3 hours per batch. The process is fully developed to meet BNFL requirements. Other applications may require further development: (a) on throughput optimization; (b) for treatment of other metals; and (c) for treatment of spent electrolyte containing dissolved metals and radionuclides where no site liquid effluent treatment facilities are available. The electrodeplating process is not patentable. The intellectual property rights resides in BNFL's knowhow - design and operating experience. The process generates liquid effluent (1M nitric acid containing dissolved metal ions and radionuclides) and small amounts of sludge. No hydrogen is evolved during electrodeplating. The treated surface is suitable for re-use and can be readily decontaminated again.

Source of Information : International TechCon

CONSTRUCTION MATERIALS/DEBRIS

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☐ SVOC	☐ Other Contaminant
☒ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Electrical Separation*

Technology Name : Electrolytic Decontamination to Free Release Levels

Application : On-site Ex-situ

Brief Description : WasteChem has developed an effective method of decontaminating large quantities of reactor steel and concrete to free release levels using electrolysis. This has been demonstrated on 14 towers of reactor waste at a UK nuclear site.

Company Name/POC: WASTECHEM Ltd/Dr. M.G. Down

Address : Earl Road/Stanley Green/Wilmslow SR93RL UK

Phone Number : 161 485 8231

Fax Number : 161 482 813

Technology Maturity : Commercial use experience

Performance History : Commercial scale demonstration on 14 towers of steel under contract to UKAEA. Successfully decontaminated to free release levels.

Comments : WasteChem, in collaboration with independent consultants, has developed an effective method of decontaminating large quantities of reactor steel to free release level using electrolysis. The general method is well known and papers have been published based on laboratory data. However, despite the generally favorable findings, electrolysis has not previously been adopted by the nuclear industry. In an initial operation, 14 tonnes of reactor waste have been cleaned by WasteChem at a national reactor site - probably the largest amount treated in the UK by this method. Once the steel has been treated the residual activity has to be measured to ensure that the total activity remaining is less than 0.4Bq/gm. To achieve this in a cost effective manner, special instruments have been developed to enable the two critical radionuclides, that is, ⁶⁰Co and ⁵⁵Fe to be promptly and accurately measured on-site by non-scientific staff. It has been shown that decontamination by electrolysis for recycling is considerably less costly than disposal. Contrary to popular belief the method does not produce radioactivity in the electrolyte or the air. Furthermore, as it is a tightly and remotely controlled process, the dose to operators is also significantly reduced compared to the dose received when using abrasive decontamination techniques or during cutting and packing for disposal purposes.

Source of Information : International TechCon

CONTAMINANTS:

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

■ Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

Halogenated VOC

N/A

TECHNOLOGY TYPE: *Other*

Technology Name : Plasma Tritium Decontamination

Application :	On-site	Ex-situ
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Brief Description : A plasma is used to remove tritium bound on surfaces of uranium shipping containers.

Address : 2700 Lake Shore Drive/Mississauga L5J1K3

Phone Number : 905 855-4717

Fax Number : 905 823-8020

Technology Maturity : Field demo complete

Performance History : Limited experience with cleaning of low surface activity tools (stainless steel). Extensive experience with cleaning uranium shipping containers.

Comments : Subatmospheric pressure required. Surfaces to be cleaned limited to sizes which fit inside vacuum vessel (30 cm diameter, 50 cm long for the current model). The technique requires a moderate vacuum. Reduction of surface activities below 1 uCi/m(2) can be readily achieved if the original surface activity results from external contamination. Tritium originating from the bulk to contaminate the surface is more difficult to remove. However, modest success has been attained in reducing the surface activity to 1 uCi/m(2) particularly if the surface is not heavily oxidized. Regrowth of surface activity, due to tritium migration from the bulk to the surface is slow or non-existent, over the range of conditions investigated. Single walled uranium storage beds are routinely decontaminated to about 1 uCi/m(2). Generates large volumes of low level radioactive liquid.

Source of Information : International TechCon

CONSTRUCTION MATERIALS/DEBRIS

CONTAMINANTS: ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☒ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE: *Other*

Technology Name: Magnetic Separation

Application: On-site Ex-situ

Brief Description: The technology removes magnetic objects from shooting ranges.

Company Name/POC: Slaggrprodukter/Hans Larsson

Address: Box 244/ 30104 Halmstad, Sweden

Phone Number: 4660 122072

Fax Number: 4660 12106

Technology Maturity:

Performance History: Contact company for performance data.

Comments: None.

Source of Information: International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Other*

Technology Name : Studsvik Metal Melter

Application : Off-site Ex-situ

Brief Description : Technology is an induction heated metal melter with a capacity of melting 1.5 metric tons of steel metal per hour (each charge 5 metric tons) and an electric arc furnace for melting of aluminum, brass and copper with a capacity of melting 250 kg per hour (each charge 600 kg). The furnaces are provided with a remotely operated lid (top) with a suction of gases at the top of the crucible. The furnaces are hydraulically tipped for pouring molten metal into molds. The melters and facility have been operable since 1989 and have melted more than two thousand tons of material including steam generators from a decommissioned nuclear reactor.

Company Name/POC: Studsvik RadWaste AB/Olof Andersson

Address : S-611 82 NYKOPING/Sweden

Phone Number : 46 155 22 15 20

Fax Number : 46 155 26 31 17

Technology Maturity : Commercial use experience

Performance History : Detailed history furnished on request to the company. Melters have processed metal generated at the Studsvik site, four reactor sites in Sweden, three reactor sites in Germany, and one site in Belgium.

Comments : None.

Source of Information : International TechCon

CONSTRUCTION MATERIALS/DEBRIS

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : Advanced Recyclable Media System

Application : Ex-situ

Brief Description : The Advanced Recyclable Media System (ARMS) is a new cleaning system that removes radionuclides and other contaminants from building surfaces and equipment. The technology does not use water or chemical solvents to perform these functions. The system delivers sponge media particles to a surface and can then recycle these particles for reuse on the project.

Company Name/POC: Aerojet/Steve Pocock

Address : Old Highway 11-East/Jonesborough, TN 37659

Phone Number : 423 753 1200

Fax Number : 423 753-864

Technology Maturity : Commercial use experience

Performance History : Performance Data are available.

Comments :

U.S. Army: Decontaminated five grinding machines impacted with depleted uranium. Contact Mike Styvert, U.S. Army Arsenal, Rock Island, Illinois, at 309/782-0880. Scientific Ecology Group; Setting up decontamination station for commencement of operations on 10/01/94. Aerojet will be decontaminating lead blocks, concrete, and various equipment from the Oak Ridge reservation.

The ARMS decontamination system provided by Aerojet can maximize recycling of decommissioned materials and minimize the volume of wastes from anticipated D&D operations. The ARMS system is very portable, easy to deploy, economical, and provides DOE with a true waste minimization and resource recovery option for D&D operations. Aerojet has a solid 15-year track record of manufacturing depleted uranium ordnance for the U.S. Army and Air Force. We have a high degree of proficiency in health physics and radioactive waste/disposal matters. Aerojet has a very good combination of decontamination technology and expertise to perform successful cleanups within the DOE site infrastructure.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides☒ Heavy Metals☒ PCB☒ Explosives/Propellants☒ Petroleum Hydrocarbons☒ Radionuclides☒ SVOC☒ Other Contaminant☒ Nonhalogenated VOC☒ Halogenated VOC☒ N/A**TECHNOLOGY TYPE :** *Mechanical Surface Cleaning***Technology Name :** CO2 Cleanblast/CO2 Miniblast**Application :**

Ex-situ

Brief Description :

This surface cleaning technology uses small dry ice pellets accelerated through one of a variety of Alpheus cleaning nozzles by compressed air (variable from 50-250 psi). When the pellets hit the surface to be cleaned, their kinetic energy causes them to penetrate to the base material, at which point they shatter, blasting fragments laterally in all directions, releasing the contaminant from the base material. Instantaneously, the dry ice fragments sublime (turn directly from solid to gas). The expansion of the CO2 from solid to gas adds a lifting force to speed removal of the contaminant. The debris falls away, and the CO2 gas returns harmlessly to the atmosphere.

Company Name/POC: Alpheus Cleaning Technologies Corp./Scott Stratford**Address :** 9119 Milliken Avenue/Rancho Cucamonga, CA 91720**Phone Number :** 909 481 6444**Fax Number :** 909 980-3885**Technology Maturity :** Commercial use experience**Performance History :** Performance Data are available.

More than 100 environmental job sites: EG&G Rocky Flats, Lavell Knight (Nuclear Decon) 303/966-4293; Westinghouse SRS, Randy Singer (Nuclear Decon) 803/725-2407; EPA, Thor Cutler (Mercury Decon) 513/569-7931; Sematech, Ed Burrati (Arsenic Decon) 512/356-5069; FQS, Ed Guthrie (Petroleum Waste) 800/827-9790; NDC, Pat Gillis (Assorted Hazardous Waste) 509/660-2628.

Comments :

This system is exceptionally easy to use. It uses standard industrial utilities (electricity and compressed air). The primary benefit is that cleaning is accomplished without generating any additional waste. The cleaning media, dry-ice pellets, disappear upon impact and all that remains is the contaminant that has been removed from the target surface. Cleaning can also be accomplished with little or no disassembly of the object being cleaned.

Source of Information : TechCon

CONSTRUCTION MATERIALS/DEBRIS

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Mechanical Surface Cleaning

Technology Name : Portable Shot Blast Cleaning System (BLASTRAC)

Application : On-site Ex-situ

Brief Description : Cleans, profiles (to any depth) concrete or steel. Removes contaminants, paint, dirt, glues, etc., from concrete or steel. Utilizes HEPA filtration for exhaust air.

Company Name/POC: ARAMSCO/Mark Perry

Address : c/o Aramsco/906 Grace St./Elgin, IL 60120

Phone Number : 800 767-9981

Fax Number : 708 741-1211

Technology Maturity : Commercial use experience

Performance History : Numerous jobs by concrete contractors: NAVY (steel structures), Great Lakes Naval Base; FDA food establishments; hazwaste jobs (Westinghouse-Haztech), steel mills (Chemical Waste Management, Inc.).

Comments : None.

Source of Information : TechCon

CONTAMINANTS :

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

■ Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

Halogenated VOC

■ N/A

TECHNOLOGY TYPE: *Mechanical Surface Cleaning*

Technology Name : Wet Abrasive Particle Impact Cleaning

Application :	On-site	Ex-situ
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Brief Description : The technology is a semi-automatic fully contained wet abrasive particle impact cleaner designed for nuclear use. It uses long life abrasive media, which is recycled. The liquid effluent quantities are relatively low. Decontamination factors of up to 100 for loose contamination are achieved.

The alternative to this technology is manual operation of the same basic decontamination technique, which is labour intensive and leads to increased operator dose uptake.

The technology has been tested on a range of Beta-Gamma contaminated metal tools and components.

Company Name/POC: British Nuclear Fuels plc/Janet Jackson

Address : Risley, Warrington WA3 6AS Cheshire, England

Phone Number : 1925 832735

Fax Number : 1925 835722

Technology Maturity : Pilot plant testing

Performance History : Wet abrasive particle impact cleaning is a well established process for metal cleaning and finishing in manufacturing industry. A decontamination system for use in the nuclear industry, based on this technique has been developed and tested jointly by BNFL and the UKAEA. Vapormatt Ltd are licensed to manufacture and market the equipment.

Two machines have been sold and are in service at the Joint European Torus Project (JET) at Culham Laboratories, Oxford, UK.

Comments : There is an upper size limitation of about 50cm in any direction on items that can be handled in the current design of the machine. Very small items present difficulties because they can be blown away by the force of the abrasive jet. Articles with crevices inaccessible to the abrasive cannot be cleaned completely. Ease of use and flexibility are typical of any spray booth operation. The equipment can be readily configured to meet the clients specifications. Infrastructure requirements are mainly a provision of HEPA filtration for the exit air.

Source of Information : International TechCon

CONSTRUCTION MATERIALS/DEBRIS

CONTAMINANTS :

☐ Pesticides/Herbicides☐ Heavy Metals☐ PCB☐ Explosives/Propellants☐ Petroleum Hydrocarbons☐ Radionuclides☐ SVOC☐ Other Contaminant☐ Nonhalogenated VOC☐ Halogenated VOC☒ N/A

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : SCARP Coatings Removal System

Application : On-site

Brief Description : The SCARP coatings removal system is a mobile self-powered, self-contained system which provides two methods for removing paints and other surface-bound coatings from various structural materials. One method is mechanical impact through rotary and linear action air driven tools; the second method is abrasive media blasting. Upon removal, the coating is instantaneously captured and transferred away from the surface and processed by the system. Coating materials along with other debris is contained for disposal.

Company Name/POC: Container Products Corporation/J. Hughes, J. King, J. Grantham

Address : P.O. Box 3767/Wilmington, North Carolina 28406

Phone Number : 910 392-6100

Fax Number : 910 392-677

Technology Maturity :

Field demo complete

Performance History : Contact company for performance data.

Comments : None.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : Super Self-Supporting All Purpose Cleaning System (S/SSAP)

Application : On-site

Brief Description : This Mobile Decon System provides fast and effective decon utilizing the spray-vac technique. The unit is totally self-supporting, i.e., it has it's own power supply, fresh water supply which is recirculate and re-used, oil filtration and separation system and all of the KELLY System spray vac tools can be utilized with this totally stainless steel vehicle. This technology will enable you to decon to releasable level structures or equipment that were inaccessible to decon because no utilities were available, due to this unit being totally self supporting.

Company Name/POC: Container Products Corporation/J. Hughes, J. King, J. Grantham

Address : P.O. Box 3767/Wilmington, North Carolina 28406

Phone Number : 910 392-6100

Fax Number : 910 392-6778

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Comments :

This technology has been well proven over the last decade. The superheated water spray vacuum technique has been immeasurable in the types of surfaces being cleaned.

This totally self-supporting all purpose vehicle, is mounted on a F-700 series Ford truck, with it's own power supply, fresh water supply and recirculation system. Support services required are personnel to operate and facilities to refuel and resupply vehicle. The S/SSAPS now in operation are currently limited to 3 man operation for approximately 8 hours of on the job deconning. The S/SSAP is easy to use. Just drive to site, start up unit and hook up the spray vac tools, and with qualified operators, commence decon operations.

Source of Information : TechCon

CONSTRUCTION MATERIALS/DEBRIS

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : KELLY Decon Glove Booth

Application : On-site

Brief Description : The KELLY Decon Glove Booth performs radioactive decontamination in an ergonomic atmosphere for cleaning such items as hand tools, lead bricks, pump seals, etc. Decontamination of various surfaces, such as S/S, carbon steel head, etc. can be accomplished in the 300 CFM negative pressure chamber, without producing mixed waste and a low volume of waste water. The technology replaces freon and expensive decon fluids and the high up-keep that CO2 causes without producing airborne contaminants.

Company Name/POC: Container Products Corporation/J. King, J. Hughes, J. Grantham

Address : P.O. Box 3767/Wilmington, North Carolina 28406

Phone Number : 910 392-6100

Fax Number : 910 392-677

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

15 Decon Booths operational throughout country. Most are used on a daily basis, which have greatly reduced the facilities cost of replacing and disposing of equipment that can be deconned and reused. References and more information available upon request.

Comments :

Standard Booth Size 48" Wide, 32 1/2" Deep, 93 1/2" High - 1,100 Pounds (Est.)

Filter unit 48" wide, 37 1/2" deep, 39" high, 300 pounds

Worktable 48" wide, 32 1/2" deep, 39" High, 70 pounds

Utilities required - 220-600 volts available, water supply, waste water drain, compressed air - 60 psi

This unit can be implemented with ease without affecting current operations. The design and technology lets the system be put to immediate use. Infrastructure need is only the service connections required. Totally mobile self supporting units available also.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : KELLY Decontamination System

Application : On-site

Brief Description : The KELLY Decon System was developed to provide a cost-effective technique for general area decontamination. This system utilizes the spray vacuum technique which introduces a pressurized spray of superheated water (up to 300 degrees Fahrenheit) to the surface being cleaned, thus expanding the pores and allowing the imbedded contaminants to be removed with a 187 CFM HEPA-filtered vacuum system. The KELLY Decon System can eliminate such methods as basic janitorial, strippable coatings, and pressure washing, which produce hazardous run offs and a high volume of waste water and mixed waste.

Company Name/POC: Container Products Corporation/J. King, J. Hughes, J. Grantham

Address : P.O. Box 3767/Wilmington, North Carolina 28406

Phone Number : 910 392-6100

Fax Number : 910 392-6778

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

With over 45 systems in use around the country, thousands of hours of on-the-job experience has proven the KELLY System's effectiveness in removing high- and low-level contamination from surfaces such as stainless steel, carbon steel, lead, painted surfaces, bare concrete, asphalt and even wood.

Comments :

Main Unit - 46" L x 44"H x 33"W x 950 lbs
 Vacuum Unit - 50"L x 42"H, x 21"W x 500 lbs
 Cyclone Separator - 27"L x 40"H x 29"W x 125 lbs
 HEPA Filter Unit - 36"L x 48"H x 29"W x 360 lbs
 Storage Boxes - 3 @ 32L x 40H x 32W x 125 lbs ea

The KELLY Decon System was designed with simplicity in using the system; general safety requirements must be adhered to in addition to the few listed with the system. The system is very flexible due to its ability to be moved from one location to another. Infrastructure needed is service connections and trained personnel.

Source of Information : TechCon

CONSTRUCTION MATERIALS/DEBRIS

CONTAMINANTS :

☐ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☒ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : CO2 Blast Cleaning

Application : On-site

Brief Description : CO2 Blast Cleaning is a decontamination process which uses solid dry ice (CO2) pellets as a cleaning media. The pellets are propelled onto the surface by compressed air or other compressed gasses. As the pellets impact the surface, they sublime, returning to their natural state in the atmosphere as a gas. Cleaning occurs as the turbulence caused by the sublimation flushes the surface and lifts contaminants away. The CO2 gas and contaminants are then entrained in an airstream and captured in a HEPA filter. The CO2 gas is filtered and released.

Company Name/POC: Environmental Alternatives, Inc./Andrea Howe

Address : 867 Route 12/Unit 7/West Moreland, New Hampshire 03467

Phone Number : 603 357-8814

Fax Number : 603 358-691

Technology Maturity : Commercial use experience

Performance History : Process used at more than 20 facilities, decontaminating radwaste, heavy metals and organics. Job size varied from handtools to a reactor cavity floor.

Comments : The area to be decontaminated must be within 100 feet of RDU. HEPA ventilation must be supplied. Process is very easy to use. The size of the decontamination job will dictate the space requirements.

Source of Information : TechCon

**CONSTRUCTION
MATERIALS/DEBRIS**

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : High Power Impulse Decontamination

Application : On-site Ex-situ

Brief Description : This technology can be used in cases where CO2/ice and chemical deco methods are not sufficient. Especially cristaline contamination in tanks with high activity can be decontaminated.

Company Name/POC: Hansa Projekt Anlagentechnik GmbH/Michael Szukala

Address : Tarpenring 4/22419 Hamburg, Germany

Phone Number : 49 40 527 02 62

Fax Number : 49 40 527 56 6

Technology Maturity : Field demo complete

Performance History : Contact company for performance history.

Comments : Does not work on elastic contaminants. Ease of use because of a fully automized process, can be connected to remotely operated equipment.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : Ultrahigh - Pressure Waterjet Equipment

Application : Other Application

Brief Description : Flow International Corporation has developed a surface cleaning and cutting tool using ultrahigh - pressure waterjet equipment that produces a secondary waste stream at 5 - 7 gallons per minute.

Company Name/POC: Flow International Environmental Application Division/Tom Cross

Address : 23500 64th South/Kent, Washington 98032

Phone Number : 206 872-4900

Fax Number : 206 813-3285

Technology Maturity : Commercial use experience

Performance History : Partial reference list: EG&G Idaho, Idaho Falls; Kaisers Engineers Hanford, Richland, WA; Westinghouse Savannah River, Aiken, SC; Babcock & Wilcox, Idaho Falls, ID; Lawrence Livermore Natl. Lab., Livermore, CA; Oak Ridge Natl. Lab., Oak Ridge, TN; Argonne Natl. Lab., Argonne, IL; Pacific Northwest Lab., Richland, WA; Scientific Ecology Group, Oak Ridge, TN.

Comments : Application identified as: Surface Cleaning.

Flow International is currently working on containment, filtration and water recycle technology. More work needs to be done in this area. Flow equipment is easy to use. The ultrahigh-pressure pumps are totally mobile. Available with both diesel and electric prime movers, these units can be used both in plant and in field. Flow International Corporation has had equipment in the nuclear D&D environment for many years. Flow International has recently formed an entire new division called the Environmental Applications Division, this group of seasoned waterjet professionals is dedicated to helping its customers in the nuclear industry solve their cleaning and cutting problems.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : Mulden - Reinigunge - Reaktor

Application : On-site Ex-situ

Brief Description : MURR-System is designed for decontamination of bulk-material (i.e., soil, cracked concrete) and sludge from hydrocarbons, chloride hydrocarbons, BTEX and heavy metals. Typical amount of one charge is 6 - 500 tons. After decontamination cleaned material can be used as construction material for roads landfill and similar use. The system is mobile and can be also used as a fixed installation. Technology alternatives include high pressure cleaning, and bio bed.

Company Name/POC: HGN Hydrogeologic GmbH/Hans-Gunther Knackstedt

Address : Niederlassung Dortmund/Otto-Hahn-Strabe 27/D-44227/Dortmund, Germany

Phone Number : 0049 231 9750750

Fax Number : 231 9750 7520

Technology Maturity : Commercial use experience

Performance History : HGN is working with this soil and demolition waste treatment system since 1993 in over 100 projects. For example: bioremediation and stripping of soil from gasoline stations for shell, fina, and elf oil; washing of heavy metal-contaminated demolition waste from metal plants in Dortmund and Ergste.

Comments : On-site facilities required to support use of this technology include: electric energy, water supply, truck, caterpillar. Technology limitations include: grease degradation, PCP. General challenges include cleaning of HM-contaminated material, esp. Hg.

	Treatment Requirements	Status of residual
hydrocarbons	100000 mg/kg	<500 mg/kg
PAH	1000 mg/kg	<10 mg/kg
BTEX	1000 mg/kg	<5 mg/kg
chloride hydrocarbons	1000 mg/kg	<1 mg/kg
heavy metals		
Pb, Cr, Cu, Ni, Zn	2000 mg/kg	<50 mg/kg
As	500 mg/kg	<20 mg/kg
Cd, Hg	100 mg/kg	<1 mg/kg

Source of Information : International TechCon

**CONSTRUCTION
MATERIALS/DEBRIS**

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : Ice Blast

Application : ☐ On-site ☐ Ex-situ

Brief Description : Pure ice crystals are formed and propelled onto surfaces to remove contaminants from surfaces. No chemicals or abrasives are used. Very little residual water remains.

Company Name/POC: Ice Blast West Inc.

Address : 1801 130th Ave., NE/Bellevue, WA 98005/Rory Clarke

Phone Number : 206 883-1470

Fax Number : 206 881-684

Technology Maturity : Commercial use experience

Performance History : Very successful operation at Hanford's "T" plant.

Comments : None.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : Surface Removal of Contamination from Concrete Surface Layers

Application : On-site Ex-situ

Brief Description : In general, mainly the concrete surface layer will be contaminated. By microwave techniques this layer can be removed with no secondary contamination. The remaining structure can be dismantled in a conventioned way. The technology is applicable for all kinds of contaminants, provided they are concentrated in the surface layer.

Company Name/POC: KEMA Nederland B.V./H.A.W. Cornelissen

Address : P.O.Box 9035/NL-6800 ET ARNHEM, The Netherlands

Phone Number : 31 2635 63370

Fax Number : 31 2644 23635

Technology Maturity :

Bench scale testing, only

Performance History : The technology and equipment were developed at lab scale.

Comments : Especially appropriate for flat concrete surfaces. Method can be robotized. The method based on microwave heating was very promising because of the following reasons: no secondary contamination of equipment and environment, adjustable depth of layer to be removed, easy handling of equipment, suited for remote control and robotics, no process water or gas needed. With microwaves the separation process can be performed by quickly heating the surface of concrete structures. By thermal stresses or by steam the top layer is separated from the rest of the structure. The method can be used to selectively demolish chemically or radioactively contaminated buildings. Frequencies both in the 900 and 2450 MHz range are used. Reported depths of removal as indicated in the literature vary between 20 to 90 mm with 896/915 MHz and between 3 to 25 mm with 2450 MHz. The depth of removal depends on the power, the distance from the antenna to the concrete, and the loss factor of the concrete. The average efficiency of the technology is about 1 to 2 litres of concrete per kWh.

Source of Information : International TechCon

**CONSTRUCTION
MATERIALS/DEBRIS**

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : Mechanical Surface Cleaning

Technology Name : Non-Destructive Cleaning (NDC)

Application : On-site Ex-situ

Brief Description : Self-contained decontamination facilities and fixtures that use dry ice pellets as their cleaning medium. These mobile, self-contained NDC decontamination facilities provide all the decon media delivery, contaminant ventilation controls and filtration of the waste gases in one stand-alone facility. NDC has six mobile facilities currently furnishing decon services to the nuclear power industry and at DOE sites. They work so well that many service customers have purchased their units. NDC replaces water, chemical and abrasive media decontamination.

Company Name/POC: Non-Destructive Cleaning, Inc./Patrick J. Gillis, Jr.

Address : 1600 Providence Highway/Walpole, Massachusetts 02081

Phone Number : 508 660-3064

Fax Number : 508 660-306

Technology Maturity : Commercial use experience

Performance History : All NDC projects have been 100% successful. Problem: Customer does not furnish materials to be cleaned fast enough to keep up with NDC.

Comments : NDC facilities come in two basic sizes: 20' x 40' or 40' x 40'. They are designed to set up anywhere out of doors with no foundation or special supports. A firm surface is all that is required. The only service required is 480V power. NDC decontamination facilities are self-sufficient, including HVAC and HEPA exhaust filtration. NDC is a line-of-sight surface cleaner. It will also do limited subsurface cleaning. The limit of near surface or subsurface cleaning is the depth to which it will clean. Most NDC facilities are designed to be set up at the job site and the materials are brought into NDC for cleaning. NDC also has a line of vacuum cleaning fixtures that perform in-situ cleaning. Hardware development of fixtures to perform high-volume cleaning of internal surfaces, convoluted surfaces and remote applications is a general challenge.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE: *Mechanical Surface Cleaning*

Technology Name : Soda Blasting

Application :	On-site	Ex-situ
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Brief Description :	Removes low-level radioactive and other hazardous surface contaminants. Abrasive blasting with sodium bicarbonate, which is later dissolved so the contaminants can be removed to reduce the generated waste by up to 75 percent. Up to 99 percent reduction of surface contamination.
Company Name/BOC:	ORC Technical Services, Inc.

Company Name/POC: OBG Technical Services, Inc./Eric Neubauer

Address : 5000 Brittonfield Parkway/East Syracuse, New York 13057

Phone Number : 315 437-6400

Fax Number : 315 437-9800

Technology Maturity : Field demo complete

Performance History : Demonstration project at K-25, ORNL, Bldg. K-29.

Comments : Site requirements are: compressed air - 120 psi 300 + cfm; tap water - std. pressure; 110V AC.

Surface decontamination only. For removal of lead paint, PCBs, LLR surface contaminants. Decon moveable parts/equipment such as air cylinders. Decon concrete floors, walls and ceilings. Overcoming the concept of individuals' believing that surfaces can be decontaminated with baking soda. Dust - water is added to control dust - a down-draft blast room would be an ideal situation for blasting parts.

Source of Information : TechCon

**CONSTRUCTION
MATERIALS/DEBRIS**

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Mechanical Surface Cleaning

Technology Name : Remotely Operated Scrubbber-MOOSE

Application : On-site Ex-situ

Brief Description : Automatic removal of contaminated surfaces of concrete floors and slabs (either bare or painted). Reciprocating scabbling pistons pulverize surface while an integrated vacuum simultaneously picks up debris and deposits into waste drums. Entire process is 100 percent dustless and remotely controlled. Replaces sandblasting, shot-blasting, high pressure water, jack-hammers, and manual scabblers. Chief advantage is completely dustless operation (No secondary containment or respirators are required), minimized waste generation, and automatic packaging of completely dry concrete waste for further disposal.

Company Name/POC: PENTEK, Inc./Eric Crivella

Address : 1026 Fourth Avenue/Corapolis, PA 15108-1659

Phone Number : 412 262-0725

Fax Number : 412 262-073

Technology Maturity : Commercial use experience

Performance History : MOOSE technology is commercially available. Nominal size of decontamination projects is on the order of 20,000 sq. ft. to depths of 1/4 to 1/2 inch. Local scabbling of "hot-spots" to depths of 1 to 3 inches is typical.

Comments : Best application of MOOSE technology is to floor areas greater than 200 sq. ft., with slab thickness of greater than 4 inches. Closest approach to walls or obstructions is 6 inches. Implementation is immediate, with only standard 110 VAC power and compressed air required. There are no unresolved technical challenges which would prevent or limit application of MOOSE technology at contaminated DOE facilities. Productivity increases to 1,200 sq. ft./hour are feasible given a customer requirement. MOOSE embodies the cleanest surface removal technique available, allowing for the physical removal and drumming of contaminated concrete and coatings at the rate of 400 sq. ft./hour. The process generates an absolute minimal volume of waste (i.e., only the mass of concrete removed), without generating any airborne discharge, and deposits over 99.5 percent of the solid concrete rubble into waste drums for further disposition (e.g., direct disposal, recycling into concrete waste solidification processes). The process is remotely controlled, and is capable of limiting decontamination only to the coatings, or extending removal to a 3-inch deep practical limit. Decontaminated surfaces are left in a mechanically scarified condition suitable for immediate resurfacing.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : Vac-Pac

Application : On-site Ex-situ

Brief Description : A modular system consisting of self-drumming HEPA vacuum and manually operated power tools to decontaminate concrete and steel surfaces while generating no air-borne dust or debris. The system uses mechanical scarification and scabbling devices. The system contains only a few moving parts, and performs with exceptionally high efficiency and reliability. It replaces abrasive blasting, shot-blasting, jack hammers, and other surface demolition alternatives. It provides a very clean working environment and an absolute minimum waste volume.

Company Name/POC: PENTEK, Inc./Eric Crivella

Address : 1026 Fourth Avenue/Corapolis, PA 15108-1659

Phone Number : 412 262-0725

Fax Number : 412 262-0731

Technology Maturity : Commercial use experience

Performance History : This technology has been in commercial use for 7 years, and has been utilized at most DOE sites. Detailed contact information is available on request.

Comments : Weight of modules varies: 10 lb. for Corner-cutter, 50 lb. for Squirrel, and 750 lb. for the Vac-Pac. Components are completely portable and require only a supply of compressed air. The complete system can decontaminate complex surfaces including corners, rivet heads, weld seams, and curves. Vac-Pac can be located up to 100 to 200 feet from the work area. Corner-Cutter will scarify any friable or brittle surface. Squirrel is designed only for concrete floors. Very compact and easy to deploy. There are no special infrastructure requirements. Access requirements are only limited by restrictions preventing workers to access the contaminated area surface. On a productivity basis, the system decontamination rate is between 50 and 100 percent of conventional systems. However, waste only consists of the contaminated surface material, resulting in waste volumes up to only 5 percent of conventional techniques. In addition, truly dustless operation and ergonomic design provides a more controlled and cleaner working environment, resulting in higher worker productivity. Therefore, overall system economics are lower than conventional systems. Vac-Pac's self-cleaning filtration system and self-drumming features limit HEPA vacuum filter replacements to an annual task. This lowers overall operating costs and worker exposure tremendously.

Source of Information : TechCon

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Mechanical Surface Cleaning*

Technology Name: Flashlamp StarBoldt (TM)

Application: On-site Ex-situ

Brief Description: StarBoldt is a system that utilizes Xenon flashlamps to generate high-intensity light to ablate coatings or contaminants from substrates without damage, or by adjusting operating controls, ablates concrete substrates to remove contaminated top layers. StarBoldt is a self-contained method that does not generate any added waste streams and actually reduces coatings to a fraction of their original weight for optimum waste minimization. The StarBoldt process is operator-safe because byproduct is contained at the point of generation through a vacuum source in the application head. StarBoldt is an environmentally sound alternative to coatings removal methods such as media blasting and chemical strippers, while increasing operation productivity and cost savings. As an alternative to these methods, StarBoldt is operator safe, reduces waste, increases productivity and reduces costs.

Company Name/POC: Polygon Industries, Inc./Christa Chiacos

Address: 2 Embarcadero Center/San Francisco, California 94111

Phone Number: 415 391-6063

Fax Number: 415 292-522

Technology Maturity: Field demo complete

Performance History: September 19, 1994: Field demonstration at the DOE-RMI site in Ashtabula, Ohio managed by Parsons Environmental Services, Inc. The program jointly sponsored by DOE and Parsons was the first of its kind to combine an innovative technology with a qualified workforce in a decontamination effort. Air monitors were placed in the surrounding area and on service personnel. 100 percent containment of byproduct at the source was verified. StarBoldt successfully decontaminated both concrete and steel surfaces to release levels without posing a threat to the personnel or the surrounding environment.

Comments: StarBoldt sold as a system is complete and can be used anywhere an electricity source is available. A system consists of the following: power supply, PFN, controller and chiller housed in a console on wheels 19 in. W x 36 in. D x 71 in. H, 750 lbs. a vacuum 72 in. H x 60 in. W x 20 in. D, 1, 100 lbs., a fume scrubber 86 in. H x 38 in. W, 400 lbs. electrical requirements: 220-240 VAC, 100 amps. Application limitations are as follows: getting into confined spaces with the application head (e.g., behind pipes or tight corners). The system is mobile and versatile; special facilities to use the system are not required. Can be used indoors or outdoors without ambient containment devices. Because a StarBoldt system has not yet been used in a full-scale operation, technological challenges are not determined. Demonstrated in short-term use, for example, a full week of constant use, the system is not without challenges. Volume of waste generation: minimal, as the StarBoldt process uses light, not blasting media or chemicals or water to strip coatings from surfaces or decontaminate surfaces; byproduct consists of trace amounts of gas and ash.

Source of Information: TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides☐ Heavy Metals☐ PCB☐ Explosives/Propellants☐ Petroleum Hydrocarbons☐ Radionuclides☐ SVOC☐ Other Contaminant☐ Nonhalogenated VOC☐ Halogenated VOC☐ N/A**TECHNOLOGY TYPE :** *Mechanical Surface Cleaning***Technology Name :** Cleaner/Scarifier System**Application :****Brief Description :**

The Cleaner/Scarifier System is a combination tool that can be used to clean metal surfaces and to remove the surface layers of contaminated surfaces. The tool uses multiple ultra high-pressure water jets mounted on a rotating arm to clean or remove surface layers. It is propelled and steered by remotely operated drive wheels. A shroud and vacuum system contains and recovers the cleaning spoils, concrete spoils, and water for proper disposal. Even when operated on walls, the surface is reported to be left virtually dry. The Cleaner/Scarifier System was developed for the U.S. Department of Energy to meet the need for safer, more efficient decommissioning methods.

Company Name/POC: Quest, Integrated, Inc./Dr. Edward Bohn**Address :** Technology Division, 21414 - 68th Avenue South, /Kent, WA 98032**Phone Number :** 206 872-9500**Fax Number :** 206 872-8967**Technology Maturity :**

Field demo complete

Performance History : Contact the company for performance history data.**Comments :** None**Source of Information :** TechCon

**CONSTRUCTION
MATERIALS/DEBRIS**

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : High Pressure KEW Unit with Turbo Nozzle and Sandblasting Equipment

Application : On-site Ex-situ

Brief Description : This technology is a gasoline powered igh pressure water cleaning system that works at a pressure of 150 bar. The turbo nozzle has an oscillating jet-stream. It can also be supplied with a sandblasting device which injects sand in the water jet-stream.

Company Name/POC: Riso National Laboratory/Jorn Roed

Address : Environmental Science and Technology Department/P.O. Box 49/DK-4000 Roskilde, Denmark

Phone Number : 454677 4186

Fax Number : 454237 002

Technology Maturity : Commercial use experience

Performance History : This system has been used for many years in decontamination of non radioactive surfaces. It showed very good performance in decontaminating Cs isotopes both in the CIS countries and in Sweden.

Comments : Scaffolding is sometimes required. Use on more than a three story building is a limitation. The operator has to be experienced with the equipment.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : Roof Washer

Application : On-site Ex-situ

Brief Description : Used for asbestos abatement. Rotating brush mounted on extendable rod allows operation from the ground. Air compressor provides pressure for rotating the brush and tap water of ordinary pressure is needed for rinsing. A filter system can enable recycling of the water. Can be used for rinsing asbestos roofs.

Company Name/POC: Riso National Laboratory/Jorn Roed

Address : Environmental Science and Technology Department/P.O. Box 49/DK-4000 Roskilde, Denmark

Phone Number : 454677 4186

Fax Number : 454237 0025

Technology Maturity : Commercial use experience

Performance History : Contact company for performance data.

Comments : As asbestos cannot be cleaned by normal operation, this tool has been developed in order to safely clean roofs that are contaminated by hazardous material.

None.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Mechanical Surface Cleaning***Technology Name :** Cryogeneis**Application :** On-site Ex-situ

Brief Description : Cryogenesis is the process which utilizes pellets of dry ice which are directed at a surface to be decontaminated. Upon impacting on the surface, the pellets of dry ice sublime, leaving only the removed contaminate for disposal. Cryogenesis have very effectively demonstrated its performance in nuclear decontamination.

Company Name/POC: Waste Minimization and Containment Corp./Jim Becker**Address :** 2140 Scranton Road/Cleveland, OH. 44113**Phone Number :** 216 696 8797**Fax Number :** 216 696-879**Technology Maturity :** Commercial use experience.

Performance History : The technology is used on a daily basis in an extremely wide range of industries. Specific information regarding individual customers/applications will be made available on an as-needed basis by Waste Minimization and Containment Corp.

Comments : Cryogenesis is a portable and completely pneumatic system and does not require any electrical service. A gaseous nitrogen supply hose is required to operate the system. Cryogenesis Model 1350-1 weighs only 350 pounds when empty (500 pounds when filled with dry ice). The dimension of the unit are 49.5"L x 22"W x 49"H. The only limitations are related to its ability to remove certain types of coating (paint) systems. However, work continues to use paint softeners without technology to speed up the paint removal process. Cryogenesis is an extremely easy system to use. The system is reliable, maintainable, easily serviceable, and user-friendly.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Chemical Surface Cleaning*

Technology Name : Decontamination for Decommissioning

Application : On-site Other Application

Brief Description : Analogous with a previously developed process for operational reactors (LOMI); Bradtec Ltd, in conjunction with EPRI, have a new decontamination process for decommissioning reactor and chemical treatment plants. The process offers a dilute chemical application for the removal of radioactive oxides from the internal surfaces of a plant while minimizing waste volumes. The system is designed to achieve high DF;s and hence significantly reduce worker exposure. The process is new; the application technology is well tried and tested; (i.e., civil nuclear decontaminations).

Company Name/POC: Bradtec Ltd/George Elder

Address : University of the West of England/Cold Harbour Lane/Bristol BS 16 1QY, United Kingdom

Phone Number : 44 117 976 3937

Fax Number : 44 117 976 3892

Technology Maturity : Bench scale testing, only

Performance History : Still at development stage.

Comments : Decon systems are flexible skid mounted units. Collaborating with the utility, the vendor supplies procedures, QA, equipment and operators. The utility supplies services and supervises interfacing.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Chemical Surface Cleaning*

Technology Name : Chemical Decontamination of Metals

Application : On-site ☐ Ex-situ ☐
Off-site ☐

Brief Description : The process involves treatment with a series of chemical reagents in tanks. The process is specifically designed to remove uranium, neptunium and technetium contamination from aluminum alloy and steel. The process is semi-automatic so that potential hazards to operators are minimized. Its application has allowed large tonnages of metal to be returned to commerce thus avoiding the need for the more expensive options of long-term storage or disposal to land burial.

Company Name/POC: British Nuclear Fuels plc/Janet Jackson

Address : H242 Hinton House/Risley, Warrington Cheshire, England WA3 6AS

Phone Number : 1925 832735

Fax Number : 1925 83572

Technology Maturity : Commercial use experience

Performance History : Several thousand metric tonnes of metal have been decontaminated and sold for recycle since the facility commenced operation in 1990.

Comments : The facility, which contains two identical treatment lines, each with five reagent tanks, served by overhead cranes, measures approximately 60m long x 20m wide x 7m high. The utilities required are domestic water, steam, electricity, compressed air and respirator air.

When steel is the metal to be decontaminated, it must be free from surface coatings or corrosion products for the process to have maximum effectiveness.

The plant can be operated remotely from the control room. Local effluent treatment by ion exchange is provided.

The process is fully developed and engineered to meet specific requirements at the site where decommissioning is in progress.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☒ Radionuclides	☐ SVOC	☐ Other Contaminant
☒ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Chemical Surface Cleaning*

Technology Name : Contaminant Extraction Technology

Application : On-site Ex-situ

Brief Description : EET's Contaminant Extraction Technology is a safe, cost-effective chemical process for the removal of contaminants from the surface and substrate of solid materials. The technology uses sophisticated chemistry to penetrate into the pores at a microscopic level, bind the contaminants, and extract them.

Company Name/POC: EET, Inc./Mike Bonem

Address : 4710 Bellaire Blvd, Suite 300/Bellaire, Texas 77401

Phone Number : 713 662-0727

Fax Number : 713 662-2322

Technology Maturity : Commercial use experience

Performance History : The Contaminant Extraction Technology has been successfully employed in a wide variety of projects. The technology has been 100 percent successful in the extraction of radionuclides, heavy metals, PCBs, and organics. It has been applied on concrete, brick, steel and other metals, and has extracted at depths of more than 3 inches with reductions of 90 - 99percent per cycle. Case histories describe PCB, heavy metal, and radionuclide extraction projects. In total, EET (or its predecessor company) has completed over 200 projects, some in excess of \$1 million, with a 100% rate of success in reaching the client's stated decontamination objectives.

Comments : The Contaminant Extraction Technology is fully commercialized and readily available. It can be used on all sizes of jobs. The technology has minimal site requirements. Personnel must be able to reach the contaminated surface to apply the chemicals. The technology will not be effective if chemicals cannot make contact with all affected surface areas. Productivity is higher on large areas with a smooth surface, even though the technology can be applied to any surface. Other operations or activities in the area can continue while EET's work is in progress. Standard electrical service is required. The effectiveness of the technology is its extraction of subsurface contaminants, 100 percent success record, and rapid reduction in contaminant levels (90-99 percent per one-day cycle). EET's chemicals contain no RCRA constituents, waste disposal is characterized by the extracted contaminants. The waste stream will be an aqueous liquid, which can be incinerated or solidified with cement, depending on the customer's requirements. EET's waste-minimizing design typically results in only 0.03-0.06 gallons of total liquid waste per square foot cleaned. No permits have been required for any of EET's projects. The technology is not a treatment process, nor is it subject to any air emission regulations.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Chemical Surface Cleaning*

Technology Name : Fluorocarbon Surfactant Decontamination

Application : On-site Ex-situ
 Off-site

Brief Description : The ESI process is designed to nondestructively remove radioactive particles bonded by secondary valence forces from the surfaces of complex parts. The part to be decontaminated is contacted with a fluorocarbon surfactant solution under conditions of shear, as in an ultrasonic bath or a low pressure spray system. Under these conditions, solid particles, including radioactive particles, bound to the subsurface by secondary valence forces, are suspended in the flowing fluorinated liquid. These particles are then removed from the process liquids by simple filtration, thus allowing these liquids to be recycled. After the desired level of decontamination has been achieved, the part is rinsed with surfactant free fluorocarbon rinse liquid and air dried. The fluorinated liquids used in the ESI process are not CFCs. They are nontoxic, nonflammable, and do not present a hazard to the ozone layer.

Company Name/POC: Entropic Systems, Inc./R: Kaiser

Address : P.O. Box 397/Winchester, Massachusetts 01890

Phone Number : 617 938-7588

Fax Number : 617 938-758

Technology Maturity : Pilot plant testing

Performance History : Performance data are available.

The feasibility of using the ESI particle removal process to the nondestructive decontamination of nuclear equipment was demonstrated under the aegis of a Phase I SBIR program funded by the Nuclear Regulatory Commission (NRC). The fluorocarbon surfactant solutions used as a working media in the ESI process survived exposure of up to 10 mrad doses of gamma rays, and are thus sufficiently radiation resistant for use as decontamination media. Ultrasonic cleaning in perfluorinated surfactant solutions was found to be an effective method of removing radioactive iron (59Fe) oxide particles from contaminated test pieces. Fifteen test assemblies were examined. Decontamination levels ranging from 88 percent to 100 percent (within experimental error) were obtained. For twelve of the fifteen assemblies tested, residual contamination levels were below the release level for fixed beta and gamma contamination of 1,100 decays/min/100 cm².

Comments : Full-scale prototype available. Radioactive particles suspended in the process liquids could be quantitatively removed by filtration through a 0.1 um membrane filter, so that these process liquids can be recycled for further use. Projected economics indicate a pretax pay back time of 1 month for a commercial scale system. To date, experimental work has been limited to test pieces less than 10 cm in maximum dimension. However, there are no inherent technology limitations for decontamination of large scale industrial equipment. Site requirements to be determined.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Chemical Surface Cleaning***Technology Name :** Electropolishing with Acid Regeneration**Application :** On-site**Brief Description :** Decontamination of steel components by electropolishing in phosphoric acid. High efficiency removal of surface contamination down to the free release level, e.g., 50,000 Bq/cm (squared) to less than 0.5 Bq/cm (squared) for unrestricted reuse of the material. Periodical regeneration of the phosphoric acid by precipitation of the dissolved material.**Company Name/POC:** Kernkraftwerke Gundremmingen/Norbert Eickelpasch**Address :** Betriebsgesellschaft mbH/Postfach 3 00/D-89355/Gundremmingen, Germany**Phone Number :** 011 49 8224 78 2170**Fax Number :** 011 49 8224 78 2900**Technology Maturity :** Commercial use experience**Performance History :** Electropolishing:

1. Pilot-phase; 100 tons of contaminated material from the turbine hall in 1983.
2. Full scale operation; approx 2000 tons since 1984.

Acid regeneration:

Unrestricted reuse of phosphoric acid by regeneration since 1985.

Comments : Dimension of the workpieces determine the size of the decontamination basins.**Source of Information :** International TechCon

**CONSTRUCTION
MATERIALS/DEBRIS**

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Chemical Surface Cleaning*

Technology Name : Pentek-600

Application : On-site Ex-situ

Brief Description : Removes surface contamination and oxidized surface layers from ferritic and stainless steels, lead, and other non-ferrous metals. Upon application, polymer dries, shrinks, and peels off of surfaces, encapsulating contamination within polymer matrix. Can replace grinding, high-pressure blasting, and strippable coatings. Waste volume is limited to a 10 mil thick film of plastic.

Company Name/POC: PENTEK, Inc./Eric Crivella

Address : 1026 Fourth Avenue/Corapolis, PA 15108-1659

Phone Number : 412 262-0725

Fax Number : 412 262-073

Technology Maturity : Commercial use experience

Performance History : Pentek 600 polymers have been in commercial use for about 6 years. They have been deployed in a variety of applications including reactor refueling cavities, glove boxes, and lead bricks.

Comments : Curing of the material is sensitive to temperature & humidity. Best performance is obtained at room temperature and 50 - 75 percent humidity. The commercial material cannot be sprayed. Directly implementable using brush application or direct dipping into the product. Drying time is dependent on temperature and humidity, but is usually less than 24 hours. Production of commercial quantities of this product has presented a challenge. An experimental variation of the product (Pentek 620) has been produced in limited quantities for use in the decontamination of chemical warfare agents from field equipment. Its chief characteristics are its ability to be applied by a power spray and its ability to dry quickly.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Chemical Surface Cleaning*

Technology Name : Decontamination of Metal by Decontgel

Application : On-site Ex-situ

Brief Description : Decontamination of metal surfaces through the use of a fixotrope mix of acids. Because of the nonliquid (fixotrop, pestons) quality of the special decontgel it stays attached to vertical surfaces, thus allowing the chemical reaction to occur. After a reaction time of 2 hours the surface are cleaned by high pressurized water.

Company Name/POC: Richard Buchen GmpH/Dr. Jorg Unk

Address : Gawerbering 4 - 8/76149 Karlsruhe/Germany

Phone Number : 011 49 7247 20311

Fax Number : 011 49 7247 21893

Technology Maturity : Commercial use experience

Performance History : The technology was developed in 1992 and has since been used during decommissioning work at the nuclear research reactor FR 2 in Karlsruhe, Germany.

Comments : The use of the technology is limited by the hydrogen concentration in the room air. This limitation can be controlled by calculation of treated surfaces and measured during operation. The equipment is easy to operate.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Chemical Surface Cleaning*

Technology Name : Ozone Decontamination Process (SODP)

Application : On-site Ex-situ

Brief Description : The process is used to decontaminate radioactive metallic surfaces and remove the activity. Since SODP will remove oxides and some microns of base material, levels below 1 Bq/g are received.

Company Name/POC: Studsvik RadWaste AB/Olof Andersson

Address : S-611 82 NYKOPING/Sweden

Phone Number : 46 155 22 15 20

Fax Number : 46 155 26 31 17

Technology Maturity : Commercial use experience

Performance History : Decontamination of: heat exchanger in Ringhals 2, PWR (1986). Decontamination factor ~10. Two steam generators from Agesta HPWR (1993) to free release (greater than or equal to 1 Bq/g).

Comments : None.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Recycle*

Technology Name : Melting and Recycling of Radioactively and/or Chemically Contaminated Scrap

Application : On-site ☒ Ex-situ ☒
Off-site ☒

Brief Description : Contaminated scrap is brought to a melting plant and melted under controlled conditions. From the molten material, new shielding components, such as blocks, plates, doors, casks, etc. are produced for use in nuclear installations.

Company Name/POC: SIEMPELKAMP GIESSEREI GmbH & CO./Dr. Manfred Sappok

Address : Siempelkampstrasse 45/D-47803 Krefeld, Germany

Phone Number : 49 0 2151 894205

Fax Number : 49 0 2151 89445

Technology Maturity : Commercial use experience

Performance History : In Germany: 8,000 tons since 1987
In Sweden: 2,000 tons since 1989
In the US: 6,000 tons since 1992
In France: 5,000 tons since 1992
In Chernobyl, a melting plant is in the planning phase (licensing procedure).

Comments : Limitations include (1) maximum alpha, beta, gamma-activity: 1,000 Bq/g; (2) metal scrap, cuttable to size of 20'-containers. Melting plant is installed in combination with a foundry to produce cast iron containers or other recycling products. Melting technology has been in commercial use since 1987; reduces final repository volume; use of molten material for production of containers for final storage of high-level waste; low volume of secondary waste produced (maximum 5 percent); easy measuring of residual activity by taking samples from liquid material; separation of different materials in the melting process.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Recycle*

Technology Name : Battery Waste Treatment Process (BWTP)

Application : On-site Ex-situ

Brief Description : The technology uses washing, liberation and gravity separation techniques to treat waste from battery wrecking operations and produce recyclable products. Typically, the technology will treat mixed and/or landfilled battery wastes, and produce clean hard rubber, clean plastic, and lead concentrate products. The hard rubber and plastic products pass the TCLP test for lead. The lead concentrate products contain chemical lead compounds in a cake or metallic form. These materials are recyclable for their lead content. The washing step is followed by a separation step where streams are segregated based on the relative differences in density. The process recycles the water stream to create a closed loop system.

Company Name/POC: Smith Environmental Technologies Corp./Dave Ettlers

Address : 304 Inverness Way South/Suite 200/Englewood, Colorado 80112

Phone Number : 303 790-1747

Fax Number : 303 799-0186

Technology Maturity : Commercial use experience

Performance History : The technology has been developed on the Gould Superfund site in Portland, Oregon. It has been demonstrated from bench-scale through full commercial scale (10 tons per hour). This remedy has been accepted by the EPA Region 10 for remediation of the Gould site. Full-scale operation at the site started June 1993. Test work is being conducted on samples from a battery wrecking site in Region 5. The process is fully commercial at the present time.

Comments : The process uses existing physical separation equipment configured in an innovative way. Depending on the site, up to 80 percent of the source material can be removed as recyclable products for on-site disposal. The process will not treat materials containing chemically combined lead in low concentrations.

Source of Information : VISITT 3.0

**CONSTRUCTION
MATERIALS/DEBRIS****CONTAMINANTS :**

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Recycle***Technology Name :** Battery Waste Treatment Process (BWTP)**Application :** On-site Ex-situ

Brief Description : This technology uses washing, liberation and gravity separation techniques to treat waste from battery wrecking operations and produce recyclable products. Typically, the technology will treat mixed and/or landfilled battery wastes, and produce clean hard rubber, clean plastic, and lead concentrate products. The hard rubber and plastic products pass the TCLP test for lead. The lead concentrate products contain chemical lead compounds in a cake or metallic form. These materials are recyclable for their lead content. The washing step is followed by a separation step where streams are segregated based on the relative differences in density. The process recycles the water stream to create a closed loop system.

Company Name/POC: Smith Environmental Technologies Corp./Dave Ettlers**Address :** 304 Inverness Way South/Suite 200/Englewood, Colorado 80112**Phone Number :** 303 790-1747**Fax Number :** 303 799-018**Technology Maturity :** Commercial use experience

Performance History : The technology has been developed on the Gould Superfund site in Portland, Oregon. It has been demonstrated from bench-scale through full commercial scale (10 tons per hour). This remedy has been accepted by the EPA Region 10 for remediation of the Gould site. Full-scale operation at the site started June 1993. Test work is being conducted on samples from a battery wrecking site in Region 5. The process is fully commercial at the present time.

Comments : The process uses existing physical separation equipment configured in an innovative way. Depending on the site, up to 80 percent of the source material can be removed as recyclable products. The process will not treat materials containing chemically combined lead in low concentrations.

Source of Information : VISITT 3.0

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Dust Control*

Technology Name : Long Duration Foam

Application : On-site Ex-situ

Brief Description : Rusmar Long Duration foam is applied over an emitting surface to control odors, VOC's, dust and other emissions. The foam creates a continuous barrier between the surface and the atmosphere. Rusmar Long Duration Foam Technology is very effective in controlling any emission. Long Duration Foam is utilized in place of soils, tarps and other cover materials to control odors, VOC's, dust, windblown emissions, etc. Long Duration Foam completely covers any surface to which it is applied and it will conform to irregular and vertical surfaces. Long Duration Foam can be applied quickly, easily and provides a superior barrier to emissions than soil or tarps. It is non-toxic, non-hazardous, non-flammable and biodegradable.

Company Name/POC: Rusmar Incorporated/Laura White

Address : 216 Garfield Avenue/West Chester, Pennsylvania 19380

Phone Number : 610 436-4314

Fax Number : 610 436-8436

Technology Maturity : Commercial use experience

Performance History : Rusmar Long Duration Foam has been used throughout the United States and abroad for a variety of applications including: remediation projects, Superfund projects, lagoon and pond closures. It has been used as odor control on a liquid surface, for dust and VOC's suppression, emergency response, vapor and odor suppression in industrial applications and erosion control and to prevent surface water infiltration on stock piled soils. Additionally, Long Duration Foam has been used for in transit odor control on sludge filled containers and dust control during demolition of asbestos contaminated buildings.

Comments : Some of the Long Duration Foam products require water to dilute the product prior to use. The water must have less than 300 PPM of hardness. The smaller Pneumatic Foam Units are trailer mounted and require a piece of equipment to tow them around the site. During months of freezing weather, all Long Duration Foam products must be protected from freezing. The Pneumatic Foam Units are completely self contained and require no outside source of power. During freezing weather, a source of electricity is required to operate the freeze protection system on the larger Pneumatic Foam Units. There are no application temperature limitations on Long Duration Foam Products. Care must be exercised when applying AC-900 Series products with respect to weather, a heavy rain will not allow the membrane to form. After the first day, AC-900 Series products are unaffected by weather, i.e., rain, snow, wind, etc. Long Duration Foam is easily applied utilizing a Rusmar Incorporated Pneumatic Foam Unit. Long Duration Foam is a single component material requiring non chemical mixing and no post application cleanup. The Pnuematic Foam Units are simple and easy to operate; they require no special training. Long Duration Foam is available with durations ranging from a few hours to six months. The Pnuematic Foam Units are available in a variety of sizes ranging from a small skid mounted unit to a large self propelled track mounted unit. These units are available for purchase or rental. Long Duration Foam and Pnuematic Foam Units have been in use in the field for the past nine years. They do not face any general challenges. Long Duration Foam can be applied at a rate of 500 square feet per minute and requires only one operator.

Source of Information : TechCon

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1. The first of the two main parts of the report is a description of the work done during the year. This is divided into two sections, one for the first half of the year and one for the second half. The second part of the report is a summary of the results of the work.

2. The first section of the report describes the work done during the first half of the year. This includes a description of the work done on the various projects, and a summary of the results of the work.

3. The second section of the report describes the work done during the second half of the year. This includes a description of the work done on the various projects, and a summary of the results of the work.

Containers/Equipment

Treatment

Containers/Equipment

Treatment

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Chemical Reduction/Oxidation*

Technology Name : Gas Phase Chemical Reduction

Application : On-site Ex-situ

Brief Description : The ECO LOGIC Process involves the gas-phase reduction of hazardous organic contaminants. The system is capable of treating any form of organic contamination at any concentration with proven destruction and removal efficiencies (DREs) of at least 99.9999 percent. Contaminants entrained in liquids, soils and bulk solids can be destroyed without the formation of hazardous organic residuals. The system has been verified by various government agencies worldwide including the US EPA through the Superfund Innovative Technology Evaluation program. The ECO LOGIC Process is currently offered as a commercial-scale system for on-site treatment. The closed-loop destruction process ensures that no uncontrolled emissions result while the use of a reducing atmosphere ensures that dioxins and furans are not formed as byproducts. The system is mobile and may be utilized for on-site destruction.

Company Name/POC: ELI Eco Logic International Inc./Jim Nash

Address : 143 Dennis Street/Rockwood, Ontario, Canada NOB2KO

Phone Number : 519 856-9591

Fax Number : 519 856-9235

Technology Maturity : Commercial use experience

Performance History : Development of the technology began in 1986 and proceeded through the bench-scale and laboratory-scale. In 1991, a pilot-scale unit was constructed and tested extensively at Hamilton Harbour, Ontario, Canada. Demonstrations on sediment contaminated with 300,000 ppm PAH and 400 ppm PCBs confirmed DREs of 99.9999 percent. The pilot-scale unit was tested in Bay City, Michigan, the following year for the US EPA and PCB contaminated oil (25 percent PCBs), water and soil. Once again DREs of at least 99.9999 percent were confirmed. Following the Bay City demonstration further modifications were made to the front-end preprocessing units as well as scaling up the technology to a commercial-scale. At the time of this writing, (May 1995) the first commercial-scale unit was operating in Australia on pesticide residuals and PCB contaminated electrical equipment. The second and third commercial-scale units are presently being constructed and will be utilized by General Motors of Canada Ltd. and the steel manufacturing firm Dofasco Inc.

Comments : The ECO LOGIC Process treats only the organic portion of the waste stream. Any inorganic co-contaminants will remain in the treated soil or be separated in the grit and scrubber as metal hydrides, depending on their physical characteristics. Additionally, the radioactive component of a mixed low level waste stream would be captured at various specific locations in the Process. With the ECO LOGIC Process, a mixed waste stream would undergo significant volume reduction and separate the radioactive component into a form that is more amenable to traditional methods of disposal. The ECO LOGIC Process is mobile and mounted on several drop-deck highway trailers. It may be transported to the waste site and set-up within four weeks. Once the on-site waste has been destroyed, the system is simply moved to the next site. The mobility and closed-loop destruction process have garnered significant public acceptance for the technology while being offered at a competitive cost. The ECO LOGIC Process is at an advanced state of development for an alternative remediation technology and is presently offered at a commercial-scale.

Source of Information : International TechCon

CONTAINERS/EQUIPMENT

CONTAMINANTS: ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE: Vitrification (Ex Situ)

Technology Name: Plasma Torch

Application: On-site ☐ Ex-situ ☐
Off-site ☐

Brief Description: Vitrification of materials using a Plasma Torch is used to treat materials such as fly ash, chlorinated wastes, asbestos, and hospital wastes.

Company Name/POC: Aérospatiale/Herve Saul

Address: P.O. BP2/78133 Les Mureaux Cedex, France

Phone Number: 33 1 34 92 39 00 **Fax Number:** 33 1 34 92 11 9

Technology Maturity: Commercial use experience

Performance History: More than 20 industrial plasma systems have been sold to clients like EDE, Nippon Steel, Rengeot, and Lorfont.

Comments: None.

Source of Information: International TechCon

CONTAINERS/EQUIPMENT

CONTAMINANTS: ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE: Electrical Separation

Technology Name: Portable Electro-decontamination Process

Application: On-site ☐ Ex-situ ☐

Brief Description: This technology is a portable electrodeplating unit for the removal of contamination from stainless steel. It is particularly suitable for decontamination of hot spots inside gloveboxes and produces only small volumes of dilute nitric acid effluent, which is easily treatable. The alternative is to use aggressive, high concentration chemical reagents which present more onerous disposal problems, or prolonged wiping/scouring which is more labor intensive. Current experience relates to stainless steel plutonium glovebox decontamination.

Company Name/POC: British Nuclear Fuels plc/Janet Jackson

Address: Risley, Warrington, WA3 6AS, Cheshire England

Fax Number: 1025 83572

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Electrical Separation***Technology Name :** Electrolytic Decontamination to Free Release Levels**Application :** On-site Ex-situ**Brief Description :** WasteChem has developed an effective method of decontaminating large quantities of reactor steel and concrete to free release levels using electrolysis. This has been demonstrated on 14 towers of reactor waste at a UK nuclear site.**Company Name/POC:** WASTECHEM Ltd/Dr. M.G. Down**Address :** Earl Road/Stanley Green/Wilmslow SR93RL UK**Phone Number :** 161 485 8231**Fax Number :** 161 482 8137**Technology Maturity :** Commercial use experience**Performance History :** Commercial scale demonstration on 14 towers of steel under contract to UKAEA. Successfully decontaminated to free release levels.

Comments : WasteChem, in collaboration with independent consultants, has developed an effective method of decontaminating large quantities of reactor steel to free release level using electrolysis. The general method is well known and papers have been published based on laboratory data. However, despite the generally favorable findings, electrolysis has not previously been adopted by the nuclear industry. In an initial operation, 14 tonnes of reactor waste have been cleaned by WasteChem at a national reactor site - probably the largest amount treated in the UK by this method. Once the steel has been treated the residual activity has to be measured to ensure that the total activity remaining is less than 0.4Bq/gm. To achieve this in a cost effective manner, special instruments have been developed to enable the two critical radionuclides, that is, ^{60}Co and ^{55}Fe to be promptly and accurately measured on-site by non-scientific staff. It has been shown that decontamination by electrolysis for recycling is considerably less costly than disposal. Contrary to popular belief the method does not produce radioactivity in the electrolyte or the air. Furthermore, as it is a tightly and remotely controlled process, the dose to operators is also significantly reduced compared to the dose received when using abrasive decontamination techniques or during cutting and packing for disposal purposes.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Other**Technology Name :** Plasma Tritium Decontamination**Application :** On-site Ex-situ**Brief Description :** A plasma is used to remove tritium bound on surfaces of uranium shipping containers.**Company Name/POC:** Ontario Hydro Technologies/Paul Gierszewski**Address :** 2700 Lake Shore Drive/Mississauga L5J1K3**Phone Number :** 905 855-4717**Fax Number :** 905 823-802**Technology Maturity :** Field demo complete**Performance History :** Limited experience with cleaning of low surface activity tools (stainless steel). Extensive experience with cleaning uranium shipping containers.

Comments : Subatmospheric pressure required. Surfaces to be cleaned limited to sizes which fit inside vacuum vessel (30 cm diameter, 50 cm long for the current model). The technique requires a moderate vacuum. Reduction of surface activities below 1 uCi/m(2) can be readily achieved if the original surface activity results from external contamination. Tritium originating from the bulk to contaminate the surface is more difficult to remove. However, modest success has been attained in reducing the surface activity to 1 uCi/m(2) particularly if the surface is not heavily oxidized. Regrowth of surface activity, due to tritium migration from the bulk to the surface is slow or non-existent, over the range of conditions investigated. Single walled uranium storage beds are routinely decontaminated to about 1 uCi/m(2). Generates large volumes of low level radioactive liquid.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : Advanced Recyclable Media System

Application : Ex-situ

Brief Description : The Advanced Recyclable Media System (ARMS) is a new cleaning system that removes radionuclides and other contaminants from building surfaces and equipment. The technology does not use water or chemical solvents to perform these functions. The system delivers sponge media particles to a surface and can then recycle these particles for reuse on the project.

Company Name/POC: Aerojet/Steve Pocock

Address : Old Highway 11 East/Jonesborough, TN 37659

Phone Number : 423 753 1200

Fax Number : 423 753-8645

Technology Maturity : Commercial use experience

Performance History : Performance Data are available.

Comments :

U.S. Army: Decontaminated five grinding machines impacted with depleted uranium. Contact Mike Styvert, U.S. Army Arsenal, Rock Island, Illinois, at 309/782-0880. Scientific Ecology Group: Setting up decontamination station for commencement of operations on 10/01/94. Aerojet will be deconning lead blocks, concrete, and various equipment from the Oak Ridge reservation.

The ARMS decontamination system provided by Aerojet can maximize recycling of decommissioned materials and minimize the volume of wastes from anticipated D&D operations. The ARMS system is very portable, easy to deploy, economical, and provides DOE with a true waste minimization and resource recovery option for D&D operations. Aerojet has a solid 15-year track record of manufacturing depleted uranium ordnance for the U.S. Army and Air Force. We have a high degree of proficiency in health physics and radioactive waste/disposal matters. Aerojet has a very good combination of decontamination technology and expertise to perform successful cleanups within the DOE site infrastructure.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Mechanical Surface Cleaning

Technology Name : CO2 Cleanblast/CO2 Miniblast

Application : Ex-situ

Brief Description : This surface cleaning technology uses small dry ice pellets accelerated through one of a variety of Alpheus cleaning nozzles by compressed air (variable from 50-250 psi). When the pellets hit the surface to be cleaned, their kinetic energy causes them to penetrate to the base material, at which point they shatter, blasting fragments laterally in all directions, releasing the contaminant from the base material. Instantaneously, the dry ice fragments sublime (turn directly from solid to gas). The expansion of the CO2 from solid to gas adds a lifting force to speed removal of the contaminant. The debris falls away, and the CO2 gas returns harmlessly to the atmosphere.

Company Name/POC: Alpheus Cleaning Technologies Corp./Scott Stratford

Address : 9119 Milliken Avenue/Rancho Cucamonga, CA 91720

Phone Number : 909 481 6444

Fax Number : 909 980-388

Technology Maturity : Commercial use experience

Performance History : Performance Data are available.

More than 100 environmental job sites: EG&G Rocky Flats, Lavell Knight (Nuclear Decon) 303/966-4293; Westinghouse SRS, Randy Singer (Nuclear Decon) 803/725-2407; EPA, Thor Cutler (Mercury Decon) 513/569-7931; Sematech, Ed Burrati (Arsenic Decon) 512/356-5069; FQS, Ed Guthrie (Petroleum Waste) 800/827-9790; NDC, Pat Gillis (Assorted Hazardous Waste) 509/660-2628.

Comments : This system is exceptionally easy to use. It uses standard industrial utilities (electricity and compressed air). The primary benefit is that cleaning is accomplished without generating any additional waste. The cleaning media, dry-ice pellets, disappear upon impact and all that remains is the contaminant that has been removed from the target surface. Cleaning can also be accomplished with little or no disassembly of the object being cleaned.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides☒ Heavy Metals☒ PCB☒ Explosives/Propellants☒ Petroleum Hydrocarbons☒ Radionuclides☒ SVOC☒ Other Contaminant☒ Nonhalogenated VOC☒ Halogenated VOC☒ N/A**TECHNOLOGY TYPE :** *Mechanical Surface Cleaning***Technology Name :** Portable Shot Blast Cleaning System (BLASTRAC)**Application :** On-site Ex-situ**Brief Description :** Cleans, profiles (to any depth) concrete or steel. Removes contaminants, paint, dirt, glues, etc., from concrete or steel. Utilizes HEPA filtration for exhaust air.**Company Name/POC:** ARAMSCO/Mark Perry**Address :** c/o Aramsco/906 Grace St./Elgin, IL 60120**Phone Number :** 800 767 9981**Fax Number :** 708 741-1218**Technology Maturity :** Commercial use experience**Performance History :** Numerous jobs by concrete contractors: NAVY (steel structures), Great Lakes Naval Base; FDA food establishments; hazwaste jobs (Westinghouse-Haztech), steel mills (Chemical Waste Management, Inc.).**Comments :** None.**Source of Information :** TechCon

CONTAMINANTS:

- ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : Glovebox Mounted Vacuum Cleaner

Application : On-site Ex-situ

Brief Description : This equipment is a dry vacuum cleaner for rapid removal of gross contamination from plutonium gloveboxes where radiation dose levels are a problem. Use of this technology provides an alternative to slower, more labor intensive techniques such as brushing and wiping/swabbing, which can lead to higher operator dose uptake. It has been used on aged plutonium oxide powder containing in-grown americium. Materials cleaned included all types of glovebox interior surface and equipment.

Company Name/POC: British Nuclear Fuels plc/Janet Jackson

Address : Risley, Warrington WA3 6AS Cheshire, England

Phone Number : 1925 832735

Fax Number : 1925 83572

Technology Maturity : Field demo complete

Performance History : The technology has been developed over a period of twenty years of plutonium plant operations. The current prototype has been field tested on a redundant plutonium glovebox.

Comments : The vacuum cleaner is contained within a mobile glovebox of a size permitting movement through corridors and double doors. The technology is applicable to removal of loose particulate contamination inside gloveboxes. Access to and space adjacent to the glovebox to be cleaned is required so that the portable vacuum cleaner can be positioned. The actual cleaning process is a rapid manual operation taking about 20-30 minutes for a typical glovebox. The equipment is designed for ease of maintenance. The major technical features of this technology are the use of radiation tolerant materials for hoses, filters and seals, etc. The equipment is totally enclosed in a high integrity glovebox and the whole unit is designed to meet UK standards for criticality safety.

Source of Information : International TechCon

CONTAMINANTS :

- ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : Wet Abrasive Particle Impact Cleaning

Application : On-site Ex-situ

Brief Description :

The technology is a semi-automatic fully contained wet abrasive particle impact cleaner designed for nuclear use. It uses long life abrasive media, which is recycled. The liquid effluent quantities are relatively low. Decontamination factors of up to 100 for loose contamination are achieved.

The alternative to this technology is manual operation of the same basic decontamination technique, which is labour intensive and leads to increased operator dose uptake.

The technology has been tested on a range of Beta-Gamma contaminated metal tools and components.

Company Name/POC: British Nuclear Fuels plc/Janet Jackson

Address : Risley, Warrington WA3 6AS Cheshire, England

Phone Number : 1925 832735

Fax Number : 1925 835722

Technology Maturity : Pilot plant testing

Performance History : Wet abrasive particle impact cleaning is a well established process for metal cleaning and finishing in manufacturing industry. A decontamination system for use in the nuclear industry, based on this technique has been developed and tested jointly by BNFL and the UKAEA. Vapormatt Ltd are licensed to manufacture and market the equipment.

Two machines have been sold and are in service at the Joint European Torus Project (JET) at Culham Laboratories, Oxford, UK.

Comments :

There is an upper size limitation of about 50cm in any direction on items that can be handled in the current design of the machine. Very small items present difficulties because they can be blown away by the force of the abrasive jet. Articles with crevices inaccessible to the abrasive cannot be cleaned completely. Ease of use and flexibility are typical of any spray booth operation. The equipment can be readily configured to meet the clients specifications. Infrastructure requirements are mainly a provision of HEPA filtration for the exit air.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : SCARP Coatings Removal System

Application : On-site

Brief Description : The SCARP coatings removal system is a mobile self-powered, self-contained system which provides two methods for removing paints and other surface-bound coatings from various structural materials. One method is mechanical impact through rotary and linear action air driven tools; the second method is abrasive media blasting. Upon removal, the coating is instantaneously captured and transferred away from the surface and processed by the system. Coating materials along with other debris is contained for disposal.

Company Name/POC: Container Products Corporation/J. Hughes, J. King, J. Grantham

Address : P.O. Box 3767/Wilmington, North Carolina 28406

Phone Number : 910 392-6100

Fax Number : 910 392-6777

Technology Maturity :

Field demo complete

Performance History : Contact company for performance data.

Comments : None.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : Super Self-Supporting All Purpose Cleaning System (S/SSAP)

Application : On-site

Brief Description : This Mobile Decon System provides fast and effective decon utilizing the spray-vac technique. The unit is totally self-supporting, i.e., it has it's own power supply, fresh water supply which is recirculate and re-used, oil filtration and separation system and all of the KELLY System spray vac tools can be utilized with this totally stainless steel vehicle. This technology will enable you to decon to releasable level structures or equipment that were inaccessible to decon because no utilities were available, due to this unit being totally self supporting.

Company Name/POC: Container Products Corporation/J. Hughes, J. King, J. Grantham

Address : P.O. Box 3767/Wilmington, North Carolina 28406

Phone Number : 910 392-6100

Fax Number : 910 392-6778

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Comments :

This technology has been well proven over the last decade. The superheated water spray vacuum technique has been immeasurable in the types of surfaces being cleaned.

This totally self-supporting all purpose vehicle, is mounted on a F-700 series Ford truck, with it's own power supply, fresh water supply and recirculation system. Support services required are personnel to operate and facilities to refuel and resupply vehicle. The S/SSAPS now in operation are currently limited to 3 man operation for approximately 8 hours of on the job deconning. The S/SSAP is easy to use. Just drive to site, start up unit and hook up the spray vac tools, and with qualified operators, commence decon operations.

Source of Information : TechCon

CONTAMINANTS: ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Mechanical Surface Cleaning***Technology Name:** KELLY Decon Glove Booth**Application:** On-site

Brief Description: The KELLY Decon Glove Booth performs radioactive decontamination in an ergonomic atmosphere for cleaning such items as hand tools, lead bricks, pump seals, etc. Decontamination of various surfaces, such as S/S, carbon steel head, etc. can be accomplished in the 300 CFM negative pressure chamber, without producing mixed waste and a low volume of waste water. The technology replaces freon and expensive decon fluids and the high up-keep that CO2 causes without producing airborne contaminants.

Company Name/POC: Container Products Corporation/J. King, J. Hughes, J. Grantham**Address:** P.O. Box 3767/Wilmington, North Carolina 28406**Phone Number:** 910 392-6100**Fax Number:** 910 392-677**Technology Maturity:** Commercial use experience**Performance History:** Performance data are available.

15 Decon Booths operational throughout country. Most are used on a daily basis, which have greatly reduced the facilities cost of replacing and disposing of equipment that can be deconned and reused. -References and more information available upon request.

Comments:

Standard Booth Size 48" Wide, 32 1/2" Deep, 93 1/2" High - 1,100 Pounds (Est.)

Filter unit 48" wide, 37 1/2" deep, 39" high, 300 pounds

Worktable 48" wide, 32 1/2" deep, 39" High, 70 pounds

Utilities required - 220-600 volts available, water supply, waste water drain, compressed air - 60 psi

This unit can be implemented with ease without affecting current operations. The design and technology lets the system be put to immediate use. Infrastructure need is only the service connections required. Totally mobile self supporting units available also.

Source of Information: TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Mechanical Surface Cleaning***Technology Name :** KELLY Decontamination System**Application :** On-site

Brief Description : The KELLY Decon System was developed to provide a cost-effective technique for general area decontamination. This system utilizes the spray vacuum technique which introduces a pressurized spray of superheated water (up to 300 degrees Fahrenheit) to the surface being cleaned, thus expanding the pores and allowing the imbedded contaminants to be removed with a 187 CFM HEPA-filtered vacuum system. The KELLY Decon System can eliminate such methods as basic janitorial, strippable coatings, and pressure washing, which produce hazardous run offs and a high volume of waste water and mixed waste.

Company Name/POC: Container Products Corporation/J. King, J. Hughes, J. Grantham**Address :** P.O. Box 3767/Wilmington, North Carolina 28406**Phone Number :** 910 392-6100**Fax Number :** 910 392-6778**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.

With over 45 systems in use around the country, thousands of hours of on-the-job experience has proven the KELLY System's effectiveness in removing high- and low-level contamination from surfaces such as stainless steel, carbon steel, lead, painted surfaces, bare concrete, asphalt and even wood.

Comments :

Main Unit - 46" L x 44"H x 33"W x 950 lbs
 Vacuum Unit - 50"L x 42"H, x 21"W x 500 lbs
 Cyclone Separator - 27"L x 40"H x 29"W x 125 lbs
 HEPA Filter Unit - 36"L x 48"H x 29"W x 360 lbs
 Storage Boxes - 3 @ 32L x 40H x 32W x 125 lbs ea

The KELLY Decon System was designed with simplicity in using the system; general safety requirements must be adhered to in addition to the few listed with the system. The system is very flexible due to its ability to be moved from one location to another. Infrastructure needed is service connections and trained personnel.

Source of Information : TechCon

CONTAINERS/EQUIPMENT

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : CO2 Blast Cleaning

Application : On-site

Brief Description : CO2 Blast Cleaning is a decontamination process which uses solid dry ice (CO2) pellets as a cleaning media. The pellets are propelled onto the surface by compressed air or other compressed gasses. As the pellets impact the surface, they sublime, returning to their natural state in the atmosphere as a gas. Cleaning occurs as the turbulence caused by the sublimation flushes the surface and lifts contaminants away. The CO2 gas and contaminants are then entrained in an airstream and captured in a HEPA filter. The CO2 gas is filtered and released.

Company Name/POC: Environmental Alternatives, Inc./Andrea Howe

Address : 867 Route 12/Unit 7/West Moreland, New Hampshire 03467

Phone Number : 603 357-8814

Fax Number : 603 358-691

Technology Maturity : Commercial use experience

Performance History : Process used at more than 20 facilities, decontaminating radwaste, heavy metals and organics. Job size varied from handtools to a reactor cavity floor.

Comments : The area to be decontaminated must be within 100 feet of RDU. HEPA ventilation must be supplied. Process is very easy to use. The size of the decontamination job will dictate the space requirements.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : Ultrahigh - Pressure Waterjet Equipment

Application :

Other Application

Brief Description : Flow International Corporation has developed a surface cleaning and cutting tool using ultrahigh - pressure waterjet equipment that produces a secondary waste stream at 5 - 7 gallons per minute.

Company Name/POC: Flow International Environmental Application Division/Tom Cross

Address : 23500 64th South/Kent, Washington 98032

Phone Number : 206 872-4900

Fax Number : 206 813-3285

Technology Maturity : Commercial use experience

Performance History : Partial reference list: EG&G Idaho, Idaho Falls; Kaisers Engineers Hanford, Richland, WA; Westinghouse Savannah River, Aiken, SC; Babcock & Wilcox, Idaho Falls, ID; Lawrence Livermore Natl. Lab., Livermore, CA; Oak Ridge Natl. Lab., Oak Ridge, TN; Argonne Natl. Lab., Argonne, IL; Pacific Northwest Lab., Richland, WA; Scientific Ecology Group, Oak Ridge, TN.

Comments : Application identified as: Surface Cleaning.

Flow International is currently working on containment, filtration and water recycle technology. More work needs to be done in this area. Flow equipment is easy to use. The ultrahigh-pressure pumps are totally mobile. Available with both diesel and electric prime movers, these units can be used both in plant and in field. Flow International Corporation has had equipment in the nuclear D&D environment for many years. Flow International has recently formed an entire new division called the Environmental Applications Division, this group of seasoned waterjet professionals is dedicated to helping its customers in the nuclear industry solve their cleaning and cutting problems.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Mechanical Surface Cleaning***Technology Name :** High Power Impulse Decontamination**Application :** On-site Ex-situ**Brief Description :** This technology can be used in cases where CO₂/ice and chemical deco methods are not sufficient. Especially cristaline contamination in tanks with high activity can be decontaminated.**Company Name/POC:** Hansa Projekt Anlagentechnik GmbH/Michael Szukala**Address :** Tarpenring 4/22419 Hamburg, Germany**Phone Number :** 49 40 527 02 62**Fax Number :** 49 40 527 56 6**Technology Maturity :** Field demo complete**Performance History :** Contact company for performance history.**Comments :** Does not work on elastic contaminants. Ease of use because of a fully automized process, can be connected to remotely operated equipment.**Source of Information :** International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Mechanical Surface Cleaning***Technology Name :** Ice Blast**Application :** On-site Ex-situ**Brief Description :** Pure ice crystals are formed and propelled onto surfaces to remove contaminants from surfaces. No chemicals or abrasives are used. Very little residual water remains.**Company Name/POC:** Ice Blast West Inc.**Address :** 1801 130th Ave., NE/Bellevue, WA 98005/Rory Clarke**Phone Number :** 206 883-1470**Fax Number :** 206 881-6843**Technology Maturity :** Commercial use experience**Performance History :** Very successful operation at Hanford's "T" plant.**Comments :** None.**Source of Information :** TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : Non-Destructive Cleaning (NDC)

Application : On-site Ex-situ

Brief Description : Self-contained decontamination facilities and fixtures that use dry ice pellets as their cleaning medium. These mobile, self-contained NDC decontamination facilities provide all the decon media delivery, contaminant ventilation controls and filtration of the waste gases in one stand-alone facility. NDC has six mobile facilities currently furnishing decon services to the nuclear power industry and at DOE sites. They work so well that many service customers have purchased their units. NDC replaces water, chemical and abrasive media decontamination.

Company Name/POC: Non-Destructive Cleaning, Inc./Patrick J. Gillis, Jr.

Address : 1600 Providence Highway/Walpole, Massachusetts 02081

Phone Number : 508 660-3064

Fax Number : 508 660-3064

Technology Maturity : Commercial use experience

Performance History : All NDC projects have been 100% successful. Problem: Customer does not furnish materials to be cleaned fast enough to keep up with NDC.

Comments : NDC facilities come in two basic sizes: 20' x 40' or 40' x 40'. They are designed to set up anywhere out of doors with no foundation or special supports. A firm surface is all that is required. The only service required is 480V power. NDC decontamination facilities are self-sufficient, including HVAC and HEPA exhaust filtration. NDC is a line-of-sight surface cleaner. It will also do limited subsurface cleaning. The limit of near surface or subsurface cleaning is the depth to which it will clean. Most NDC facilities are designed to be set up at the job site and the materials are brought into NDC for cleaning. NDC also has a line of vacuum cleaning fixtures that perform in-situ cleaning. Hardware development of fixtures to perform high-volume cleaning of internal surfaces, convoluted surfaces and remote applications is a general challenge.

Source of Information : TechCon

CONTAMINANTS :

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

■ Petroleum Hydrocarbons

■ Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

■ **Halogenated VOC**

N/A

TECHNOLOGY TYPE: *Mechanical Surface Cleaning*

Technology Name : Soda Blasting

Application :

On-site

Ex-situ

Brief Description :

Removes low-level radioactive and other hazardous surface contaminants. Abrasive blasting with sodium bicarbonate, which is later dissolved so the contaminants can be removed to reduce the generated waste by up to 75 percent. Up to 99 percent reduction of surface contamination.

Company Name/POC: OBG Technical Services, Inc./Eric Neubauer

Address : 5000 Brittonfield Parkway/East Syracuse, New York 13057

Phone Number : 315 437-6400

Fax Number : 315 437-9800

Technology Maturity :

Field demo complete

Performance History : Demonstration project at K-25, ORNL, Bldg. K-29.

Comments :

Site requirements are: compressed air - 120 psi 300 + cfm; tap water - std. pressure; 110V AC.

Surface decontamination only. For removal of lead paint, PCBs, LLR surface contaminants. Decon moveable parts/equipment such as air cylinders. Decon concrete floors, walls and ceilings. Overcoming the concept of individuals' believing that surfaces can be decontaminated with baking soda. Dust - water is added to control dust - a down-draft blast room would be an ideal situation for blasting parts.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : Vac-Pac

Application : On-site Ex-situ

Brief Description : A modular system consisting of self-drumming HEPA vacuum and manually operated power tools to decontaminate concrete and steel surfaces while generating no air-borne dust or debris. The system uses mechanical scarification and scabbling devices. The system contains only a few moving parts, and performs with exceptionally high efficiency and reliability. It replaces abrasive blasting, shot-blasting, jack hammers, and other surface demolition alternatives. It provides a very clean working environment and an absolute minimum waste volume.

Company Name/POC: PENTEK, Inc./Eric Crivella

Address : 1026 Fourth Avenue/Corapolis, PA 15108-1659

Phone Number : 412 262-0725

Fax Number : 412 262-073

Technology Maturity : Commercial use experience.

Performance History : This technology has been in commercial use for 7 years, and has been utilized at most DOE sites. Detailed contact information is available on request.

Comments : Weight of modules varies: 10 lb. for Corner-cutter, 50 lb. for Squirrel, and 750 lb. for the Vac-Pac. Components are completely portable and require only a supply of compressed air. The complete system can decontaminate complex surfaces including corners, rivet heads, weld seams, and curves. Vac-Pac can be located up to 100 to 200 feet from the work area. Corner-Cutter will scarify any friable or brittle surface. Squirrel is designed only for concrete floors. Very compact and easy to deploy. There are no special infrastructure requirements. Access requirements are only limited by restrictions preventing workers to access the contaminated area surface. On a productivity basis, the system decontamination rate is between 50 and 100 percent of conventional systems. However, waste only consists of the contaminated surface material, resulting in waste volumes up to only 5 percent of conventional techniques. In addition, truly dustless operation and ergonomic design provides a more controlled and cleaner working environment, resulting in higher worker productivity. Therefore, overall system economics are lower than conventional systems. Vac-Pac's self-cleaning filtration system and self-drumming features limit HEPA vacuum filter replacements to an annual task. This lowers overall operating costs and worker exposure tremendously.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : Flashlamp StarBoldt (TM)

Application : On-site Ex-situ

Brief Description : StarBoldt is a system that utilizes Xenon flashlamps to generate high-intensity light to ablate coatings or contaminants from substrates without damage, or by adjusting operating controls, ablates concrete substrates to remove contaminated top layers. StarBoldt is a self-contained method that does not generate any added waste streams and actually reduces coatings to a fraction of their original weight for optimum waste minimization. The StarBoldt process is operator-safe because byproduct is contained at the point of generation through a vacuum source in the application head. StarBoldt is an environmentally sound alternative to coatings removal methods such as media blasting and chemical strippers, while increasing operation productivity and cost savings. As an alternative to these methods, StarBoldt is operator safe, reduces waste, increases productivity and reduces costs.

Company Name/POC: Polygon Industries, Inc./Christa Chiacos

Address : 2 Embarcadero Center/San Francisco, California 94111

Phone Number : 415 391-6063

Fax Number : 415 292-5228

Technology Maturity : Field demo complete

Performance History : September 19, 1994: Field demonstration at the DOE-RMI site in Ashtabula, Ohio managed by Parsons Environmental Services, Inc. The program jointly sponsored by DOE and Parsons was the first of its kind to combine an innovative technology with a qualified workforce in a decontamination effort. Air monitors were placed in the surrounding area and on service personnel. 100 percent containment of byproduct at the source was verified. StarBoldt successfully decontaminated both concrete and steel surfaces to release levels without posing a threat to the personnel or the surrounding environment.

Comments : StarBoldt sold as a system is complete and can be used anywhere an electricity source is available. A system consists of the following: power supply, PFN, controller and chiller housed in a console on wheels 19 in. W x 36 in. D x 71 in. H, 750 lbs. a vacuum 72 in. H x 60 in. W x 20 in. D, 1,100 lbs., a fume scrubber 86 in. H x 38 in. W, 400 lbs. electrical requirements: 220-240 VAC, 100 amps. Application limitations are as follows: getting into confined spaces with the application head (e.g., behind pipes or tight corners). The system is mobile and versatile; special facilities to use the system are not required. Can be used indoors or outdoors without ambient containment devices. Because a StarBoldt system has not yet been used in a full-scale operation, technological challenges are not determined. Demonstrated in short-term use, for example, a full week of constant use, the system is not without challenges. Volume of waste generation: minimal, as the StarBoldt process uses light, not blasting media or chemicals or water to strip coatings from surfaces or decontaminate surfaces; byproduct consists of trace amounts of gas and ash.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Mechanical Surface Cleaning

Technology Name : Cleaner/Scarifier System

Application :

Brief Description : The Cleaner/Scarifier System is a combination tool that can be used to clean metal surfaces and to remove the surface layers of contaminated surfaces. The tool uses multiple ultra high-pressure water jets mounted on a rotating arm to clean or remove surface layers. It is propelled and steered by remotely operated drive wheels. A shroud and vacuum system contains and recovers the cleaning spoils, concrete spoils, and water for proper disposal. Even when operated on walls, the surface is reported to be left virtually dry. The Cleaner/Scarifier System was developed for the U.S. Department of Energy to meet the need for safer, more efficient decommissioning methods.

Company Name/POC: Quest, Integrated, Inc./Dr. Edward Bohn

Address : Technology Division, 21414 - 68th Avenue South, Kent, WA 98032

Phone Number : 206 872-9500

Fax Number : 206 872-896

Technology Maturity :

Field demo complete

Performance History : Contact the company for performance history data.

Comments : None

Source of Information : TechCon

CONTAMINANTS:

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE: *Mechanical Surface Cleaning*

Technology Name : High Pressure KEW Unit with Turbo Nozzle and Sandblasting Equipment

Application :	On-site	Ex-situ
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Brief Description : This technology is a gasoline powered high pressure water cleaning system that works at a pressure of 150 bar. The turbo nozzle has an oscillating jet-stream. It can also be supplied with a sandblasting device which injects sand in the water jet-stream.

Company Name/POC: Riso National Laboratory/Jorn Roed

Address : Environmental Science and Technology Department/P.O. Box 49/DK-4000 Roskilde, Denmark

Phone Number : 454677 4186

Fax Number : 454237 0025

Technology Maturity : Commercial use experience

Performance History : This system has been used for many years in decontamination of non radioactive surfaces. It showed very good performance in decontaminating Cs isotopes both in the CIS countries and in Sweden.

Comments : Scaffolding is sometimes required. Use on more than a three story building is a limitation. The operator has to be experienced with the equipment.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : Roof Washer

Application : On-site Ex-situ

Brief Description : Used for asbestos abatement. Rotating brush mounted on extendable rod allows operation from the ground. Air compressor provides pressure for rotating the brush and tap water of ordinary pressure is needed for rinsing. A filter system can enable recycling of the water. Can be used for rinsing asbestos roofs.

Company Name/POC: Riso National Laboratory/Jorn Roed

Address : Environmental Science and Technology Department/P.O. Box 49/DK-4000 Roskilde, Denmark

Phone Number : 454677 4186

Fax Number : 454237 002

Technology Maturity : Commercial use experience

Performance History : Contact company for performance data.

As asbestos cannot be cleaned by normal operation, this tool has been developed in order to safely clean roofs that are contaminated by hazardous material.

Comments : None.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Mechanical Surface Cleaning***Technology Name :** Cleaning with Dry Ice**Application :** On-site Ex-situ

Brief Description : The system involves a spray of dry ice; it is sold as the Sno Gun. It is used for very delicate cleaning on telescope mirrors, semiconductors, and hybrid circuits. Very small (1 micron) wires are not moved by the dry ice spray, dust particles as small as 0.1 micron have been removed. Larger particles, paint and metal can be removed by higher velocities. After use the dry ice turns into Carbon dioxide gas so there is no collection problem. The system replaces sand or shot blasting that leaves the sand or shot to be collected. It replaces liquid cleaning that provides toxic gases that must be exhausted through cleaning systems. It is far more efficient than gas cleaning; there is no boundary-layer problem. The Sno Gun is sold to the optical semiconductor and hybrid industries by Va-Tran Systems, Inc.

Company Name/POC : Va-Tran Systems, Inc./James Sloan**Address :** 677 Anita St./Suite A/Chula Vista, CA 91911**Phone Number :** 619 423-4555**Fax Number :** 619 423-4604**Technology Maturity :** Commercial use experience**Performance History :** Contact vendor for performance history.

Comments : There are no limitations as far as dust removal is concerned. If there is extensive deposit of "soft material" like semisolid solder flux, grease or dirt, a spray of chemical material may be needed before or associated with the dry ice. If the contamination is very deep, a special nozzle may be used to penetrate the material or the dry ice can be used in a high velocity airstream to "cut and remove" the base material. The device is about 18" long and 3" in diameter, with a metal reinforced hose about 4' long. The Carbon Dioxide tank may be of varying size depending on whether the use is portable or fixed to one spot. For long term, large use, a system is provided that makes use of bulk, gaseous Carbon Dioxide and, liquifies it as needed. The system can be held in a person's hand during use. There is no requirement for a special booth or passerby protection. Calculations have indicated that the person using the device emits more Carbon Dioxide in exhalation than that produced by the Sno Gun. The gun is made with a series of nozzles so that it can get into "blind holes" as small as 0.020 of an inch (0.51 mm) in diameter. Larger areas (i.e., 2 meter mirrors) can be covered as fast as the gun can be moved. The dry ice spray can be 2 inches (5.1 cm) in diameter. The device would have to be tested on some of the surfaces that must be cleaned. Concrete cleaning at depth must be studied. Heavy coatings of grease or dirt might have to be removed by a spray of a solvent applied just before or at the same time as the dry ice. Hard materials are usually removed easily; soft or semi-solid substances may have to be attacked first by solvents.

Source of Information : TechCon

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Mechanical Surface Cleaning*

Technology Name: Cryogeneis

Application: On-site Ex-situ

Brief Description: Cryogenesis is the process which utilizes pellets of dry ice which are directed at a surface to be decontaminated. Upon impacting on the surface, the pellets of dry ice sublime, leaving only the removed contaminate for disposal. Cryogenesis have very effectively demonstrated its performance in nuclear decontamination.

Company Name/POC: Waste Minimization and Containment Corp./Jim Becker

Address: 2140 Scranton Road/Cleveland, OH 44113

Phone Number: 216 696 8797

Fax Number: 216 696-879

Technology Maturity: Commercial use experience

Performance History: The technology is used on a daily basis in an extremely wide range of industries. Specific information regarding individual customers/applications will be made available on an as-needed basis by Waste Minimization and Containment Corp.

Comments: Cryogenesis is a portable and completely pneumatic system and does not require any electrical service. A gaseous nitrogen supply hose is required to operate the system. Cryogenesis Model 1350-1 weighs only 350 pounds when empty (500 pounds when filled with dry ice). The dimension of the unit are 49.5"L x 22"W x 49"H. The only limitations are related to its ability to remove certain types of coating (paint) systems. However, work continues to use paint softeners without technology to speed up the paint removal process. Cryogenesis is an extremely easy system to use. The system is reliable, maintainable, easily serviceable, and user-friendly.

Source of Information: TechCon

CONTAMINANTS :

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

■ Petroleum Hydrocarbons

Radionuclides

 SVOC

Other Contaminant

Nonhalogenated VOC

■ **Halogenated VOC**

N/A

TECHNOLOGY TYPE : *Chemical Surface Cleaning*

Technology Name : Decontamination for Decommissioning

Application :

On-site

Other Application

Brief Description : Analogous with a previously developed process for operational reactors (LOMI); Bradtec Ltd, in conjunction with EPRI, have a new decontamination process for decommissioning reactor and chemical treatment plants. The process offers a dilute chemical application for the removal of radioactive oxides from the internal surfaces of a plant while minimizing waste volumes. The system is designed to achieve high DF;s and hence significantly reduce worker exposure. The process is new; the application technology is well tried and tested; (i.e., civil nuclear decontaminations).

Company Name/POC: Bradtec Ltd/George Elder

Address : University of the West of England/Cold Harbour Lane/Bristol BS 16 1QY, United Kingdom

Phone Number : 44 117 976 3937

Fax Number : 44 117 976 3892

Technology Maturity :

Bench scale testing, only

Performance History : Still at development stage.

Comments : Decon systems are flexible skid mounted units. Collaborating with the utility, the vendor supplies procedures, QA, equipment and operators. The utility supplies services and supervises interfacing.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Chemical Surface Cleaning***Technology Name :** Chemical Decontamination of Metals

Application : On-site Ex-situ
Off-site

Brief Description : The process involves treatment with a series of chemical reagents in tanks. The process is specifically designed to remove uranium, neptunium and technetium contamination from aluminum alloy and steel. The process is semi-automatic so that potential hazards to operators are minimized. Its application has allowed large tonnages of metal to be returned to commerce thus avoiding the need for the more expensive options of long-term storage or disposal to land burial.

Company Name/POC: British Nuclear Fuels plc/Janet Jackson**Address :** H242 Hinton House/Risley, Warrington Cheshire, England WA3 6AS**Phone Number :** 1925 832735**Fax Number :** 1925 83572**Technology Maturity :** Commercial use experience

Performance History : Several thousand metric tonnes of metal have been decontaminated and sold for recycle since the facility commenced operation in 1990.

Comments : The facility, which contains two identical treatment lines, each with five reagent tanks, served by overhead cranes, measures approximately 60m long x 20m wide x 7m high. The utilities required are domestic water, steam, electricity, compressed air and respirator air.

When steel is the metal to be decontaminated, it must be free from surface coatings or corrosion products for the process to have maximum effectiveness.

The plant can be operated remotely from the control room. Local effluent treatment by ion exchange is provided.

The process is fully developed and engineered to meet specific requirements at the site where decommissioning is in progress.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Chemical Surface Cleaning*

Technology Name : Fluorocarbon Surfactant Decontamination

Application : Ex-situ

Brief Description : The ESI process is designed to nondestructively remove radioactive particles bonded by secondary valence forces from the surfaces of complex parts. The part to be decontaminated is contacted with a fluorocarbon surfactant solution under conditions of shear, as in an ultrasonic bath or a low pressure spray system. Under these conditions, solid particles, including radioactive particles, bound to the subsurface by secondary valence forces, are suspended in the flowing fluorinated liquid. These particles are then removed from the process liquids by simple filtration, thus allowing these liquids to be recycled. After the desired level of decontamination has been achieved, the part is rinsed with surfactant free fluorocarbon rinse liquid and air dried. The fluorinated liquids used in the ESI process are not CFCs. They are nontoxic, nonflammable, and do not present a hazard to the ozone layer.

Company Name/POC: Entropic Systems, Inc./R. Kaiser

Address : P.O. Box 397/Winchester, Massachusetts 01890

Phone Number : 617 938-7588

Fax Number : 617 938-7589

Technology Maturity : Pilot plant testing

Performance History : Performance data are available.

The feasibility of using the ESI particle removal process to the nondestructive decontamination of nuclear equipment was demonstrated under the aegis of a Phase I SBIR program funded by the Nuclear Regulatory Commission (NRC). The fluorocarbon surfactant solutions used as a working media in the ESI process survived exposure of up to 10 mrad doses of gamma rays, and are thus sufficiently radiation resistant for use as decontamination media. Ultrasonic cleaning in perfluorinated surfactant solutions was found to be an effective method of removing radioactive iron (^{59}Fe) oxide particles from contaminated test pieces. Fifteen test assemblies were examined. Decontamination levels ranging from 88 percent to 100 percent (within experimental error) were obtained. For twelve of the fifteen assemblies tested, residual contamination levels were below the release level for fixed beta and gamma contamination of 1,100 decays/min/100 cm².

Comments : Radioactive particles suspended in the process liquids could be quantitatively removed by filtration through a 0.1 μm membrane filter, so that these process liquids can be recycled for further use. Projected economics indicate a pretax pay back time of 1 month for a commercial scale system. To date, experimental work has been limited to test pieces less than 10 cm in maximum dimension. However, there are no inherent technology limitations for decontamination of large scale industrial equipment. Site requirements to be determined.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Chemical Surface Cleaning***Technology Name :** Electropolishing with Acid Regeneration**Application :** On-site

Brief Description : Decontamination of steel components by electropolishing in phosphoric acid. High efficiency removal of surface contamination down to the free release level, e.g., 50,000 Bq/cm (squared) to less than 0.5 Bq/cm (squared) for unrestricted reuse of the material. Periodical regeneration of the phosphoric acid by precipitation of the dissolved material.

Company Name/POC: Kernkraftwerke Gundremmingen/Norbert Eickelpasch**Address :** Betriebsgesellschaft mbH/Postfach 3 00/D-89355/Gundremmingen, Germany**Phone Number :** 011 49 8224 78 2170 **Fax Number :** 011 49 8224 78 290**Technology Maturity :** Commercial use experience**Performance History :** Electropolishing:

1. Pilot-phase; 100 tons of contaminated material from the turbine hall in 1983.
2. Full scale operation; approx 2000 tons since 1984.

Acid regeneration:

Unrestricted reuse of phosphoric acid by regeneration since 1985.

Comments : Dimension of the workpieces determine the size of the decontamination basins.**Source of Information :** International TechCon

CONTAMINANTS :

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

■ Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

Halogenated VOC

☒ N/A

TECHNOLOGY TYPE : *Chemical Surface Cleaning*

Technology' Name : Pentek-600

Application :

On-site

Ex-situ

Brief Description : Removes surface contamination and oxidized surface layers from ferritic and stainless steels, lead, and other non-ferrous metals. Upon application, polymer dries, shrinks, and peels off of surfaces, encapsulating contamination within polymer matrix. Can replace grinding, high-pressure blasting, and strippable coatings. Waste volume is limited to a 10 mil thick film of plastic.

Company Name/POC: PENTEK, Inc./Eric Crivella

Address : 1026 Fourth Avenue/Corapolis, PA 15108-1659

Phone Number : 412 262-0725

Fax Number : 412 262-0731

Technology Maturity : Commercial use experience

Performance History : Pentek 600 polymers have been in commercial use for about 6 years. They have been deployed in a variety of applications including reactor refueling cavities, glove boxes, and lead bricks.

Comments : Curing of the material is sensitive to temperature & humidity. Best performance is obtained at room temperature and 50 - 75 percent humidity. The commercial material cannot be sprayed. Directly implementable using brush application or direct dipping into the product. Drying time is dependent on temperature and humidity, but is usually less than 24 hours. Production of commercial quantities of this product has presented a challenge. An experimental variation of the product (Pentek 620) has been produced in limited quantities for use in the decontamination of chemical warfare agents from field equipment. Its chief characteristics are its ability to be applied by a power spray and its ability to dry quickly.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Chemical Surface Cleaning*

Technology Name : Decontamination of Metal by Decontgel

Application : On-site Ex-situ

Brief Description : Decontamination of metal surfaces through the use of a fixotrope mix of acids. Because of the nonliquid (fixotrop, pestons) quality of the special decontgel it stays attached to vertical surfaces, thus allowing the chemical reaction to occur. After a reaction time of 2 hours the surface are cleaned by high pressurized water.

Company Name/POC: Richard Buchen GmPH/Dr. Jorg Unk

Address : Gawerbering 4 - 8/76149 Karlsruhe/Germany

Phone Number : 011 49 7247 20311

Fax Number : 011 49 7247 2189

Technology Maturity : Commercial use experience

Performance History : The technology was developed in 1992 and has since been used during decommissioning work at the nuclear research reactor FR 2 in Karlsruhe, Germany.

Comments : The use of the technology is limited by the hydrogen concentration in the room air. This limitation can be controlled by calculation of treated surfaces and measured during operation. The equipment is easy to operate.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant,
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Chemical Surface Cleaning***Technology Name :** Chemical Extraction**Application :** On-site Ex-situ**Brief Description :** Rust Remedial Servies has several proprietary chemical extractions that have been used in decontamination of surfaces.**Company Name/POC:** Rust Remedial Services/John Westcott**Address :** Clemson Technical Center, 100 Technology Dr./Clemson Research Park, Anderson, SC 29625**Phone Number :** 803 646-2413**Fax Number :** 803 646-5311**Technology Maturity :** Commercial use experience**Performance History :** Process has been succesfully applied commercially.**Comments :** Few or no challenges exist when applied to appropriate waste streams. Technology availability : Equipment for unit is available in the U.S. through Rust Remedial Services; however, Rust does not sell the equipment.**Source of Information :** TechCon

CONTAINERS/EQUIPMENT

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Chemical Surface Cleaning*

Technology Name : Ozone Decontamination Process (SODP)

Application : ☐ On-site ☐ Ex-situ

Brief Description : The process is used to decontaminate radioactive metallic surfaces and remove the activity. Since SODP will remove oxides and some microns of base material, levels below 1 Bq/g are received.

Company Name/POC: Studsvik RadWaste AB/Olof Andersson

Address : S-611 82 NYKOPING/Sweden

Phone Number : 46 155 22 15 20

Fax Number : 46 155 26 31 1

Technology Maturity : Commercial use experience

Performance History : Decontamination of: heat exchanger in Ringhals 2, PWR (1986). Decontamination factor ~10.
Two steam generators from Agesta HPWR (1993) to free release (greater than or equal to 1 Bq/g).

Comments : None.

Source of Information : International TechCon

CONTAMINANTS :

Pesticides/Herbicides

Heavy Metals

Explosives/Propellants

Petroleum Hydrocarbons

Radionuclides

Other Contaminant

Nonhalogenated VOC

☒ Halogenated VOC

N/A

TECHNOLOGY TYPE : *Recycle*

Technology Name : Catalytic Extraction Processing

Application :

On-site

Ex-situ

Off-site

Brief Description :

CEP uses the catalytic action of a molten metal bath to revert waste streams to their elemental constituents. Selective reactant addition allows controlled partitioning and the production of recovered resource streams, typically synthesis gas (CO and H₂), ferroalloys, and specialty inorganics. CEP is applicable to RCRA, TSCA, and radioactive wastes and process feeds of any physical form.

Company Name/POC: Molten Metal Technology, Inc./Dr. Victor Gatto

Address : 51 Sawyer Road/Waltham, Massachusetts 02154

Phone Number: 617 487-7642

Fax Number : 617 487-7870

Technology Maturity :

Field demo complete

Performance History :

Sandia: weapons components, bench scale, >99.99 percent DRE for organics.
International chemical manufacturer: biosludge, small commercial scale.
Major U.S. chemical manufacturer: polyaromatic hydrocarbons contaminated with metals; conversion to synthesis gas.
Over 10 successful customer demonstrations or feasibility analyses.

Comments :

Facility requirements for 4,200 tpy: 75' x 125' space; 40' height; liquid O2 and N2, natural gas; power, water: boiler feed, cooling, fresh, sewer; caustic for scrubber (feed component).
Radioactive components are contained in low-volume stable vitreous matrix suitable for final form disposal.

CEP is robust to a wide range of chemical and physical feeds.

Flexibility: organics and metals, all physical metal forms, all dimensions;

product Ease of Use: little up-front characterization required, minimal feed pretreatment/separation, generation;

Infrastructure: none required.

Destruction Removal Efficiencies (DREs) of RCRA wastes can exceed 99.9999 percent. Recovered products meet or surpass commercial specifications.

Key benefits of CEP for radioactive waste processing include: controlled partitioning of radionuclides; decontamination of products allowing recycle or reuse; minimal generation of secondary waste; containment of heavy radionuclides in a non-leachable vitreous matrix suitable for final form disposal; and ability to handle mixed waste.

Source of Information : TechCon

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Recycle***Technology Name:** Melting and Recycling of Radioactively and/or Chemically Contaminated Scrap**Application:** On-site Ex-situ
Off-site**Brief Description:** Contaminated scrap is brought to a melting plant and melted under controlled conditions. From the molten material, new shielding components, such as blocks, plates, doors, casks, etc. are produced for use in nuclear installations.**Company Name/POC:** SIEMPELKAMP GIESSEREI Gmbh & CO./Dr. Manfred Sappok**Address:** Siempelkampstrasse 45/D-47803 Krefeld, Germany**Phone Number:** 49 0 2151 894205**Fax Number:** 49 0 2151 89445**Technology Maturity:** Commercial use experience**Performance History:** In Germany: 8,000 tons since 1987
In Sweden: 2,000 tons since 1989
In the US: 6,000 tons since 1992
In France: 5,000 tons since 1992
In Chernobyl, a melting plant is in the planning phase (licensing procedure).**Comments:** Limitations include (1) maximum alpha, beta, gamma-activity: 1,000 Bq/g; (2) metal scrap, cuttable to size of 20'-containers. Melting plant is installed in combination with a foundry to produce cast iron containers or other recycling products. Melting technology has been in commercial use since 1987; reduces final repository volume; use of molten material for production of containers for final storage of high-level waste; low volume of secondary waste produced (maximum 5 percent); easy measuring of residual activity by taking samples from liquid material; separation of different materials in the melting process.**Source of Information:** International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Dust Control*

Technology Name : Long Duration Foam

Application : On-site Ex-situ

Brief Description : Rusmar Long Duration foam is applied over an emitting surface to control odors, VOC's, dust and other emissions. The foam creates a continuous barrier between the surface and the atmosphere. Rusmar Long Duration Foam Technology is very effective in controlling any emission. Long Duration Foam is utilized in place of soils, tarps and other cover materials to control odors, VOC's, dust, windblown emissions, etc. Long Duration Foam completely covers any surface to which it is applied and it will conform to irregular and vertical surfaces. Long Duration Foam can be applied quickly, easily and provides a superior barrier to emissions than soil or tarps. It is non-toxic, non-hazardous, non-flammable and biodegradable.

Company Name/POC: Rusmar Incorporated/Laura White

Address : 216 Garfield Avenue/West Chester, Pennsylvania 19380

Phone Number : 610 436-4314

Fax Number : 610 436-8436

Technology Maturity : Commercial use experience

Performance History : Rusmar Long Duration Foam has been used throughout the United States and abroad for a variety of applications including: remediation projects, Superfund projects, lagoon and pond closures. It has been used as odor control on a liquid surface, for dust and VOC's suppression, emergency response, vapor and odor suppression in industrial applications and erosion control and to prevent surface water infiltration on stock piled soils. Additionally, Long Duration Foam has been used for in transit odor control on sludge filled containers and dust control during demolition of asbestos contaminated buildings.

Comments : Some of the Long Duration Foam products require water to dilute the product prior to use. The water must have less than 300 PPM of hardness. The smaller Pneumatic Foam Units are trailer mounted and require a piece of equipment to tow them around the site. During months of freezing weather, all Long Duration Foam products must be protected from freezing. The Pneumatic Foam Units are completely self contained and require no outside source of power. During freezing weather, a source of electricity is required to operate the freeze protection system on the larger Pneumatic Foam Units. There are no application temperature limitations on Long Duration Foam Products. Care must be exercised when applying AC-900 Series products with respect to weather, a heavy rain will not allow the membrane to form. After the first day, AC-900 Series products are unaffected by weather, i.e., rain, snow, wind, etc. Long Duration Foam is easily applied utilizing a Rusmar Incorporated Pneumatic Foam Unit. Long Duration Foam is a single component material requiring non chemical mixing and no post application cleanup. The Pnuematic Foam Units are simple and easy to operate; they require no special training. Long Duration Foam is available with durations ranging from a few hours to six months. The Pnuematic Foam Units are available in a variety of sizes ranging from a small skid mounted unit to a large self propelled track mounted unit. These units are available for purchase or rental. Long Duration Foam and Pnuematic Foam Units have been in use in the field for the past nine years. They do not face any general challenges. Long Duration Foam can be applied at a rate of 500 square feet per minute and requires only one operator.

Source of Information : TechCon

 

Vapor Phase

Treatment

Vapor Phase

Treatment

CONTAMINANTS :

- ☒ Pesticides/Herbicides ☐ Heavy Metals ☒ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Chemical Reduction/Oxidation***Technology Name :** Thermo Catalytic Cracking**Application :** On-site Ex-situ**Brief Description :** The technology uses a cheap but very reliable catalyser, which operates at approximately 600 degrees C to reduce molecules (e.g., nerve agents, other toxic gases or vapors). It might need a pyrolysisator in front to generate gases and vapors.**Company Name/POC:** Alba Industrie Umweltschutzservice GmbH/Dr. K. Faber**Address :** Rehrhoferweg 160/D29625 Munster, Germany**Phone Number :** 051 929 63212**Fax Number :** 051 929 6331**Technology Maturity :** Pilot plant testing**Performance History :** The technology has run successfully for one year. It was used to destroy chemical weapons (e.g., in British hand grenades, but also Lewesite, Adamsite).**Comments :** 30 Kg/h throughput.**Source of Information :** International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Dual Phase Extraction*

Technology Name : Vacuum Vaporizer Well

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : The Unterdruck-Verdampfer Brunnen (UVB) is an in situ system and uses a combination of chemical, physical and biologic processes. A UVB system consists of a specially adapted groundwater well, a negative pressure stripping reactor, an aboveground mounted blower, and a waste air decontamination system such as disposable granular activated carbon filters.

Company Name/POC: IEG - Industrie Eng./Marc R. Sick

Address : Lilienthalstr.6/D72770 Reutlingen, Germany

Phone Number : 49 7121 506665

Fax Number : 49 7121 57923

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

~12 cases in Germany; 10 reached closure within 7 years of operation.
~30 cases up and running in the U.S. since 1992.

Comments : This technology was accepted into the SITE Demonstration Program in 1993. The 6-month demonstration at March Air Force Base, California was to be completed in November 1993. Final report due in June 1995.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Dual Phase Extraction*

Technology Name : Vacuum Enhanced Pumping (VEP)

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : The use of vacuum dewatering or vacuum enhanced pumping techniques is particularly beneficial in moderate to low permeability sediments consisting of silt and clayey material. Vacuum enhanced pumping also induces the volatilization of contaminants from the soils and aquifer material by vapor flow from the vadose zone and dewatered sediments. Vacuum Enhanced Pumping (VEP) uses a modification of vacuum dewatering techniques to extract groundwater, soil vapors and nonaqueous phase liquids from the subsurface. The IT VEP system uses passive airlift techniques and either a vacuum blower or pump to extract the fluids from the subsurface. This approach eliminates the need for electrical or pneumatic pumps in the wells, greatly increases the flow rate of fluids into the well and accelerates the remediation process.

Company Name/POC: IT Corporation/Mike Capps

Address : 312 Directors Drive/Knoxville, Tennessee 37923

Phone Number : 615 690-3211

Fax Number : 615 690-3626

Technology Maturity : Commercial use experience

Performance History : Vacuum Enhanced Pumping or vacuum dewatering techniques are being applied by numerous remediation contractors. IT has completed or is implementing VEP systems at over 30 sites during the last two years. IT has several pilot test systems that are used at locations throughout the United States. The VEP approach is particularly advantageous at sites with free phase gasoline or with relatively low permeability soils. VEP's performance is far superior to conventional gravity pumping systems with low fluid yields and significant mechanical problems.

Comments : The only limitation to this approach is the local regulatory requirements for air and water discharges. If the air discharging from the vacuum system has high concentrations of hydrocarbons or other VOCs, then either vapor phase carbon, thermal or photocatalytic oxidation treatment may be required. Groundwater can be discharged directly if an NPDES permit is obtained or to a POTW. Groundwater can also be reinfiltrated on site if conditions and regulations permit. Treatment of groundwater is usually with low profile tray aeration and carbon polishing if needed.

Source of Information : VISITT 3.0

CONTAMINANTS :☒ Pesticides/Herbicides☒ Heavy Metals☒ PCB☒ Explosives/Propellants☒ Petroleum Hydrocarbons☒ Radionuclides☒ SVOC☒ Other Contaminant☒ Nonhalogenated VOC☒ Halogenated VOC☒ N/A**TECHNOLOGY TYPE :** *Bioreactors***Technology Name :** FyreZyme**Application :**

On-site

Ex-situ

Brief Description :

FyreZyme is a multifactorial liquid (aqueous) agent, combining a rich source of bacterial growth enhancing agents, extracellular enzymes, and bioemulsifiers. Any off gas generated can either be collected and reinjected into the bioremediation bed or it can be bubbled through a FyreZyme solution. Eliminating volatile organic compounds (VOC) releases may require "polishing" with an activated charcoal filter, whose useful life will be increased with the decreased VOC loading. It can be used as add-on to the soil venting, sparging, bioventing, fixed-film bioreactors, slurry phase treatment.

Company Name/POC: Ecology Technologies International, Inc./Mr. Pete Condy**Address :** 1225 So. 48th Street/Suite 2/Tempe, Arizona 85281**Phone Number :** 602 985-5524**Fax Number :** 602 985-298**Technology Maturity :** Commercial use experience

Performance History : FyreZyme is being used to entrap and oxidize off-gas volatile organic compounds (VOC), with greater than 90 percent reduction in a low-cost system, reducing the cost of compliance with strict air standards.

Comments :

Main limitations are those which limit bacterial growth such as temperature extremes, pH below 3 or above 10, and bactericidal contaminants in high concentrations. If temperature is above 100 degrees Fahrenheit, the shelf life of FyreZyme may be shortened from 5 years to 2 years. Enzyme poisons must be flooded with FyreZyme before bioremediation will ensue.

Source of Information : VISITT 3.0

CONTAMINANTS : ☐ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☒ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Filtration*

Technology Name : Alka/Sorb Process

Application : On-site Ex-situ

Brief Description : The Alka/Sorb gas cleaning system comprises the following sequence:
 1) Gas cooling, if necessary.
 2) Injection of dry hydrated lime for primary removal of acid gas and metal oxide removal.
 3) Injection of activated carbon for enhanced removal of VOCs, dioxins, and mercury.
 4) Fabric filtration.
 5) Zero liquid discharge scrubbing with recycle HCl acid for removal of residual mercury and dioxins.
 6) Optional caustic wet scrubbing for removal of residual VOC, mercury, cadmium, dioxin, and SOx removal.

Company Name/POC: BECO Engineering Co./B.J. Lerner

Address : 800 Third Street/P.O. Box 443/Oakmont, Pennsylvania 15139

Phone Number : 412 828-6080

Fax Number : 412 828-6144

Technology Maturity : Commercial use experience

Performance History : The process yields compliance with the most stringent state standards for all emissions, including dioxin/furans at 0.1 nanograms per dry standard cubic meter (ng/DSCM), and mercury at less than 50 micrograms (ug) per DSCM. The system is low-cost and compact, and may be installed indoors or outdoors. Alka/Sorb scrubbing units typically range in price from \$200,000 to \$300,000 for every 1,000 pounds per hour (lb/hr) of waste incineration capacity.

Comments : Contaminant identified as: Dioxins

The Alka/Sorb dry/wet process sequence will not operate on hot gases (greater than 500 degrees Fahrenheit) and generally requires an upstream gas cooling device. The zero-liquid-discharge version of the process cannot be implemented when there is a high load of sulfur oxides in the exhaust gases. The original Beco Alka/Sorb dry/wet process sequence was developed in 1985 for emission control on a hazardous fume incinerator installation.

Source of Information : VISITT 3.0

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Filtration***Technology Name :** In-Situ Pulsed Jet Cleaned Gas Filtration**Application :** On-site Ex-situ

Brief Description : Pulsed Jet Gas Filtration is a means by which gas streams (including ventilation streams) may be filtered to very fine levels; and the filters be self cleaned in-situ so that only the debris & contaminant removed from the gas stream need be disposed of, there being no need to dispose of the filters themselves. The filters offer very long service life and can be designed to work in extreme conditions of both temperature and chemical aggression.

Company Name/POC: Fairey Microfiltrex Ltd./Chris Chadwick**Address :** Fareham Industrial Park Unit 40/Fareham Hampshire/PO16 8XG, U.K.**Phone Number :** 1329 285616**Fax Number :** 1329 822 44**Technology Maturity :** Commercial use experience

Performance History : Fairey Microfiltrex has installed pulsed jet cleaned gas filters in UK nuclear power stations, in fuel manufacturing, conversion and reprocessing sites and have a great deal of experience in the design and application of this type of filter into critical nuclear applications where extremely fine separation, reliable operation and minimal volume for disposal are paramount.

Comments : 1000 C max operating temp; 98 percent removal of air particles above 0.4 microns; life limited by radiation accumulation over time. Highly adaptable technology capable of minimizing the size of filtration equipment and the volumes sent for disposal for almost any filtration application. Cleanability is fundamental to the success of the equipment. Fairey Microfiltrex Ltd offers specially designed, self cleaning filtration equipment capable of operating in extreme conditions of temperature and chemical aggression. Typical duties include:

- Protection of HEPA filter banks, allowing the extension of their life indefinitely and recovering the dust that would otherwise bring about their disposal.
- High temperature furnace off gas filtering.
- Waste drum venting in storage.
- Chemically aggressive gas filtration.
- Critical gas filtration applications where absolute integrity & very fine filtration are required.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Filtration*

Technology Name : Acoustic Barrier Particulate Separator

Application : Ex-situ

Brief Description : The acoustic barrier particulate separator separates particulates in a high-temperature gas flow. The separator produces an acoustic waveform directed against the gas flow, causing particulates to move opposite to the flow. The particulates drift to the wall of the separator, where they aggregate with other particulates and precipitate into a collection hopper. The acoustic barrier separator differs from other separators in that it combines both high efficiency and high-temperature capability.

Company Name/POC: General Atomics/Anthony Gattuso

Address : 3550 General Atomics Court/San Diego, California 92121

Phone Number : 619 455-2910

Fax Number : 619 455-3679

Technology Maturity : Pilot plant testing

Performance History : The acoustic barrier concept was demonstrated successfully in bench-scale tests with coal flyash and various other particulates. General Atomics-Nuclear Remediation Division was accepted into the SITE Emerging Technology Program in 1993. The principal objective of this project will be to design, construct, and test a pilot-scale acoustic barrier that is suitable for parallel arrangement into larger systems. The separator will be designed for a flow of 300 cubic feet per minute and will be tested using a simulated flue gas composed of heated gas and injected dust.

Comments : The technology can treat off-gas streams from thermal desorption, pyrolysis, and incineration of soil, sediment, sludges, other solid wastes, and liquid wastes. The process can agglomerate and remove particulates smaller than one micrometer only if a sufficient number of particulates are present to allow collisions between particulates in the acoustic field.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Filtration***Technology Name :** H. Krantz-TKT GmbH**Application :**

On-site

Ex-situ

Brief Description : Gas cleaning in Nuclear and non nuclear installations iodine sorption filters (charcoal and molecular sieves). Aerosol filtration (recleanable glass fiber filters, metal fiber filters for accident situations, high temperatures, radiation, strong conditions like steam, humidity and loading).

Company Name/POC: H. Krantz-TKT/Martinsteg, Hans**Address :** P.O. Box 20 40/52022 Aachen, Germany**Phone Number :** 0241 434 371**Fax Number :** 011 4924 1434 59**Technology Maturity :** Commercial use experience

Performance History : All German Nuclear Power Plants are equipped with metal fiber filter systems as a protection against over pressurization of the containments.

Comments : All installed systems are installations for backfitting NPP against accidents stronger than the design basic accidents. They are installed in different types of Power Plants for different gas flows and different systems. The smallest module type can pass each standard door. The physical limits are greater than or equal to 500 Grad C; unlimited radiation; no limit in humidity, filter units are also excellent droplet separators. The system pressure can reach 5 or more bar; the differential pressure may go to 1 bar. DOG-VOG-Filter systems for Reprocessing plants are available.

Source of Information : International TechCon

CONTAMINANTS :

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

Petroleum Hydrocarbons

Radionuclides

 SVOC

Other Contaminant

Nonhalogenated VOC

☒ Halogenated VOC N/A

TECHNOLOGY TYPE: *Ion Exchange*

Technology Name : Purus A2000 Air Treatment System (PADRE)

Application :	On-site	Ex-situ
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Brief Description : The technology is based on the utilization of specialized polymeric resins to adsorb VOCs in the vapor phase. The process involves one bed adsorbing VOCs from the influent air, while another bed is undergoing a desorption cycle. The desorption cycle utilizes heat and vacuum, at which time all organic contaminants trapped in the adsorbent material are removed, condensed and transferred as a liquid to a storage tank where they are easily reclaimed. The beds are automatically switched back and forth between adsorption and desorption cycles with an on-board controller system. The system can provide 99 percent plus removal rate when the system is operated and maintained to Purus specifications.

Company Name/POC: Purus/Tod Wollersheim

Address : 2713 North First Street/San Jose, CA 95134

Phone Number : 408 955-1000

Fax Number : 408 955-1010

Technology Maturity : Commercial use experience

Performance History : Contact company for performance history data.

Comments : The technology is especially useful in situations where long-term treatment capabilities are needed. The technology has distinct advantages over several other commonly utilized technologies under given circumstances. In comparing our resin adsorption technology to standard disposable carbon adsorption systems, there are several advantages that can translate into significant cost savings. First, the cost of removal and disposal of spent carbon canisters can become astronomical if remediation is long term (>1 year). Second, the potential liability imposed when sending spent carbon off site. When comparing regenerative systems, capital cost is generally less; steam isn't used to regenerate the resins; therefore no wastewater is generated that needs treatment. Also, the recovered product is much purer (very little water moisture is condensed), thus making the recovered product more likely to be recycled. The third commonly used treatment is thermal oxidation. These units can be extremely costly in up-front capital cost, plus monthly operating cost can prove to be extremely high when fuel supplement is need to run the unit. The thermal treatment has no recycling or reuse benefits associated with it and is inappropriate for treatment of compounds with low BTU value and chlorinated compounds.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Ultraviolet Oxidation*

Technology Name : Photocatalytic Oxidation (PCO) of VOCs in Air

Application : On-site Ex-situ

Brief Description : Photocatalytic oxidation (PCO) uses ultraviolet light and a titanium dioxide (TiO₂) catalyst to destroy volatile organic compounds (VOC) in air streams. The PCO treatment system consists of the PCO reactor to destroy the VOCs and acid gas scrubber to remove any HCl from chlorinated solvents, exhaust blower, and other system components such as monitoring instruments, demisters, etc. The PCO process is a continuous process which can use either UV lights or solar light to activate the TiO₂ catalyst coating. Exhaust from the PCO reactor goes to an acid gas scrubber for removal of HCl or any Cl₂ generated during the oxidation of chlorinated solvents. A caustic scrubbing solution neutralizes the HCl and Cl₂ for effective scrubbing and pH control. The scrubbed gas stream passes through a demister prior to discharge to the atmosphere.

Company Name/POC: IT Corporation/Richard Miller

Address : 312 Directors Drive/Knoxville, Tennessee 37923

Phone Number : 615 690-3211

Fax Number : 615 690-362

Technology Maturity : Commercial use experience

Performance History : PCO has been the subject of research for more than twenty years. The technology is currently being demonstrated in commercial scale equipment by developers. Several demonstration projects have been completed or are in the final planning stages. VOC destruction is rapid and greater than 99 percent with the VOCs being oxidized to carbon dioxide and water and hydrochloric acid (HCl) and trace chlorine (Cl₂) if chlorinated compounds are present.

Comments : Technical limitations for application of PCO technology include: the contaminant must have sufficient volatility to be in the gas-phase; the contaminant must be capable of oxidation or reduction on the activated TiO₂ catalyst; the destruction rate for the contaminant is compound specific (i.e., TCE is destroyed very rapidly but CCl₄ is very slow); the process needs both oxygen and water vapor.

Source of Information : VISITT 3.0

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Ultraviolet Oxidation***Technology Name :** Reductive Photo-Dehalogenation**Application :** Ex-situ

Brief Description : The process converts volatile halogenated hydrocarbons to less halogenated or fully dehalogenated materials by a photo-initiated reaction utilizing ultraviolet light to cleave halogen atoms. These atoms under a reducing atmosphere, participate in chain-branching reactions leading to dehalogenated compounds. There are three unique aspects of this technology: 1) reducing rather than oxidizing atmosphere, 2) photochemical initiation and moderate temperature, and 3) capability of both partial or complete dehalogenation, as required.

Company Name/POC: M. L. Energia, Inc./Dr. Moshe Lavid**Address :** P.O. Box 470/Princeton, New Jersey 08542**Phone Number :** 609 799-7970**Fax Number :** 609 799-0312**Technology Maturity :**

Bench scale testing, only

Performance History : The technology has been successfully demonstrated at bench-top scale for aliphatic chlorocarbons, halons and freons. Treated compounds include 1,1,1-trichloroethane, trichloroethylene, dichloroethylene, chloroform, carbon tetrachloride, dichloromethane, CFC-12, Halon 1211, and CFC 113. Pilot scale testing was scheduled for 1992.

Comments :

There are two major advantages of this technology over other chlorocarbon treatment technologies. Unlike granular activated carbon condensation and membrane separation, the process de-toxifies waste streams rather than merely absorbing or concentrating the pollutants. Second, treatment occurs under reducing conditions, thus avoiding evolution of CO₂, CO and poisonous oxychlorocarbons, as in incineration. The process operates in the gas phase and is limited to halogenated compounds.

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Ultraviolet Oxidation*

Technology Name : Titanium Dioxide Photocatalytic Treatment Systems

Application : On-site Ex-situ

Brief Description : Removes and destroys organic pollutants in air and water.
 Fixed TiO₂ semiconductor and UV light generate hydroxyl radicals which readily attack and destroy organic pollutants.
 Typical VOC removal in air is 1200 ppm TCE, PCE, removal at 50 CFM; 7.7 kW system.
 Typical VOC removal in water - BTEX destruction nominally 25 ppm/minute retention time.

Company Name/POC: Matrix Photocatalytic, Inc. (formerly NuTech)/Brian Butters

Address : 22 Pegler St./London, Ontario, Canada N5W 4C8

Phone Number : 519 660-8669

Fax Number : 519 660-852

Technology Maturity : Field demo complete

Performance History : 23 units produced to date
 Specific customer information is proprietary (contact Matrix Photocatalytic, Inc.)
 Successful pilot test at Savannah River for soil vapor extraction

Comments : Limitations include (1) Flood rates greater than: air 1000 CFM, water 100 GPM;
 (2) certain organic compounds are refractory and take extensive time to break down

Equipment is very simple and easy to install (one man, 4 hours)
 Uses common hand tools
 Maintenance procedure is easy to follow and only required every 5000 hours
 Equipment is very mobile and can easily be moved from site to site
 Equipment is modular in construction, therefore can easily be increased/decreased as flow rates vary over time

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Biofiltration*

Technology Name : Off-Gas Treatment

Application : On-site Ex-situ

Brief Description : Bohn Biofilter Corp. (BBC) has developed portable biofilters to degrade the volatile organic chemicals (VOC) and associated odors removed from contaminated soils by soil vapor extraction. Biofilters utilize the porosity and sorptive properties of soil, compost, and other organic media to remove pollutants as contaminated air flows through the bed. The sorbed gases are continually biodegraded to carbon dioxide and water. The oxygen, moisture and nutrient conditions of biofilters optimize the degradation rates. The degradation continuously regenerates the bed's sorption capacity.

Company Name/POC: Bohn Biofilter Corp./Dr. Hinrich Bohn

Address : P.O. Box 44235/Tucson, Arizona 85733-4235

Phone Number : 520 621-7225

Fax Number : 520 621-1647

Technology Maturity : Commercial use experience

Performance History : Bohn Biofilter has been in use at more than 20 permanent beds in the United States, ranging in flow rates from 200 to 300,000 cubic feet meters (cfm). Permits for biofiltration have been obtained in Arizona, California, Georgia, Illinois, Michigan, Minnesota, Mississippi, Oregon, New York, Texas, Wisconsin, and elsewhere. More than 500 permanent biofilters are operating in Western Europe and Japan.

Comments : The factors that limit biofiltration are the VOC's inherent biodegradability, temperature and moisture content of the input gas, and residence time of the VOC in the biofilter bed. The slower degradation rates of hydrocarbon VOC's means larger biofilter beds per unit of air flow. The operating range of biofilters is 40-140 degrees Fahrenheit. Microbes require high moisture content in biofilter beds, equivalent to >99 percent relative humidity in the air flowing through the beds.

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Biofiltration***Technology Name :** AEROFERM (R) - Biofilter**Application :** ☒ On-site ☒ Ex-situ**Brief Description :** Vapor-phase organic contaminants are pumped through a bark bend and sorb to the bark surface where they are degraded by microorganisms. Optimal conditions must be provided to microorganisms in order to support the adapted strains for preferential degradation of contaminants.**Company Name/POC:** Umweltschutz Nord GmbH/Hans-Peter Ratzke**Address :** Industrie Park 6, 27767 Ganderkesee/ Germany**Phone Number :** 49 4222 47 106**Fax Number :** 49 4222 47 142**Technology Maturity :** Commercial use experience**Performance History :** Contact company for performance history.**Comments :** Maximal concentration of contaminants 1 gm/cu m. Aeroferm (R) as a basic biological treatment technology that needs an adaption period of a few weeks. Aeroferm (R) is an exhausting air treatment technology.**Source of Information :** International TechCon

CONTAMINANTS :		☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
	☒ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant	
	☒ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A		
TECHNOLOGY TYPE : <i>Membrane Separation</i>					
Technology Name :		Off-Gas Treatment			
Application :		Ex-situ			
Brief Description :		Compact Membrane Systems, Inc. has developed a family of patented perfluoromembranes that can concentrate dilute VOC streams and significantly lower the cost of incineration or other abatement or recovery process. The membrane that concentrates VOCs can be used in streams (i.e. air sparging, pyrolysis, soil vapor extraction, thermal desorption, thermally enhanced recovery in situ).			
Company Name/POC:		Compact Membrane Systems, Inc./Dr. Stuart Nemser			
Address :		325 Hampton Road/Wilmington, Delaware 19803			
Phone Number :		302 984-1762	Fax Number :		302 984-1763
Technology Maturity :		Bench scale testing, only			
Performance History :		These perfluoromembranes have been demonstrated as thick films in the lab. In order to be cost/performance efficient, thin films must be fabricated and evaluated commercially. The company was in the process of doing this evaluation in 1994.			
Comments :		Unlike carbon adsorption, the membrane process has no VOC upper limit, no limit to inlet temperatures up to 130 degrees centigrade, no limit to relative humidity, no limit due to reactivity with organic acids, aldehydes, ketones, and hydrolyzable esters, and no maintenance problems since there are no moving parts. Although the perfluoropolymer is expensive (over \$1,000/lb) this is not a problem in membrane systems. This is because the thin films that are fabricated cost only a few pennies per square foot and the flows per square foot are so high that the costs are very small.			
Source of Information : VISITT 3.0					

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Membrane Separation*

Technology Name : Membrane Vapor Separation

Application : On-site Ex-situ

Brief Description : MTR's VaporSep system removes VOCs from airstreams. Separation is done by organic-permeable polymer membranes contained in durable modules. Permeate is a concentrated VOC stream; residue is clean air to be vented. Depending on the VOC, 95-99% removal is achieved. Alternative to activated carbon filtration.

Company Name/POC: Membrane Technology & Research, Inc./Marc Jacobs

Address : 1360 Willow Road/Suite 103/Menlo Park, California 94025-1516

Phone Number : 415 328-2228

Fax Number : 415 328-658

Technology Maturity : Commercial use experience

Performance History : Commercial: Vinyl chloride monomer (Goodyear) - recovery during PVC manufacture. - CFC-11 and CFC-12 drum filling operation - CFC-12 - HCFC-123 - recovery during film drying. Pilot systems: Gasoline, CFCs, HCFCs, TCE, CCl₄, CHC13.

Comments : Most cost-effective range: 1,000 ppm to saturation VOC concentration - Less concentrated streams can be treated - Economics depend on availability of other options and value of recovered material. Modular: sized for application - Microprocessor controlled pre-programmed - minimal operator involvement - Few moving parts (pumps, compressor) - MTR can provide engineering support.

Source of Information : TechCon

CONTAMINANTS :

- ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Oxidation***Technology Name :** Two Stage Absorption Integration Reaction (AIR-II)**Application :** Ex-situ

Brief Description : KSE's innovative off-gas emission control technology, also known as the AIR-II process, employs two stages: a liquid phase absorption process and a photocatalytic oxidation process. The first stage, the liquid absorption process, employs a proprietary solvent to remove dilute concentrations of contaminants from gas streams. The second stage of the AIR-II process employs a proprietary catalyst to promote the photocatalytic oxidation of chlorinated hydrocarbons by UV irradiation.

Company Name/POC: KSE, Inc./Dr. Charles W. Quinlan**Address :** 665 Amherst Road/Sunderland, Massachusetts 01375 - P.O. Box 368/Amherst, Massachusetts 01004**Phone Number :** 413 549-5506**Fax Number :** 413 549-5788**Technology Maturity :** Bench scale testing, only

Performance History : The AIR-II process has been shown to be feasible through bench-top testing in the laboratory. Laboratory feasibility studies have demonstrated complete destruction of TCE, PCE and toluene among other halogenated volatile organic compounds (HVOC) and VOCs.

Comments : The choice between using either stage alone, or the integrated two-stage process, depends on the project objective (e.g., recovery versus destruction), and on the specific application. It is expected that the first stage will find application for large volume dilute streams. The second stage can be used alone for other applications where the absorber is not required conceptually; the liquid absorption stage will compete with adsorption on solids such as carbon or molecular sieves.

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Oxidation*

Technology Name : Catalytic Oxidation

Application : On-site

Brief Description : This catalytic oxidation technology prevents an air contamination problem after soil or groundwater remediation. It is typically used behind soil vapor/vacuum extraction (with or without steam injection), behind stripping columns, or behind bioremediation scrubbers -- or any potentially contaminated air stream. The catalytic oxidizer will oxidize airborne/steam-carried volatile organic compounds to carbon dioxide (CO₂), water vapor (H₂O), and other products of thorough combustion. It utilizes a nonprecious metal catalyst that is not fouled or poisoned. Typical destruction efficiencies are 95-99.99%.

Company Name/POC: Lopata Technical Service Corp./Jim Lopata

Address : 1130 N. Dearborn St./Suite 1702/Chicago, Illinois 60610

Phone Number : 312 280-1574

Fax Number : 312 951-048

Technology Maturity : Commercial use experience

Performance History : Performance Data are available.

The company has over 50 operating/commercial field units. Contaminants include (but are not limited to): chlorinated hydrocarbons (CCl₄, TCE, vinyl chloride monomer, et al.), gasoline, BTEX (benzene, toluene, ethyl benzene, xylene) solvents (MEK, acetone, Stoddard Solvent, UM&P, mineral spirits, et al.); organo-metallic compounds (tin-butyl stearate, lead-organo compounds), and jet fuel.

Comments : The equipment is very easy to operate -- similar to a hot water heater, gas-fired furnace, or boiler. Typically, the two days of personnel training by the ARI Technologies start-up engineer for a "normal" maintenance worker or engineer is all that is required.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Electron Beam*

Technology Name : Off-Gas Treatment

Application : On-site Ex-situ

Brief Description : The Zapit Processing Unit (ZPU) is a sophisticated yet technologically well-established device which generates high-energy beams of electrons. When electrons are directed at volatile organic chemicals (VOCs), the stream of high-energy electrons creates free radicals that break down chemical bonds. The resultant energetic interactions can reduce the concentration of toxic contaminants by 99.99 percent or more in many applications. The final products of the Zapit System chemical transformation process are water, carbon dioxide, and salt.

Company Name/POC: Zapit Technology, Inc./Scott Hartung

Address : 2880 Lakeside Drive/Suite 320/Santa Clara, California 95054

Phone Number : 408 986-1700

Fax Number : 408 986-0222

Technology Maturity : Pilot plant testing

Performance History : Zapit has previously conducted treatability studies at McClellan AFB and Edwards AFB, where it will conduct a pilot-scale demonstration test under the U.S. EPA SITE Demonstration Program. The current prototype was to be flow-tested at the University of Tennessee Space Institute (UTSI) from November 1993 through March 1994.

Comments : The Zapit Processing Unit is designed for a variety of market applications including groundwater decontamination, soil decontamination, air pollution control, mixed nuclear waste treatment, industrial process waste treatment, and carbon regeneration. For successful processing through the ZPU, a waste stream must be in the vapor phase at near ambient pressure, less than 400 degrees Fahrenheit, and relatively free of particulate matter.

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Other**Technology Name :** Sorbathene/Solvent Vapor Recovery Unit**Application :** On-site Ex-situ**Brief Description :** Unit is specifically designed and engineered to each application to capture, collect, and condense various vapor emissions for recycle, incineration, or offsite disposal. Units have abatement removal efficiency of 98.5 to 99.9 percent. System operates through the pressure swing adsorption process. Meets all U.S. EPA regulations.**Company Name/POC:** DOW Environmental/C.J. Davenport**Address :** 15204 Omega Dr./Suite 200/Rockville, MD 20850**Phone Number :** 713 978-3107**Fax Number :** 713 978-295**Technology Maturity :** Commercial use experience**Performance History :** More than 17 units in operation as of September 1993. Average unit capacity of 300 CFM. All units have achieved anticipated success with minimal problems. The process is very flexible and applicable to remote locations and adapts readily to common interruptions and surges (John Driscoll - (318) 491-4466).**Comments :** Limited only to the recovery of solvent vapor emissions. Process is very flexible. It requires minimal personnel and organizational infrastructure. No unusual personnel skills are required to implement the system.**Source of Information :** TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : Other

Technology Name : RECLAIM (TM) In Situ VOCs Partitioning/Extraction

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : "RECLAIM" passive remediation is accomplished by exposing "RECLAIM" porous polymer (proprietary material) to solution-phase and/or vapor-phase volatile organics. This exposure is most often achieved through the placement of stainless mesh containers that hold the spherical beads of "RECLAIM" polymer as a unit ("canister") in monitoring or recovery wells that access VOC-contaminated soil, groundwater, or both. "RECLAIM" is an extremely hydrophobic material, very stable chemically and thermally. It adsorbs and concentrates VOCs based on partial pressures available, achieving concentrations as much as 2,000 times greater on the polymer body than in the atmosphere of the well.

Company Name/POC: Environmental Fuel Systems, Inc./Cal Chapman

Address : P.O. Box 1899/709 Main Street/Bandera, Texas 78003

Phone Number : 210 796-7767

Fax Number : 210 796-7484

Technology Maturity : Commercial use experience

Performance History : The company has performed "RECLAIM" service commercially at eighteen sites with VOC contamination in soil and/or groundwater for periods up to seven months. TPH and BTEX levels have been reduced provided no new contaminants have been introduced. The radius of influence for the RECLAIM canister has been estimated based on weights of fuel residues recovered, and periodic TPH and BTEX measurements through the treatment time frame. It appears that well grids of 40 feet are sufficient for sandy soil/water clean-up; well grid spacing tightens with lower permeabilities. At sites still dispensing fuel, a number of spills and leaks have been isolated and products often identified through gas chromatographic testing of condensates.

Comments : "RECLAIM" passive remediation is limited by the permeability of geologic structures, concentrations and vapor pressures of contaminants available, and hydraulic gradient. As these decrease, the rate of recovery decreases (as is the case with all clean-up methods). The service is labor- and travel-intensive; as a technician must provide periodic service and support at a site on a periodic basis (as with other approaches). When comparing rates of recovery of the passive "RECLAIM" approach for active methods such as vapor extraction or groundwater pumping and treatment, "RECLAIM" is usually found to be a slower process, but it is much less expensive. "RECLAIM" is only effective with organics.

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Other**Technology Name :** Mercon (TM)**Application :**

Other Application

Brief Description : Mercon (TM) is a patented liquid mercury vapor suppressant designed to stop and absorb mercury vapors. The chemical process utilized creates a mercuric salt or sulfide. The reagents react with the metal and absorb any ambient vapor. Mercon (TM) products have the ability to stop and absorb any methylation in water. Mercon (TM) products are currently used in commercial and industrial maintenance and remediation. The dilution factor of Mercon (TM) can be adjusted to fit different mercury problems.

Company Name/POC: EPS Environmental, Inc./Noel Spindler**Address :** 520 Victor Street/Saddle Brook, New Jersey 07663**Phone Number :** 201 368-7902**Fax Number :** 201 368-852**Technology Maturity :** Commercial use experience

Performance History : EPS Environmental, Inc. is currently working with many different industrial and medical companies to help solve their mercury contamination problems. EPS Environmental is bench testing and assimilating information and proposals to do a full-scale soil remediation of a heavily contaminated mercury site in northern New Jersey. Additional studies are being conducted on the eventual remediation of various estuaries with high mercury content. Several studies are being conducted for private clients with regard to contaminated sludges and bottom and fly ash, as well as various industrial maintenance programs. The company has not found a formulation of mercury contamination that cannot be handled at this time.

Comments : The Mercon (TM) product is not effective in soils. EPS Environmental has developed another technology called "Quicksilver" that specializes in remediation of soils, sludges, etc.

Source of Information : VISITT 3.0

Free Product

Treatment

Free Product

Treatment

CONTAMINANTS :

Pesticides/Herbicides

Heavy Metals

Explosives/Propellants

■ Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

☒ Halogenated VOC

N/A

TECHNOLOGY TYPE : *Chemical Reduction/Oxidation*

Technology Name : Light Activated Reduction of Chemicals (LARC)

Application :	On-site	Ex-situ
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Brief Description : LARC is a patented photochemical process (U.S. Patent No. 4, 144, 152) which uses ultraviolet light and an optimized reducing environment to dehalogenate chlorinated, brominated, and iodinated organic compounds. The photochemical conditions supplied by the LARC reactor lead to a rapid, highly controllable reaction which yields only biphenyl and sodium chloride as the final products from PCBs. No oxygenated derivatives, chlorinated dibenzofurans, or chlorinated dioxins have ever been observed in gas chromatographs or mass spectra of the intermediates or products in the LARC degradation of chlorinated organics.

Company Name/POC: ArcTech, Inc./Dr. Daman Walia

Address : 14100 Park Meadow Drive/Chantilly, Virginia 22021

Phone Number : 703 222-0280

Fax Number : 703 222-0299

Technology Maturity : Pilot plant testing

Performance History : LARC is extremely cost-competitive with the existing technologies for treatment of PCBs (significantly lower in cost than incineration). Samples containing in excess of 1,000 ppm of PCBs have been successfully decontaminated to meet federal, state, and local clean-up levels. In a pilot-test study, Arochlor 1260 was reduced from 3,000 ppm to 20 ppm, when treated by the LARC technology.

Comments : The LARC technology is not useful for treatment of metals-only or radioactive wastes. The process is designed specifically for treatment of halogen containing materials. Inorganic materials present in wastes do not interfere with the efficiency of the process.

Source of Information : VISITT 3.0

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Filtration***Technology Name:** Power Fluidic Stripper**Application:** On-site Ex-situ**Brief Description:** Replaces conventional air strippers for treating contaminated liquors. Performs as well as conventional equipment with benefit of smaller unit (1/7th size). No internal packing, makes plant mobile. Inactive situations decommissioning cost 1/5th of conventional plant.**Company Name/POC:** Power Fluidics/Paul Murray**Address:** Bldg. RD2, Risley Warrington/Cheshire, U.K. WA36AT**Phone Number:** 192 5252818**Fax Number:** 192 525245**Technology Maturity:** Commercial use experience**Performance History:** Contact company for performance data.**Comments:** Maximum gas flow 20,000 m3/hr therefore may have to stage units.**Source of Information:** International TechCon

CONTAMINANTS :

- ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : Other

Technology Name : Molten Salt Oxidation

Application :

On-site Ex-situ
Off-site

Brief Description :

MSO is a combined chemical and thermal waste treatment technology which (1) feeds wastes and air into a ceramic-lined vessel containing a bed of molten salt at 900-1000C, (2) oxidizes organic wastes, (3) uses the heat of oxidation to keep the salt molten, (4) neutralizes acid gas precursors in the bed, and (5) discharges the salt for disposal or for processing and recycle. Radioactive wastes are trapped in the melt, organic wastes are removed to 99.9999% and acid gases are retained such that off-gas scrubbing is not required. MSO is a non-combustion alternative to incineration. MSO can treat 95% of the DOE wastes that are candidates for incineration either alone or in combination with thermal desorption pretreatment. The process does not require a flame to initiate or continue reaction; destruction and removal efficiencies exceed EPA requirements, off-gas treatment does not require acid gas scrubbing.

Company Name/POC: Rockwell International/Rich Gay

Address : Rocketdyne Division/6633 Canoga Ave./Canoga Park, California 91309-7922

Phone Number : 818 586-6110

Fax Number : 818 586-5877

Technology Maturity :

Pilot plant testing

Performance History :

Energy Technology Engineering Center (ETEC) Canoga Park CA, September 1992 prototype units were used to treat 5 gallons of mixed waste hydraulic oil (Cs and Sr) for organics and attained DRE's of 99.9999% with radioactive waste entrapped in melt, generated 12 lbs of spent salt mix. Chlorinated fraction not expelled as acid gas but neutralized in melt to NaCl. Bench-scale testing at ORNL, LLNL and LANL. Preconceptual design for 100-200 lbs/hr plant is underway. In the 1980's, extensive testing up to 150lbs/hr was performed on a large variety of mixed wastes, organics, explosives, and chemical warfare agents.

Comments :

Applicable to high heating value organic liquids (solvents, waste oils) and low heating value liquids (chlorinated organic liquids) with medium applicability to aqueous sludge with heavy metals and/or organics and low ash combustibles. Not applicable to soils, inorganic salts and dilute aqueous wastes. Wastes with Hg require pretreatment. Sludges must be diluted to facilitate pumping, but water use for dilution must be minimized. Solids must be sorted to remove most metal and size reduced to <1/4 inch to facilitate pumping. Applicable to several waste streams that are unique, e.g., graphite, sodium metal, and NaK. Extensive development work and scale-up has been documented on coal gasification and hazardous waste which forms a strong experience base for the MSO process. MSO operating systems may be constructed in relatively small units for small quantity generators. Relatively simple treatment process. System is tolerant of a wide range of feed-rate fluctuations. Additional research needed to determine optimal ash content, chlorine content, and volatile metal content for operation. Residuals management needs further evaluation in terms of reducing overall volume (e.g. by salt recycle) and also in terms of leach characteristics of final stabilized waste form for disposal. Material to eliminate or reduce concerns about corrosion need to be used for design of larger-scale facilities. Plugging of feeder by frozen salt must be addressed. Two independent peer reviews have concluded that MSO could be an important technology for DOE.

Source of Information : TechCon

[illegible]

 

[illegible]

Landfills

Treatment

Landfills

Treatment

CONTAMINANTS :

- ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Biodegradation (In Situ)***Technology Name :** FyreZyme**Application :** In-situ (saturated zone)

Brief Description : FyreZyme is a multifactoral liquid (aqueous) agent, combining a rich source of bacterial growth-enhancing agents, extracellular enzymes, and bioemulsifiers. For in situ treatment, a "front" of FyreZyme-containing aerated water is moved through the groundwater by a combination of infiltration galleries of injection wells upgradient and extraction wells downgradient. Groundwater may be recycled through the bioremediation bed for both maintaining moisture levels for metabolic activity and for cleansing of groundwater. If permitting requires that groundwater extracted be cleansed prior to reinjection or discharge, suitably sized holding tanks with aeration lines to maintain aerobic conditions are utilized as bioremediation reactors.

Company Name/POC: Ecology Technologies International, Inc./Mr. Pete Condy**Address :** 1225 So. 48th Street/Suite 2/Tempe, Arizona 85281**Phone Number :** 602 985-5524**Fax Number :** 602 985-2988**Technology Maturity :** Commercial use experience

Performance History : An in-situ field program is in progress with Mobil Oil, using a combination of upgradient vertical and horizontal injection wells and a downgradient extraction well. An in-situ program is currently in progress in Waco, Texas, at a tire manufacturing plant (name withheld at client's request). a second project is underway at a California-Nevada border location, and a third one is undergoing engineering study beneath an intersection in a major metropolitan area.

Comments : FyreZyme is a concentrated aqueous solution, which is diluted to 4, 5, and 6 percent for use as a bioremediation enhancing agent. FyreZyme is stable, with a shelf life of 5 years under "normal" environmental conditions. FyreZyme is effective in accelerating bioremediation of a wide range of organic contaminants in an environmentally friendly, scientifically sound, and cost-effective manner. FyreZyme may be used as a stand-alone technology or incorporated into other technologies, such as bioventing, soil venting, sparging, slurry phase treatment, sediment treatment, pump-&-treat, etc.

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *In Situ Vitrification*

Technology Name : In Situ Vitrification

Application : In-situ (vadose zone)

Brief Description : In-situ vitrification involves electric melting of staged or in situ earthen materials (e.g., soil, sediment, mill tailings and sludges) to destroy organic contaminants and permanently immobilize heavy metals (including metallic radionuclides) in a glass and crystalline residual product. Organic destruction occurs due to thermal decomposition (pyrolysis) upon contaminant exposure to melt-temperatures, typically in the 1,600 degrees celsius to 2,000 degrees celsius range. Heavy/radioactive metal immobilization occurs due to strong chemical bonds in a high-silica glass and crystalline matrix of natural or designed chemistry. Significant volume reduction occurs (25 to 45 percent for typical soils). The ISV process possesses many advantages, compared to alternative technologies. ISV has been tested/demonstrated on a broad range of earthen materials contaminated with organic and heavy/radioactive metals. Organics of note include PCBs, dioxin, multiple pesticides, multiple explosives, PCP, and many other volatile, semivolatile and nonvolatile organics. All EPA priority pollutant heavy metals have been involved in testing. Numerous radionuclides have also been tested, including Pu, U, Am, Sr, Cs, Th, Ra, Rn and others.

Company Name/POC: Geosafe Corporation/James E. Hansen

Address : 2950 George Washington Way/Richland, Washington 99352

Phone Number : 509 375-0710

Fax Number : 509 375-772

Technology Maturity : Commercial use experience

Performance History : Performance data are available:

The ISV process has been tested/demonstrated over 180 times at various scales. It is currently being applied at large-scale on a commercial basis. Numerous other large-scale remediation and demonstration projects are currently in Geosafe's backlog (client intention basis-not necessarily already contracted). The backlog includes projects in the U.S., Australia, and Japan. The backlog contains an estimated 40,000 tons of contaminated soil.

Comments : Groundwater control may be necessary to limit recharge if processing below the water table. Contaminated matrix material must have adequate geochemistry to enable formation of a conductive melt and have sufficient glass formers to provide the desired residual vitrified product. Some modification through additives may be possible to make an unusual matrix amenable to ISV processing. ISV is not considered adequately evaluated for commercial application on ordnance, pressurized containers or sealed containers containing liquids. Existing equipment is limited to a total organic content of 10 wt percent in the matrix being treated; this limit can be increased through change of equipment. Metal debris content in the matrix is currently limited to 23 wt percent. The process cannot be used in areas where thermal effects may be damaging to underground items (e.g. pipes, cables, structures). The ISV technology is proprietary and available only from a sole source (Geosafe Corporation). ISV on-site remediation services, including full operating crew and related management, are available. For more information contact the vendor.

Source of Information : TechCon

CONTAMINANTS:

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

Halogenated VOC

☒ N/A

TECHNOLOGY TYPE: *Containment*

Technology Name : Asphaltic Concrete Linings

Application :

On-site

Ex-situ

Brief Description :

Asphaltic concrete can be designed to a high level of impermeability as a containment barrier to the passage of liquids and gasses. Having over 60 years proven performance in dam construction and other water retaining structures the technology now has a track record in continental Europe as a flexible lining membrane in a landfill environment.

Company Name/POC: Alfred McAlpine Asphalt Limited/Alan W. Christie

Address : Ashton Road/Billinge, Near Wigan/Lancashire, WN5 7XY, U.K.

Phone Number : 1744 892481

Fax Number : 1744 893208

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Early 1940;s to date -
material.

Numerous hydraulic schemes worldwide have experience with this

1979 to date -

Switzerland has approx 15 landfill sites using asphaltic concrete as a containment barrier and is one of three approved methods. Other European countries now use this method.

1993 to date -

Other European countries now examining the material.

Comments :

Most specialist asphalt manufacturers and contactors could use this material given the necessary training skills and technical support. A support pack is available from the company on this technology and includes:

Independent report from Harwell Laboratory on the performance
Various technical papers on the use of the material in continental Europe
UK Patent Certificate

UK Patent Certificate

Technical papers from the UK

The material has the support of the UK National Rivers Authority
Has now been included in the draft document

26B.

Has now been included in the draft document for Consultation of Waste -management Paper

Landfill Design Construction and Operational Practice

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Containment

Technology Name : Cryogenics

Application : In-situ (vadose zone)
 In-situ (saturated zone)

Brief Description : Provides temporary, interim and long-term barrier or containment by freezing moisture in ground structure. This is an effective technique well proven for the containment of volatile products.

Company Name/POC: CDS Research Ltd./Dr. Zohar Meratla

Address : 20 Brookbank Ave./North Vancouver, B.C. V7J2B8, Canada

Phone Number : 604 985-2865

Fax Number : 604 985-281

Technology Maturity : Commercial use experience

Performance History : Not applied to nuclear waste. Demonstration project required.

Comments : This is a containment/barrier technology, whereby contaminants are prevented from migrating to contaminated areas. Requires directional drilling, otherwise no serious challenge.

Source of Information : International TechCon

CONTAMINANTS :

- ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Containment***Technology Name :** Artificial Ground Freezing**Application :** In-situ (vadose zone)
In-situ (saturated zone)**Brief Description :** Serves the same function as a slurry wall or trench. Provides considerably less residual soil and can be installed to greater depths at a significantly lower price.**Company Name/POC:** Layne-Northwest Company/Dr. Sopko**Address :** W229 N5005 DuPlainville Rd./Pewaukee, WI 53072**Phone Number :** 414 246-4646**Fax Number :** 414 246-4784**Technology Maturity :** Commercial use experience**Performance History :** Ground freezing has been successfully used on over 100 underground construction projects and one environmental application. The reference contact for this application is: E.O. Mixon, Project Manager, J.F. Shea Company, Inc. (414) 643-5140.**Comments :**

The barrier can be installed using rotary techniques from truck-mounted drilling equipment. After installation of the system, the freezing is completed by using either a portable or permanent refrigeration plant. The system must be routinely checked and requires constant electrical services for the first 8 weeks, then intermittently during the long-term approach. The most significant disadvantage of ground freezing is that it does require the constant use of refrigeration. This use, however, is substantially less than that typically used in construction applications since there would be no exposed face of the wall. A ground freezing system can be installed in virtually any type of soil conditions. The most significant component of any ground freezing system, both in time and costs, is the drilling and installation of the freeze pipes. The method of drilling varies depending on the soil type, the presence of rocks and boulders and the depth and angle of the freeze pipes. The major infrastructure requirement is the availability of electrical power. The greatest challenge facing ground freezing as a technology is development of site specific quality control plans and programs. The concept of creating a frozen barrier is quite simple; however, review of the underground construction projects that experienced problems clearly indicates that the problems could have been avoided, by implementing close tolerances in refrigeration pipe spacing, survey instrument calibration, comprehensive monitoring of the coolant temperature and distribution system and the use of experienced drilling and supervisory personnel in the field.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Containment*

Technology Name : Subsurface Frozen Soil Barriers

Application : In-situ (vadose zone)
 In-situ (saturated zone)

Brief Description : Frozen soil barriers are an alternative to conventional containment systems such as steel, concrete, slurry walls, or grout curtains. The technology replaces conventional containment systems where complete containment (on all sides and below) is desired. Diffusion rates for contaminant migration in frozen soil are orders of magnitude lower than sheet piling, grout walls, geomembranes and other conventional materials. With a core temperature of -35C and a thickness of 40-50 feet thick, contaminants are unable to move beyond the frozen zone. Frozen soil barriers can be used in combination with in-situ remediation technologies, ensuring no releases whatsoever from the site. Barriers may than be thawed returning the site to an undisturbed original condition. Technologies include: CRYOCELL, ISOCELL and CRYOSWEEP.

Company Name/POC: RKK, Ltd./Ron King

Address : 16404 Smokey Point Boulevard/Suite 303/Arlington, Washington 98223

Phone Number : 370 653-4844 **Fax Number :** 360 653-745

Technology Maturity :

Performance History : Ground freezing has successfully been employed since the 1860s. This technology has been used in civil engineering practices for over a century for groundwater control and structural strength for excavation support.

Comments : Ground freezing represents a superior containment method for hazardous waste at depths of up to 2,000 feet. Conventional methods are generally limited to 100 feet or less. Containment of plumes >2,000 represent a potential limitation of frozen soil barriers.

Source of Information : TechCon

CONTAMINANTS :

- ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Containment*

Technology Name : Robertson Barrier Liner

Application :

On-site Ex-situ
Off-site

Brief Description : The Robertson Barrier Liner System is a patented double flexible liner system which permits the active testing of the liner system (both upper and lower liner) during installation, commissioning, operation and after facility closure, to demonstrate the presence or absence of leaks in the entire liner, not just at the seams. Since the test can be conducted prior to placing the hazardous or valuable liquid in the containment pond, it serves to identify potential liquid leak locations prior to the accumulation of the liquid in the pond. The system may be used to monitor continuously for the onset of leaks and can indicate whether the leak is getting worse or is stable. It may also be used to prevent the escape of the contained fluid in the eventuality that a small leak may develop.

Company Name/POC: Robertson Barrier Systems Corporation/Rhino Rohrs

Address : 640 Hornby St./Vancouver, B.C. V6C 3B6

Phone Number : 604 684-8072

Fax Number : 604 681-4166

Technology Maturity : Commercial use experience

Performance History : A Robertson Barrier Liner has been successfully installed at the Abbotsford Airport near Vancouver for four years, where it is used to contain apron washdown from the air tanker base of the Department of Forestry. For this installation the company was awarded the 1990 Environmental Engineering Design Award of the British Columbia Association of Professional Engineers.

Comments : Applicable to wastes for which there is a compatible flexible liner material. HDPE is compatible with inorganic, organic and radiological waste. Requires conventional double geomembrane liner installation capability and simple mechanical/electrical/plumbing capabilities for installation. The company has a licensed installer with DOE approval in the U.S. who has expertise and experience to install the entire system. It is the only system available which permits intermittent or continuous testing of the entire liner or capping system (both upper and lower liners) after installation, during active use and after facility closure. At all times the liner system integrity can be demonstrated. This testing allows the pinholes or imperfections to be detected and repaired prior to them becoming the cause of leaks. The system can also prevent actual leakage to the environment through small holes in the bottom liner. The system uses existing liner materials and construction technology, in combination with a partial vacuum testing system.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Vacuum Vapor Extraction*

Technology Name : VACU-POINT

Application : In-situ (vadose zone)
 In-situ (saturated zone)

Brief Description : Vacuum vapor extraction rapidly removes contamination from soil and groundwater and produces rapid site cleanup. In some cases, WES has remediated sites under 90 days. This technology has been tested and proven reliable and is now accepted by Florida Department of Environmental Protection (FDEP) as a short-term remedial technique.

Company Name/POC: W.E.S. Environmental Division/Anthony DeLoach

Address : 6389 Tower Lane/Sarasota, Florida 34240

Phone Number : 941 371-7617

Fax Number : 941 378-521

Technology Maturity : Commercial use experience Field demo complete

Performance History : WES has successfully demonstrated and pilot-tested more than 12 projects and installed four systems which have either remediated or reduced contaminants completely.

Chevron USA - 45 GPM, no problems. W.D. Howard 404 984-3085
 Amoco Oil - 4 projects, 1-100 GPM no problems. Bill Batts 813 661-4839
 Chevron USA - 55 GPM, no problems. John Machen 404 984-3192

Comments : This technology works well in sandy and tighter clay conditions. If water disposal after treatment is not possible, this creates a problem. For use where both groundwater and saturated soil are contaminated and the client wishes to reduce cleanup time at an accelerated rate. Examples include landfills, industrial sites, pipeline leaks, underground storage tanks, and fuel spills. VACU-POINT is a patented and trademarked technology developed by W.E.S. Environmental Division for the rapid cleanup of contaminated water and soil. To date, the State of Florida has classified this technology as a "Short-Term Remedial Approach" to site restoration.

Source of Information : TechCon

Surface Impoundment

Treatment

Surface Impoundment

Treatment

CONTAMINANTS :

☒ Pesticides/Herbicides☒ Heavy Metals☐ PCB☐ Explosives/Propellants☒ Petroleum Hydrocarbons☒ Radionuclides☒ SVOC☐ Other Contaminant☒ Nonhalogenated VOC☒ Halogenated VOC☐ N/A**TECHNOLOGY TYPE :** *Biodegradation (In Situ)***Technology Name :** FyreZyme**Application :**

On-site

Brief Description :

FyreZyme is a multifactoral liquid (aqueous) agent, combining a rich source of bacterial growth-enhancing agents, extracellular enzymes, and bioemulsifiers. In dairy farm operations, animal pen holding lagoons, are municipal wastewater ponds, FyreZyme is added daily at the ratio of one gallon of FyreZyme per 250,000 gallons of effluent. FyreZyme is mixed at the receiving end of the lagoon. The nutrient content of FyreZyme, coupled with the wide-band enzymatic action, will dramatically reduce the BOD, suspended solids, sludge volume, and fats/oils/grease component and almost completely eliminate methane gas odors.

Company Name/POC: Ecology Technologies International, Inc./Mr. Pete Condy**Address :** 1225 So. 48th Street/Suite 2/Tempe, Arizona 85281**Phone Number :** 602 985-5524**Fax Number :** 602 985-2988**Technology Maturity :** Commercial use experience

Performance History : FyreZyme has been used in a lake in Florida during a bench test to decrease nitrates and phosphorous originating in nearby agricultural applications. Treatment of refinery-sludge lagoon is underway in Brazil with Shell Oil Company. The pilot study has been completed, and full-scale program is being designed.

Comments :

The main limitations are those which limit bacterial growth such as temperature extremes, pH below 3 or above 10, and contaminants in high concentrations. If the temperature is above 100 degrees Fahrenheit, the shelf life of FyreZyme may be shortened from 5 years to 2 years. Enzyme poisons must be flooded with FyreZyme before bioremediation.

Source of Information : VISITT 3.0

 

[illegible]

 

Drums/Tanks/Piping

Treatment

DRUMS/TANKS/PIPING

DRUMS/TANKS/PIPING

DRUMS/TANKS/PIPING

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : Flashlamp StarBoldt (TM)

Application : On-site Ex-situ

Brief Description : StarBoldt is a system that utilizes Xenon flashlamps to generate high-intensity light to ablate coatings or contaminants from substrates without damage, or by adjusting operating controls, ablates concrete substrates to remove contaminated top layers. StarBoldt is a self-contained method that does not generate any added waste streams and actually reduces coatings to a fraction of their original weight for optimum waste minimization. The StarBoldt process is operator-safe because byproduct is contained at the point of generation through a vacuum source in the application head. StarBoldt is an environmentally sound alternative to coatings removal methods such as media blasting and chemical strippers, while increasing operation productivity and cost savings. As an alternative to these methods, StarBoldt is operator safe, reduces waste, increases productivity and reduces costs.

Company Name/POC: Polygon Industries, Inc./Christa Chiacos

Address : 2 Embarcadero Center/San Francisco, California 94111

Phone Number : 415 391-6063

Fax Number : 415 292-522

Technology Maturity :

Field demo complete

Performance History : September 19, 1994: Field demonstration at the DOE-RMI site in Ashtabula, Ohio managed by Parsons Environmental Services, Inc. The program jointly sponsored by DOE and Parsons was the first of its kind to combine an innovative technology with a qualified workforce in a decontamination effort. Air monitors were placed in the surrounding area and on service personnel. 100 percent containment of byproduct at the source was verified. StarBoldt successfully decontaminated both concrete and steel surfaces to release levels without posing a threat to the personnel or the surrounding environment.

Comments : StarBoldt sold as a system is complete and can be used anywhere an electricity source is available. A system consists of the following: power supply, PFN, controller and chiller housed in a console on wheels 19 in. W x 36 in. D x 71 in. H, 750 lbs. a vacuum 72 in. H x 60 in. W x 20 in. D, 1, 100 lbs., a fume scrubber 86 in. H x 38 in. W, 400 lbs. electrical requirements: 220-240 VAC, 100 amps. Application limitations are as follows: getting into confined spaces with the application head (e.g., behind pipes or tight corners). The system is mobile and versatile; special facilities to use the system are not required. Can be used indoors or outdoors without ambient containment devices. Because a StarBoldt system has not yet been used in a full-scale operation, technological challenges are not determined. Demonstrated in short-term use, for example, a full week of constant use, the system is not without challenges. Volume of waste generation: minimal, as the StarBoldt process uses light, not blasting media or chemicals or water to strip coatings from surfaces or decontaminate surfaces; byproduct consists of trace amounts of gas and ash.

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Chemical Surface Cleaning***Technology Name :** Decontamination for Decommissioning**Application :**

On-site

Other Application

Brief Description :

Analogous with a previously developed process for operational reactors (LOMI); Bradtec Ltd, in conjunction with EPRI, have a new decontamination process for decommissioning reactor and chemical treatment plants. The process offers a dilute chemical application for the removal of radioactive oxides from the internal surfaces of a plant while minimizing waste volumes. The system is designed to achieve high DF;s and hence significantly reduce worker exposure. The process is new; the application technology is well tried and tested; (i.e., civil nuclear decontaminations).

Company Name/POC: Bradtec Ltd/George Elder**Address :** University of the West of England/Cold Harbour Lane/Bristol BS 16 1QY, United Kingdom**Phone Number :** 44 117 976 3937**Fax Number :** 44 117 976 3892**Technology Maturity :**

Bench scale testing, only

Performance History : Still at development stage.**Comments :**

Decon systems are flexible skid mounted units. Collaborating with the utility, the vendor supplies procedures, QA, equipment and operators. The utility supplies services and supervises interfacing.

Source of Information : International TechCon

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

Petroleum Hydrocarbons

Radionúclides

SVOC

Other Contaminant

■ **Nonhalogenated VOC**

■ **Halogenated VOC**

■ N/A

TECHNOLOGY TYPE : Chemical Surface Cleaning

Technology Name : Chemical Decontamination of Metals

Application :

On-site

Ex-situ

Off-site

Brief Description : The process involves treatment with a series of chemical reagents in tanks. The process is specifically designed to remove uranium, neptunium and technetium contamination from aluminum alloy and steel. The process is semi-automatic so that potential hazards to operators are minimized. Its application has allowed large tonnages of metal to be returned to commerce thus avoiding the need for the more expensive options of long-term storage or disposal to land burial.

Company Name/POC: British Nuclear Fuels plc/Janet Jackson

Address : H242 Hinton House/Risley, Warrington Cheshire, England WA3 6AS

Phone Number : 1925 832735

Fax Number : 1925 83572

Technology Maturity : Commercial use experience

Performance History : Several thousand metric tonnes of metal have been decontaminated and sold for recycle since the facility commenced operation in 1990.

Comments : The facility, which contains two identical treatment lines, each with five reagent tanks, served by overhead cranes, measures approximately 60m long x 20m wide x 7m high. The utilities required are domestic water, steam; electricity, compressed air and respirator air.

When steel is the metal to be decontaminated, it must be free from surface coatings or corrosion products for the process to have maximum effectiveness.

The plant can be operated remotely from the control room. Local effluent treatment by ion exchange is provided.

The process is fully developed and engineered to meet specific requirements at the site where decommissioning is in progress.

Source of Information :International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☒ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Chemical Surface Cleaning*

Technology Name : PCB Line Cleaning

Application : Other Application

Brief Description : The system removes PCB contamination from the interior of metallic piping systems via chemical action and turbulent flow. The chemicals used are nonhazardous and leave no harmful or corrosive residues. Older technologies have used chlorinated solvents that have the potential for RCRA related problems and the possibility of harmful residues.

Company Name/POC: Foss Environmental Services/Rick Janecek

Address : 5420 N. Lagoon, Portland, OR 97217

Phone Number : 503 283-1150

Fax Number : 503 289-6568

Technology Maturity : Commercial use experience

Performance History : 31 sites decontaminated successfully.

Mr. Ken Schorre	Tenneco Gas	(713) 757-3365
Mr. Robert Jarabeck	Equitable Resources	(412) 553-5793
Dr. Henry Vann	El Paso Natural Gas	(915) 541-2832

Comments : System requires electrical power, water. Units mounted on 40' flatbed trailers. Removes PCB contamination from metallic piping systems quickly with minimal disruption to plant operation. System is considered to be an alternative to disposal in a TSCA approved facility. EPA operating permit issued 12/19/91.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Chemical Surface Cleaning*

Technology Name : Decontamination of Tubing

Application : ☐ On-site ☐ Ex-situ

Brief Description : Decontamination of pipelines by dissolution or scraping of contaminants up to clearance levels of radioactivity. The technology has been developed as part of the decommissioning project of the KEMA Suspension Test Reactor.

Company Name/POC: KEMA Nederland B.V./J. van der Steen

Address : P.O.Box 9035/NL-6800 ET ARNHEM, The Netherlands

Phone Number : 31 2635 63370

Fax Number : 31 2644 2363

Technology Maturity : Commercial use experience

Performance History : Several jobs for decontamination of tubings in oil/gas industry. Tubing decontaminated from fission products in the decommissioning of KEMA Suspension Test Reactor.

Comments : The technology can be implemented quite easily at the site. Infrastructural needs are small, as the equipment needs only electrical power. The challenge is to scale up the technology for the capacity needed at the site.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Chemical Surface Cleaning*

Technology Name : Pentek-600

Application : On-site Ex-situ

Brief Description : Removes surface contamination and oxidized surface layers from ferritic and stainless steels, lead, and other non-ferrous metals. Upon application, polymer dries, shrinks, and peels off of surfaces, encapsulating contamination within polymer matrix. Can replace grinding, high-pressure blasting, and strippable coatings. Waste volume is limited to a 10 mil thick film of plastic.

Company Name/POC: PENTEK, Inc./Eric Crivella

Address : 1026 Fourth Avenue/Corapolis, PA 15108-1659

Phone Number : 412 262-0725

Fax Number : 412 262-0731

Technology Maturity : Commercial use experience

Performance History : Pentek 600 polymers have been in commercial use for about 6 years. They have been deployed in a variety of applications including reactor refueling cavities, glove boxes, and lead bricks.

Comments : Curing of the material is sensitive to temperature & humidity. Best performance is obtained at room temperature and 50 - 75 percent humidity. The commercial material cannot be sprayed. Directly implementable using brush application or direct dipping into the product. Drying time is dependent on temperature and humidity, but is usually less than 24 hours. Production of commercial quantities of this product has presented a challenge. An experimental variation of the product (Pentek 620) has been produced in limited quantities for use in the decontamination of chemical warfare agents from field equipment. Its chief characteristics are its ability to be applied by a power spray and its ability to dry quickly.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Chemical Surface Cleaning*

Technology Name : Decontamination of Metal by Decontgel

Application : ☒ On-site ☒ Ex-situ

Brief Description : Decontamination of metal surfaces through the use of a fixotrope mix of acids. Because of the nonliquid (fixotrop, pestons) quality of the special decontgel it stays attached to vertical surfaces, thus allowing the chemical reaction to occur. After a reaction time of 2 hours the surface are cleaned by high pressurized water.

Company Name/POC: Richard Buchen GmH/Dr. Jorg Unk

Address : Gawerbering 4 - 8/76149 Karlsruhe/Germany

Phone Number : 011 49 7247 20311

Fax Number : 011 49 7247 2189

Technology Maturity : Commercial use experience.

Performance History : The technology was developed in 1992 and has since been used during decommissioning work at the nuclear research reactor FR 2 in Karlsruhe, Germany.

Comments : The use of the technology is limited by the hydrogen concentration in the room air. This limitation can be controlled by calculation of treated surfaces and measured during operation. The equipment is easy to operate.

Source of Information : International TechCon

CONTAMINANTS:

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Dust Control*

Technology Name : Long Duration Foam

Application :	On-site	Ex-situ

Brief Description : Rusmar Long Duration foam is applied over an emitting surface to control odors, VOC's, dust and other emissions. The foam creates a continuous barrier between the surface and the atmosphere. Rusmar Long Duration Foam Technology is very effective in controlling any emission. Long Duration Foam is utilized in place of soils, tarps and other cover materials to control odors, VOC's, dust, windblown emissions, etc. Long Duration Foam completely covers any surface to which it is applied and it will conform to irregular and vertical surfaces. Long Duration Foam can be applied quickly, easily and provides a superior barrier to emissions than soil or tarps. It is non-toxic, non-hazardous, non-flammable and biodegradable.

Company Name/POC: Rusmar Incorporated/Laura White

Address : 216 Garfield Avenue/West Chester, Pennsylvania 19380

Phone Number : 610 436-4314

Fax Number : 610 436-8436

Technology Maturity : Commercial use experience

Performance History : Rusmar Long Duration Foam has been used throughout the United States and abroad for a variety of applications including: remediation projects, Superfund projects, lagoon and pond closures. It has been used as odor control on a liquid surface, for dust and VOC's suppression, emergency response, vapor and odor suppression in industrial applications and erosion control and to prevent surface water infiltration on stock piled soils. Additionally, Long Duration Foam has been used for in transit odor control on sludge filled containers and dust control during demolition of asbestos contaminated buildings.

Comments : Some of the Long Duration Foam products require water to dilute the product prior to use. The water must have less than 300 PPM of hardness. The smaller Pneumatic Foam Units are trailer mounted and require a piece of equipment to tow them around the site. During months of freezing weather, all Long Duration Foam products must be protected from freezing. The Pneumatic Foam Units are completely self contained and require no outside source of power. During freezing weather, a source of electricity is required to operate the freeze protection system on the larger Pneumatic Foam Units. There are no application temperature limitations on Long Duration Foam Products. Care must be exercised when applying AC-900 Series products with respect to weather, a heavy rain will not allow the membrane to form. After the first day, AC-900 Series products are unaffected by weather, ie., rain, snow, wind, etc. Long Duration Foam is easily applied utilizing a Rusmar Incorporated Pneumatic Foam Unit. Long Duration Foam is a single component material requiring non chemical mixing and no post application cleanup. The Pnuematic Foam Units are simple and easy to operate; they require no special training. Long Duration Foam is available with durations ranging from a few hours to six months. The Pnuematic Foam Units are available in a variety of sizes ranging from a small skid mounted unit to a large self propelled track mounted unit. These units are available for purchase or rental. Long Duration Foam and Pnuematic Foam Units have been in use in the field for the past nine years. They do not face any general challenges. Long Duration Foam can be applied at a rate of 500 square feet per minute and requires only one operator.

Source of Information : TechCon

 

CONTAMINANTS :

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

■ Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

Halogenated VOC

☒ N/A

TECHNOLOGY TYPE: *Containment*

Technology Name : Asphaltic Concrete Linings

Application :

On-site

Ex-situ

Brief Description : Asphaltic concrete can be designed to a high level of impermeability as a containment barrier to the passage of liquids and gasses. Having over 60 years proven performance in dam construction and other water retaining structures the technology now has a track record in continental Europe as a flexible lining membrane in a landfill environment.

Company Name/POC: Alfred McAlpine Asphalt Limited/Alan W. Christie

Address : Ashton Road/Billinge, Near Wigan/Lancashire, WN5 7XY, U.K.

Phone Number : 1744 892481

Fax Number : 1744 893208

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Early 1940;s to date - Numerous hydraulic schemes worldwide have experience with this material.

1979 to date - Switzerland has approx 15 landfill sites using asphaltic concrete as a containment barrier and is one of three approved methods.
1993 to date - Other European countries now examining the material.

Comments : Most specialist asphalt manufacturers and contactors could use this material given the necessary training skills and technical support. A support pack is available from the company on this technology and includes:

Independent report from Harwell Laboratory on the performance
Various technical papers on the use of the material in continental Europe
UK Patent Certificate

UK Patent Certificate
Technical papers from the UK
The following is a list of technical papers from the UK Patent Office, which are available for sale at a special price of £10.00 per copy. The papers are available in both hard copy and microfiche format. The microfiche format is available for £5.00 per copy. The papers are available in both hard copy and microfiche format. The microfiche format is available for £5.00 per copy.

The material has the support of the UK National Rivers Authority
Has now been included in the draft document.

26B, has now been included in the draft document for Consultation of Waste -management Paper
Landfill Design Construction and Operational Practice

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : Containment

Technology Name : Cryogenics

Application : In-situ (vadose zone)
 In-situ (saturated zone)

Brief Description : Provides temporary, interim and long-term barrier or containment by freezing moisture in ground structure. This is an effective technique well proven for the containment of volatile products.

Company Name/POC: CDS Research Ltd./Dr. Zoher Meratla

Address : 20 Brookbank Ave./North Vancouver, B.C. V7J2B8, Canada

Phone Number : 604 985-2865

Fax Number : 604 985-281

Technology Maturity : Commercial use experience

Performance History : Not applied to nuclear waste. Demonstration project required.

Comments : This is a containment/barrier technology, whereby contaminants are prevented from migrating to contaminated areas. Requires directional drilling, otherwise no serious challenge.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Containment***Technology Name :** Artificial Ground Freezing**Application :**
In-situ (vadose zone)
In-situ (saturated zone)**Brief Description :** Serves the same function as a slurry wall or trench. Provides considerably less residual soil and can be installed to greater depths at a significantly lower price.**Company Name/POC:** Layne-Northwest Company/Dr. Sopko**Address :** W229 N5005 DuPlainville Rd./Pewaukee, WI 53072**Phone Number :** 414 246-4646**Fax Number :** 414 246-4784**Technology Maturity :** Commercial use experience**Performance History :** Ground freezing has been successfully used on over 100 underground construction projects and one environmental application. The reference contact for this application is: E.O. Mixon, Project Manager, J.F. Shea Company, Inc. (414) 643-5140.**Comments :**

The barrier can be installed using rotary techniques from truck-mounted drilling equipment. After installation of the system, the freezing is completed by using either a portable or permanent refrigeration plant. The system must be routinely checked and requires constant electrical services for the first 8 weeks, then intermittently during the long-term approach. The most significant disadvantage of ground freezing is that it does require the constant use of refrigeration. This use, however, is substantially less than that typically used in construction applications since there would be no exposed face of the wall. A ground freezing system can be installed in virtually any type of soil conditions. The most significant component of any ground freezing system, both in time and costs, is the drilling and installation of the freeze pipes. The method of drilling varies depending on the soil type, the presence of rocks and boulders and the depth and angle of the freeze pipes. The major infrastructure requirement is the availability of electrical power. The greatest challenge facing ground freezing as a technology is development of site specific quality control plans and programs. The concept of creating a frozen barrier is quite simple; however, review of the underground construction projects that experienced problems clearly indicates that the problems could have been avoided, by implementing close tolerances in refrigeration pipe spacing, survey instrument calibration, comprehensive monitoring of the coolant temperature and distribution system and the use of experienced drilling and supervisory personnel in the field.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Containment*

Technology Name : Subsurface Frozen Soil Barriers

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Frozen soil barriers are an alternative to conventional containment systems such as steel, concrete, slurry walls, or grout curtains. The technology replaces conventional containment systems where complete containment (on all sides and below) is desired. Diffusion rates for contaminant migration in frozen soil are orders of magnitude lower than sheet piling, grout walls, geomembranes and other conventional materials. With a core temperature of -35C and a thickness of 40-50 feet thick, contaminants are unable to move beyond the frozen zone. Frozen soil barriers can be used in combination with in-situ remediation technologies, ensuring no releases whatsoever from the site. Barriers may then be thawed returning the site to an undisturbed original condition. Technologies include: CRYOCELL, ISOCELL and CRYOSWEEP.

Company Name/POC: RKK, Ltd./Ron King

Address : 16404 Smokey Point Boulevard/Suite 303/Arlington, Washington 98223

Phone Number : 370 653-4844

Fax Number : 360 653-745

Technology Maturity :

Performance History : Ground freezing has successfully been employed since the 1860s. This technology has been used in civil engineering practices for over a century for groundwater control and structural strength for excavation support.

Comments : Ground freezing represents a superior containment method for hazardous waste at depths of up to 2,000 feet. Conventional methods are generally limited to 100 feet or less. Containment of plumes >2,000 represent a potential limitation of frozen soil barriers.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Containment***Technology Name :** Robertson Barrier Liner**Application :**

On-site Ex-situ
Off-site

Brief Description :

The Robertson Barrier Liner System is a patented double flexible liner system which permits the active testing of the liner system (both upper and lower liner) during installation, commissioning, operation and after facility closure, to demonstrate the presence or absence of leaks in the entire liner, not just at the seams. Since the test can be conducted prior to placing the hazardous or valuable liquid in the containment pond, it serves to identify potential liquid leak locations prior to the accumulation of the liquid in the pond. The system may be used to monitor continuously for the onset of leaks and can indicate whether the leak is getting worse or is stable. It may also be used to prevent the escape of the contained fluid in the eventuality that a small leak may develop.

Company Name/POC: Robertson Barrier Systems Corporation/Rhino Rohrs**Address :** 640 Hornby St./Vancouver, B.C. V6C 3B6**Phone Number :** 604 684-8072**Fax Number :** 604 681-4166**Technology Maturity :** Commercial use experience

Performance History : A Robertson Barrier Liner has been successfully installed at the Abbotsford Airport near Vancouver for four years, where it is used to contain apron washdown from the air tanker base of the Department of Forestry. For this installation the company was awarded the 1990 Environmental Engineering Design Award of the British Columbia Association of Professional Engineers.

Comments :

Applicable to wastes for which there is a compatible flexible liner material. HDPE is compatible with inorganic, organic and radiological waste. Requires conventional double geomembrane liner installation capability and simple mechanical/electrical/plumbing capabilities for installation. The company has a licensed installer with DOE approval in the U.S. who has expertise and experience to install the entire system. It is the only system available which permits intermittent or continuous testing of the entire liner or capping system (both upper and lower liners) after installation, during active use and after facility closure. At all times the liner system integrity can be demonstrated. This testing allows the pinholes or imperfections to be detected and repaired prior to them becoming the cause of leaks. The system can also prevent actual leakage to the environment through small holes in the bottom liner. The system uses existing liner materials and construction technology, in combination with a partial vacuum testing system.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Vacuum Vapor Extraction*

Technology Name : VACU-POINT

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Vacuum vapor extraction rapidly removes contamination from soil and groundwater and produces rapid site cleanup. In some cases, WES has remediated sites under 90 days. This technology has been tested and proven reliable and is now accepted by Florida Department of Environmental Protection (FDEP) as a short-term remedial technique.

Company Name/POC: W.E.S. Environmental Division/Anthony DeLoach

Address : 6389 Tower Lane/Sarasota, Florida 34240

Phone Number : 941 371-7617

Fax Number : 941 378-521

Technology Maturity : Commercial use experience Field demo complete

Performance History : WES has successfully demonstrated and pilot-tested more than 12 projects and installed four systems which have either remediated or reduced contaminants completely.

Chevron USA - 45 GPM, no problems. W.D. Howard 404 984-3085
 Amoco Oil - 4 projects, 1-100 GPM no problems. Bill Batts 813 661-4839
 Chevron USA - 55 GPM, no problems. John Machen 404 984-3192

Comments : This technology works well in sandy and tighter clay conditions. If water disposal after treatment is not possible, this creates a problem. For use where both groundwater and saturated soil are contaminated and the client wishes to reduce cleanup time at an accelerated rate. Examples include landfills, industrial sites, pipeline leaks, underground storage tanks, and fuel spills. VACU-POINT is a patented and trademarked technology developed by W.E.S. Environmental Division for the rapid cleanup of contaminated water and soil. To date, the State of Florida has classified this technology as a "Short-Term Remedial Approach" to site restoration.

Source of Information : TechCon

Surface Impoundment

Treatment

Surface Impoundment

Treatment

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Biodegradation (In Situ)*

Technology Name : FyreZyme

Application : On-site

Brief Description : FyreZyme is a multifactoral liquid (aqueous) agent, combining a rich source of bacterial growth-enhancing agents, extracellular enzymes, and bioemulsifiers. In dairy farm operations, animal pen holding lagoons, are municipal wastewater ponds, FyreZyme is added daily at the ratio of one gallon of FyreZyme per 250,000 gallons of effluent. FyreZyme is mixed at the receiving end of the lagoon. The nutrient content of FyreZyme, coupled with the wide-band enzymatic action, will dramatically reduce the BOD, suspended solids, sludge volume, and fats/oils/grease component and almost completely eliminate methane gas odors.

Company Name/POC: Ecology Technologies International, Inc./Mr. Pete Condy

Address : 1225 So. 48th Street/Suite 2/Tempe, Arizona 85281

Phone Number : 602 985-5524

Fax Number : 602 985-2988

Technology Maturity : Commercial use experience

Performance History : FyreZyme has been used in a lake in Florida during a bench test to decrease nitrates and phosphorous originating in nearby agricultural applications. Treatment of refinery-sludge lagoon is underway in Brazil with Shell Oil Company. The pilot study has been completed, and full-scale program is being designed.

Comments : The main limitations are those which limit bacterial growth such as temperature extremes, pH below 3 or above 10, and contaminants in high concentrations. If the temperature is above 100 degrees Fahrenheit, the shelf life of FyreZyme may be shortened from 5 years to 2 years. Enzyme poisons must be flooded with FyreZyme before bioremediation.

Source of Information : VISITT 3.0

 

Drums/Tanks/Piping

Treatment

Drums/Tanks/Piping

Treatment

CONTAMINANTS :

☐ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☒ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Solidification/Stabilization (Ex Situ)*

Technology Name : Customized Grout Applications for Waste Management

Application : On-site Ex-situ
Off-site

Brief Description : The company offers design and specification of customized grout formulations and mobile and fixed mixing plants to carry out void filling of drums containing solid wastes, plastics, etc. End products are large containers of decommissioned waste from soil stabilization or hydraulic cut-offs that sensibly meet the present regulations.

Company Name/POC: A-Z WASTE TEK Ltd./David J. Brown

Address : 32A Pooch Rd/Upton Poole/Dorset England BH16 5JB

Phone Number : 01144 1202 624985

Fax Number : 01144 1202 625177

Technology Maturity : Commercial use experience

Performance History : DJ Brown/A-Z is the originator of designs of many of the acceptable cement based grout. Currently used in the UK nuclear industry. A-Z has extended designs/specifications into a second generation of high performance grouting systems that have greater flexibility, longer working times and better end product performances.

Comments : Technology uses readily available equipment. Organic wastes can be a problem. A-Z can demonstrate the acceptability to grout containers with solid or decommissioned wastes from 200 liters to large ISO freight sizes. In its own laboratories A-Z have designed and demonstrated novel grouts and grouting systems to handle:

- Thickened slurries
- Solid simulated asbestos waste
- To produce special absorbents
- Synergized performance grouts

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Vitrification (Ex Situ)*

Technology Name : DC Graphite Arc

Application : Ex-situ

Brief Description : DC Graphite Arc technology is a high-temperature graphite-arc-based technology which is used to destroy organic materials, and melt ceramics and metal at temperatures >1600 degrees Celcius. The system operates in a sealed furnace. Volume reduction and stabilization of products are realized. Applicable to soils and mixed waste.

Company Name/POC: Electro-Pyrolysis, Inc./Charles H. Titus

Address : 996 Old Eagle School Road/Suite 1118/Wayne, Pennsylvania 19087

Phone Number : 610 687-9070

Fax Number : 610 964-857

Technology Maturity : Pilot plant testing

Performance History : Performance data are available.

A 3000 pound/hour unit has been built; Prototype 100 pound/hour in operation at MIT; Prototype 500 pound/hour in construction.

Comments : Useful for all types of solid waste. However, a cost penalty is paid for energy for high water content waste.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Electrical Separation*

Technology Name : Electrochemical Decontamination Tank

Application : On-site Ex-situ
Off-site

Brief Description : Stainless steel items are decontaminated by packing them in a titanium basket, which is immersed in nitric acid electrolyte, in a stainless steel tank. The items in the basket are electrodeplated at a controlled rate down to levels for re-use or recycle. This process removes contaminated metal surfaces at a controlled rate using only dilute nitric acid in place of phosphoric acid electrolytes or aggressive chemical reagents, which generate less manageable effluents. Contaminants typically fixed include alpha/beta/gamma from reprocessing, e.g., ingrained uranium and mixed fission products (Cs, Sr, Ce). Major material treated is unwetted stainless steel. Heavily oxidized steel from reactors is also treatable.

Company Name/POC: British Nuclear Fuels plc/Janet Jackson

Address : Risley, Warrington WA3 6AS Cheshire, England

Phone Number : 1925 832735

Fax Number : 1925 835722

Technology Maturity : Commercial use experience

Performance History : The electro decontamination process is based upon 40 years of general decontamination experience and 2 years of specific process development, which included full-scale non-active and active trials. Operational experience has been gained on decontamination of AGR skips and Magnox fuel slitherheads. The process is installed in the THORP decontamination centre currently undergoing decommissioning at Sellafield.

Comments : Main operating limitation is tank size and throughput. Packing of titanium basket to maximize throughput is required. Protective coatings or grease need to be removed prior to treatment as the process treats base metal surfaces only. Small bore pipework may need to be cut into short lengths for effective decontamination of the internals. The process is designed for remote operation in a shielded cell. An in-cell hoist or crane is required to operate the system. The tanks can be used as simple decontamination tanks using chemical reagents, for additional flexibility if required. Treatment time is 2-3 hours per batch. The process is fully developed to meet BNFL requirements. Other applications may require further development: (a) on throughput optimization; (b) for treatment of other metals; and (c) for treatment of spent electrolyte containing dissolved metals and radionuclides where no site liquid effluent treatment facilities are available. The electrodeplating process is not patentable. The intellectual property rights resides in BNFL's knowhow - design and operating experience. The process generates liquid effluent (1M nitric acid containing dissolved metal ions and radionuclides) and small amounts of sludge. No hydrogen is evolved during electrodeplating. The treated surface is suitable for re-use and can be readily decontaminated again.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : Wet Abrasive Particle Impact Cleaning

Application : On-site Ex-situ

Brief Description : The technology is a semi-automatic fully contained wet abrasive particle impact cleaner designed for nuclear use. It uses long life abrasive media, which is recycled. The liquid effluent quantities are relatively low. Decontamination factors of up to 100 for loose contamination are achieved.

The alternative to this technology is manual operation of the same basic decontamination technique, which is labour intensive and leads to increased operator dose uptake.

The technology has been tested on a range of Beta-Gamma contaminated metal tools and components.

Company Name/POC: British Nuclear Fuels plc/Janet Jackson

Address : Risley, Warrington WA3 6AS Cheshire, England

Phone Number : 1925 832735

Fax Number : 1925 83572

Technology Maturity : Pilot plant testing

Performance History : Wet abrasive particle impact cleaning is a well established process for metal cleaning and finishing in manufacturing industry. A decontamination system for use in the nuclear industry, based on this technique has been developed and tested jointly by BNFL and the UKAEA. Vapormatt Ltd are licensed to manufacture and market the equipment.

Two machines have been sold and are in service at the Joint European Torus Project (JET) at Culham Laboratories, Oxford, UK.

Comments :

There is an upper size limitation of about 50cm in any direction on items that can be handled in the current design of the machine. Very small items present difficulties because they can be blown away by the force of the abrasive jet. Articles with crevices inaccessible to the abrasive cannot be cleaned completely. Ease of use and flexibility are typical of any spray booth operation. The equipment can be readily configured to meet the clients specifications. Infrastructure requirements are mainly a provision of HEPA filtration for the exit air.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : SCARP Coatings Removal System

Application : On-site

Brief Description : The SCARP coatings removal system is a mobile self-powered, self-contained system which provides two methods for removing paints and other surface-bound coatings from various structural materials. One method is mechanical impact through rotary and linear action air driven tools; the second method is abrasive media blasting. Upon removal, the coating is instantaneously captured and transferred away from the surface and processed by the system. Coating materials along with other debris is contained for disposal.

Company Name/POC: Container Products Corporation/J. Hughes, J. King, J. Grantham

Address : P.O. Box 3767/Wilmington, North Carolina 28406

Phone Number : 910 392-6100

Fax Number : 910 392-6778

Technology Maturity : Field demo complete

Performance History : Contact company for performance data.

Comments : None.

Source of Information : TechCon

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Mechanical Surface Cleaning*

Technology Name: Decontamination of Tubing

Application: On-site Ex-situ

Brief Description: Decontamination of pipelines by dissolution or scraping of contaminants up to clearance levels of radioactivity. The technology has been developed as part of the decommissioning project of the KEMA Suspension Test Reactor.

Company Name/POC: KEMA Nederland B.V./J. van der Steen

Address: P.O.Box 9035/NL-6800 ET ARNHEM, The Netherlands

Phone Number: 31 2635 63370

Fax Number: 31 2644 2363

Technology Maturity: Commercial use experience

Performance History: Several jobs for decontamination of tubings in oil/gas industry. Tubing decontaminated from fission products in the decommissioning of KEMA Suspension Test Reactor.

Comments: The technology can be implemented quite easily at the site. Infrastructural needs are small, as the equipment needs only electrical power. The challenge is to scale up the technology for the capacity needed at the site.

Source of Information: International TechCon

CONTAMINANTS :

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

Halogenated VOC

 N/A

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : Non-Destructive Cleaning (NDC)

Application :	On-site	Ex-situ

Brief Description : Self-contained decontamination facilities and fixtures that use dry ice pellets as their cleaning medium. These mobile, self-contained NDC decontamination facilities provide all the decon media delivery, contaminant ventilation controls and filtration of the waste gases in one stand-alone facility. NDC has six mobile facilities currently furnishing decon services to the nuclear power industry and at DOE sites. They work so well that many service customers have purchased their units. NDC replaces water, chemical and abrasive media decontamination.

Company Name/POC: Non-Destructive Cleaning, Inc./Patrick J. Gillis, Jr.

Address : 1600 Providence Highway/Walpole,Massachusetts 02081

Phone Number : 508 660-3064

Fax Number : 508 660-3067

Technology Maturity : ' Commercial use experience'

Performance History : All NDC projects have been 100% successful. Problem: Customer does not furnish materials to be cleaned fast enough to keep up with NDC.

Comments : NDC facilities come in two basic sizes: 20' x 40' or 40' x 40'. They are designed to set up anywhere out of doors with no foundation or special supports. A firm surface is all that is required. The only service required is 480V power. NDC decontamination facilities are self-sufficient, including HVAC and HEPA exhaust filtration. NDC is a line-of-sight surface cleaner. It will also do limited subsurface cleaning. The limit of near surface or subsurface cleaning is the depth to which it will clean. Most NDC facilities are designed to be set up at the job site and the materials are brought into NDC for cleaning. NDC also has a line of vacuum cleaning fixtures that perform in-situ cleaning. Hardware development of fixtures to perform high-volume cleaning of internal surfaces, convoluted surfaces and remote applications is a general challenge.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : Soda Blasting

Application : On-site Ex-situ

Brief Description : Removes low-level radioactive and other hazardous surface contaminants. Abrasive blasting with sodium bicarbonate, which is later dissolved so the contaminants can be removed to reduce the generated waste by up to 75 percent. Up to 99 percent reduction of surface contamination.

Company Name/POC: OBG Technical Services, Inc./Eric Neubauer

Address : 5000 Brittonfield Parkway/East Syracuse, New York 13057

Phone Number : 315 437-6400

Fax Number : 315 437-980

Technology Maturity :

Field demo complete

Performance History : Demonstration project at K-25, ORNL, Bldg. K-29.

Comments : Site requirements are: compressed air - 120 psi 300 + cfm; tap water - std. pressure; 110V AC.

Surface decontamination only. For removal of lead paint, PCBs, LLR surface contaminants. Decon moveable parts/equipment such as air cylinders. Decon concrete floors, walls and ceilings. Overcoming the concept of individuals' believing that surfaces can be decontaminated with baking soda. Dust - water is added to control dust - a down-draft blast room would be an ideal situation for blasting parts.

Source of Information : TechCon

CONTAMINANTS :

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

Halogenated VOC

N/A

TECHNOLOGY TYPE: *Mechanical Surface Cleaning*

Technology Name : Vac-Pac

Application :

On-site

Ex-situ

Brief Description :

A modular system consisting of self-drumming HEPA vacuum and manually operated power tools to decontaminate concrete and steel surfaces while generating no air-borne dust or debris. The system uses mechanical scarification and scabbling devices. The system contains only a few moving parts, and performs with exceptionally high efficiency and reliability. It replaces abrasive blasting, shot-blasting, jack hammers, and other surface demolition alternatives. It provides a very clean working environment and an absolute minimum waste volume.

Company Name/POC: PENTEK, Inc./Eric Crivella

Address : 1026 Fourth Avenue/Corapolis, PA 15108-1659

Phone Number : 412 262-0725

Fax Number : 412 262-0731

Technology Maturity : Commercial use experience

Performance History : This technology has been in commercial use for 7 years, and has been utilized at most DOE sites. Detailed contact information is available on request.

Comments : Weight of modules varies: 10 lb. for Corner-cutter, 50 lb. for Squirrel, and 750 lb. for the Vac-Pac. Components are completely portable and require only a supply of compressed air. The complete system can decontaminate complex surfaces including corners, rivet heads, weld seams, and curves. Vac-Pac can be located up to 100 to 200 feet from the work area. Corner-Cutter will scarify any friable or brittle surface. Squirrel is designed only for concrete floors. Very compact and easy to deploy. There are no special infrastructure requirements. Access requirements are only limited by restrictions preventing workers to access the contaminated area surface. On a productivity basis, the system decontamination rate is between 50 and 100 percent of conventional systems. However, waste only consists of the contaminated surface material, resulting in waste volumes up to only 5 percent of conventional techniques. In addition, truly dustless operation and ergonomic design provides a more controlled and cleaner working environment, resulting in higher worker productivity. Therefore, overall system economics are lower than conventional systems. Vac-Pac's self-cleaning filtration system and self-drumming features limit HEPA vacuum filter replacements to an annual task. This lowers overall operating costs and worker exposure tremendously.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Mechanical Surface Cleaning*

Technology Name : Flashlamp StarBoldt (TM)

Application : On-site Ex-situ

Brief Description : StarBoldt is a system that utilizes Xenon flashlamps to generate high-intensity light to ablate coatings or contaminants from substrates without damage, or by adjusting operating controls, ablates concrete substrates to remove contaminated top layers. StarBoldt is a self-contained method that does not generate any added waste streams and actually reduces coatings to a fraction of their original weight for optimum waste minimization. The StarBoldt process is operator-safe because byproduct is contained at the point of generation through a vacuum source in the application head. StarBoldt is an environmentally sound alternative to coatings removal methods such as media blasting and chemical strippers, while increasing operation productivity and cost savings. As an alternative to these methods, StarBoldt is operator safe, reduces waste, increases productivity and reduces costs.

Company Name/POC: Polygon Industries, Inc./Christa Chiacos

Address : 2 Embarcadero Center/San Francisco, California 94111

Phone Number : 415 391-6063

Fax Number : 415 292-522

Technology Maturity : Field demo complete

Performance History : September 19, 1994: Field demonstration at the DOE-RMI site in Ashtabula, Ohio managed by Parsons Environmental Services, Inc. The program jointly sponsored by DOE and Parsons was the first of its kind to combine an innovative technology with a qualified workforce in a decontamination effort. Air monitors were placed in the surrounding area, and on service personnel. 100 percent containment of byproduct at the source was verified. StarBoldt successfully decontaminated both concrete and steel surfaces to release levels without posing a threat to the personnel or the surrounding environment.

Comments : StarBoldt sold as a system is complete and can be used anywhere an electricity source is available. A system consists of the following: power supply, PFN, controller and chiller housed in a console on wheels 19 in. W x 36 in. D x 71 in. H, 750 lbs. a vacuum 72 in. H x 60 in. W x 20 in. D, 1, 100 lbs., a fume scrubber 86 in. H x 38 in. W, 400 lbs. electrical requirements: 220-240 VAC, 100 amps. Application limitations are as follows: getting into confined spaces with the application head (e.g., behind pipes or tight corners). The system is mobile and versatile; special facilities to use the system are not required. Can be used indoors or outdoors without ambient containment devices. Because a StarBoldt system has not yet been used in a full-scale operation, technological challenges are not determined. Demonstrated in short-term use, for example, a full week of constant use, the system is not without challenges. Volume of waste generation: minimal, as the StarBoldt process uses light, not blasting media or chemicals or water to strip coatings from surfaces or decontaminate surfaces; byproduct consists of trace amounts of gas and ash.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☒ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Chemical Surface Cleaning*

Technology Name : Decontamination for Decommissioning

Application : On-site Other Application

Brief Description : Analogous with a previously developed process for operational reactors (LOMI); Bradtec Ltd, in conjunction with EPRI, have a new decontamination process for decommissioning reactor and chemical treatment plants. The process offers a dilute chemical application for the removal of radioactive oxides from the internal surfaces of a plant while minimizing waste volumes. The system is designed to achieve high DF;s and hence significantly reduce worker exposure. The process is new; the application technology is well tried and tested; (i.e., civil nuclear decontaminations).

Company Name/POC: Bradtec Ltd/George Elder

Address : University of the West of England/Cold Harbour Lane/Bristol BS 16 1QY, United Kingdom

Phone Number : 44 117 976 3937

Fax Number : 44 117 976 3892

Technology Maturity : Bench scale testing, only

Performance History : Still at development stage.

Comments : Decon systems are flexible skid mounted units. Collaborating with the utility, the vendor supplies procedures, QA, equipment and operators. The utility supplies services and supervises interfacing.

Source of Information : International TechCon.

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Chemical Surface Cleaning*

Technology Name : Chemical Decontamination of Metals

Application : ☐ On-site ☐ Ex-situ
☐ Off-site

Brief Description : The process involves treatment with a series of chemical reagents in tanks. The process is specifically designed to remove uranium, neptunium and technetium contamination from aluminum alloy and steel. The process is semi-automatic so that potential hazards to operators are minimized. Its application has allowed large tonnages of metal to be returned to commerce thus avoiding the need for the more expensive options of long-term storage or disposal to land burial.

Company Name/POC: British Nuclear Fuels plc/Janet Jackson

Address : H242 Hinton House/Risley, Warrington Cheshire, England.WA3 6AS

Phone Number : 1925 832735

Fax Number : 1925 83572

Technology Maturity : Commercial use experience

Performance History : Several thousand metric tonnes of metal have been decontaminated and sold for recycle since the facility commenced operation in 1990.

Comments : The facility, which contains two identical treatment lines, each with five reagent tanks, served by overhead cranes, measures approximately 60m long x 20m wide x 7m high. The utilities required are domestic water, steam, electricity, compressed air and respirator air.

When steel is the metal to be decontaminated, it must be free from surface coatings or corrosion products for the process to have maximum effectiveness.

The plant can be operated remotely from the control room. Local effluent treatment by ion exchange is provided.

The process is fully developed and engineered to meet specific requirements at the site where decommissioning is in progress.

Source of Information : International TechCon

Characterization

Characterization

Soil

Characterization

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Physical Sampling*

Technology Name : Soil Gas Tracking System

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : This equipment provides automated sampling methods to obtain soil gases for analysis (helium and radon). The results have been used to detect subsurface (bedrock) fractures that are discharging groundwater. Current plans are to develop the technology with on-site analytical capability for the analysis of soil gases. The technique could be used to survey an area on a detailed or a broad grid to detect groundwater discharge, mineralization, or source of He, Rn and conceivable, H, CO, etc. Combining this technique with SpectraSmart would allow on-site sampling and analysis of volatile organic compounds. SpectrSmart has been used successfully, in the laboratory, to detect VOCs in groundwater samples.

Company Name/POC: AECL Research/C. A. McDowall

Address : Whiteshell Laboratories/ Pinawa Manitoba, Canada R0E 1L0

Phone Number : 204 753-2311

Fax Number : 204 753-2922

Technology Maturity : Field demo complete

Performance History : There has been one major contract (two phases) running from 1987-1991. Both phases were successful with no significant problems. Reference Contact: Dr. Kevin Butter/Her Majesty's Inspectorate of Pollution / U.K. Dept. of Environment/Tel: 71 276 8099.

Comments : Operation requires chemical technologist trained in mass spectrometry, radioactive counting, and organic analyses. Operation of the technology would be limited by frozen ground or bedrock at the surface. A sample vessel (for saturated soils) or an access tube (for unsaturated soils) is used at a preselected depth to collect the soil gas. The collected gas is then analyzed using a relevant method: Helium-a mass spectrometer; Radon - scintillation counting; VOCs - SpectraSmart or gas chromatography. Performance standards for specific gases are as follows: Helium - presently state-of-the-art technology with referenced journal articles to support this claim; Radon - state-of-the-art for unsaturated soils but untested, as yet, for saturated soils; VOCs - not field tested but comparable to gas chromatography. All sampling and analysis can be done in the field with a fast turn around of results. Results are comparable to other available techniques but you don't have to take samples back to the lab for analysis.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Physical Sampling*

Technology Name : Sealed Tube Soil Sampling

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Collects undisturbed soil samples during drilling operations. Encapsulates the samples into sealed teflon/stainless device once the sample is brought to the surface. Substantially reduces VOC loss during sample collection and handling. Eliminates cross-contamination during sampling.

Company Name/POC: Danish Geotechnical Institute/Jens Baumann

Address : Maglebjergvej 1/DK-2800 Lyngby, Denmark

Phone Number : 0045 4588 4444

Fax Number : 0045 4588 124

Technology Maturity : Field demo complete

Performance History : Experiments carried out at DGI showed 50-70 percent loss of VOCs within first 24 hours using traditional sample collection and storage. The standard Danish Geotechnical sampling tube was adapted for environmental purposes and the sealing capsule was developed.

Comments : Cannot be used in stony soil or in "pure" sands that are fully saturated.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Physical Sampling*

Technology Name : "Non-Drilling" Hydraulic Probe Sampling and Mobile Lab Analysis

Application : In-situ (vadose zone) Ex-situ
In-situ (saturated zone)

Brief Description : Combined "non-drilling" sampling technology for unconsolidated soils and field laboratory analysis of VOCs using lab-grade gas chromatography equipment. Rapid sample collection (soil-gas, soil and water) with minimal investigation-derived waste generation (e.g., no cutting or purge water), and real-time field analysis with a high level of QA/QC (e.g., HAZWRAP "Level B" DQO equiv.). Cost-effective, time efficient complement to traditional drill rig sample collection in unconsolidated sediment. No waste is generated and probe equipment is very safe to operate. Real-time analytical results (primarily headspace techniques) permit rapid decision-making and "one time" thorough site assessments.

Company Name/POC: EnviroSurv, Inc./Hunt Chapman

Address : 2800 C Dorr Ave./Fairfax, Virginia 22031

Phone Number : 703 204-3580

Fax Number : 703 204-3581

Technology Maturity : Commercial use experience

Performance History : DOE Contact: Dr. Robert Siegrist, Oak Ridge National Laboratory.

Comments : Technology application requires experienced field chemists and hydrogeologists. The data generated equals, or exceeds, fixed lab quality. But the CLP bias must be overcome; namely the perception that such information is always superior to field analytical results. The field results can be self supporting in terms of spikes, duplicates, calibration data and supporting documentation. Probing equipment is limited to unconsolidated sediments. Also, technique is not amendable to continuous coring, or borehole logging. Large sample throughput is primarily limited to VOCs. Fewer analyses per day are possible when extractions are required. Analysis is "efficiency" limited to 10-15 target compounds. Full scan VOCs analyses are less cost-effective and time efficient. Rapid mobilization, equipment set-up and use by experienced personnel. Only a 2-person field team required for sample acquisition and on-site analysis. Flexibility for all media sample collection and analysis (soil-gas, soil and water). Regulatory agency awareness of data quality; overcoming the "fixed-lab bias." Acceptable as a complement to the traditional drill rig/fixed lab approach to environmental site characterization. The quality of data generated depends on the experience and knowledge of field personnel. Widespread technology use will increase as more people become aware of the sample quality problems associated with handling, shipment and delayed analysis.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Drilling***Technology Name :** Ellog with Level-Specific Gas and Water Sampling**Application :** On-site Ex-situ

Brief Description : The Ellog auger drilling method provides a precise electrical and gamma log while drilling, which is interpreted into a very detailed lithology. The spectral gamma log analyzer makes it possible to detect both clay layers and radioactive pollutants. The analyzer measures the energy level of the radiation, thus making it possible to identify the radioactive elements. The undisturbed level-specific gas and water sampling gives an unseen opportunity to investigate the soil, gas, and groundwater while actively drilling. The gas and groundwater samples are pumped to the surface in a closed system preventing pollution of the samples and the surroundings. While drilling, the measuring equipment can be removed from the drilling stem allowing soil samples and placement of monitoring pipes through the hollow drilling stem. Ellog drilling replaces the use of traditional drilling techniques in depths less than 100 meters.

Company Name/POC: Kampeax Geodan/Connie D. Johnsen**Address :** Stamholmen 112/DK 2650 Hvidovre, Denmark**Phone Number :** 45 36390737**Fax Number :** 45 3677231**Technology Maturity :** Commercial use experience

Performance History : The Ellog method has been used in Denmark for 7 years, and in that period it has produced approximately 20,000 m of log, and approximately 4,000 water samples have been taken. The Ellogs have given new and unseen details about lithology and groundwater chemistry in Denmark.

Comments : The deepest drilling depth is approximately 100 m with existing equipment. The auger drill method is used solely in unconsolidated material. The drilling equipment can be mounted on almost any rotation drill rig. The system is very flexible and can easily be moved around the USA in an ordinary shipping container. The transportation of radioactive soil to the surface can be avoided, because it is possible to detect the radiation in-situ with the radiation analyzer. Then the drilling process can be stopped or the crew can protect themselves. Only about 20 liters (drilling meters) of material is transported to the surface. The actual drilling can be performed by any skilled driller, while the measurements must be done by a trained geophysicist or engineer. The logs must be interpreted by a trained geophysicist.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Energy Dispersive X-Ray Fluorescence - Thin Film

Application : On-site

Brief Description : The EDXRF does lab quality elemental analysis (Na to Pu) using proprietary technology that can meet EPA minimum detection requirements in near realtime; low ppb analysis of trace elements in solutions, low ppm for soils/solids (sub ppm with digestions) for an exceptional range of "total unknown" sample types (soils, ores, wastes, water, etc.) and concentrations (ppm to wt percent for solids). All done in one instrument with no prior knowledge of sample.

Company Name/POC: Advanced Analytical Products & Services/Jim Wrigley

Address : 1753 Cape Aston Court/San Jose, California 95133-1128

Phone Number : 408 926-4057

Fax Number : 408 926-4057

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Small jobs mainly (10 to 50 samples). Exceptionally low detection levels and very good corroboration where available; customers report accuracy is better than CLP. References: Dr. Paul LaMothe, U.S. Geol. Survey 415 329 5258; Mrs. BiShia King, U.S. Geol. Survey 415 329 5288; Dr. Bill Walker, Walsh Associates 916 737 7240; Mr. Bill Cole, Lockheed Eng. Svc. 702 897 3226; Mr. Eric Lindgren, Sandia Nat. Lab 505 844 3820.

Comments : Sample prep is simple for solutions and soil/solid samples. Soils must be dried and ground (to about 300 mesh), then prepared as a thin film. The skill needed for EDXRF spectroscopy is quite high. Therefore, the company is offering a service, not an instrument. Later they will develop an "expert system" to overcome this. Detects elements Na to Pu, but not H to F. Doesn't determine compounds. With digestions, can do some speciation (e.g., soluble chromates Cr+6 distinguished from total chrome) and get excellent results (.3-.5 ppm). Mobile, not portable. Two person team recommended for field operations, but can be done with one. The cost reduction implications for field operations are quite significant.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Mobile Laboratory for Chemical Weapons, Explosives and Propellants**Application :** On-site Ex-situ**Brief Description :** Mobile laboratory with all necessary chemical and physical equipment to detect and analyze chemical weapons, explosives, propellants and other toxic materials.**Company Name/POC:** Alba Industrie Umweltschutz Service GmbH/Dr. K. Faber**Address :** Rehrhoferweg 160/D29625 Munster/Germany**Phone Number :** 051 92 96 3212**Fax Number :** 051 92 96 3311**Technology Maturity :** Commercial use experience**Performance History :** In use for two years, e.g., in Russia and also in Germany.**Comments :** None.**Source of Information :** International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Monitoring of Chemical Weapons in Soil, Water, Air, Buildings

Application : On-site Ex-situ

Brief Description : Monitors all relevant parameters, like concentrations of chemical weapons in air, soil, water, and buildings.

Company Name/POC: Alba Industrie Umweltschutz Service GmbH/Dr. K. Faber

Address : Rehrhoferweg 160/D29625 Munster/Germany

Phone Number : 051 92 96 3212

Fax Number : 051 92 96 3311 }

Technology Maturity : Commercial use experience

Performance History : Refer to POC for performance history.

Comments : None.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Chemical Sensing with TelecommLink**Application :** In-situ (vadose zone)

Brief Description : Ariano Technologies has developed a low-cost, centrally-managed environmental sensor and telecommunications system (Sen Tel), which will give multiple-tank owners (such as those owning thousands of service stations) real-time early warning of leaks in their gasoline and chemical storage tanks around the country. In addition, its centrally managed feature will guarantee the integrity of the record-keeping process, a critical issue when establishing environmental liability insurance rates and when it becomes necessary to provide a credible audit trail in the event of an environmental incident.

Company Name/POC: Ariano Technologies, Inc./Thomas J. Cody, Jr.**Address :** 91 Harvey St./Cambridge, MA 02140**Phone Number :** 617 661-6110**Fax Number :** 617 661-603**Technology Maturity :**

Bench scale testing, only

Performance History : Contact company for performance data.

Comments : SenTel, which allows the reading of any type of commercially available sensor, features a novel hydrocarbon-vapor sensor, the company's first commercial application of a line of patented fiber-optic chemical sensors and related instrumentation for detecting the presence of hazardous chemicals in air, soil or groundwater. The sensor, including a site-specific RF-transmitter link, can be battery-powered to operate independently of electrical or fiber-optic conduit beyond the immediate vicinity of the sensor. The core of the company's chemical-sensor technology was developed at Tufts University in Boston. Ariano has exclusive, worldwide environmental rights to all related patents and know-how developed to date, and has certain rights to similar technology developed at Tufts in the future. The individual unit operations of the SenTel system have been built and tested successfully, and the Company now intends to fabricate six integrated commercial prototypes for more extensive demonstration in the field. The SenTel system is expected to be sold on an EOM basis at a price well below the cost-per-sensing-point level of environmental sensors currently on the market.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : SMP (Sub Mitochondrial Particles)

Application : On-site

Brief Description : The technology utilizes submitochondrial particles (SMP) and is based on the mammalian enzyme complex that mediates cellular electron transport. These bioassays have broad application wherever rapid, inexpensive information about acute toxicity of aquatic or soil samples is needed. SMP-based bioassay products will complement analytical chemistry analysis and whole-organism bioassays by speeding the flow of information and lowering the overall cost of environmental monitoring. SMP tests were designed to provide a means for rapid inexpensive bioassay of harmful materials in environmental samples such as wastewater effluents, landfill leachates, or soil extracts. These tests can be used as a prescreening tool to select samples of concern for further analysis. Based on results of SMP prescreening, follow-up analysis may be carried out using analytical chemistry or whole-organism bioassays (e.g. USEPA's fathead minnow survival test or Ceriodaphnia magna reproduction tests). SMP tests take less than thirty minutes to perform. In comparison, the whole-organism bioassays require 7 days.

Company Name/POC: Biorenewal Technologies, Inc./Alan J. Dines

Address : 2800 S. Fish Hatchery Rd./Madison, Wisconsin 53711

Phone Number : 608 276-8980

Fax Number : 608 273-6989

Technology Maturity : Commercial use experience

Performance History : Performance data are available. This technology has been used in round robin EPA toxicity tests several times during the past three years. Results are available upon request. The test is currently being used in an EPA funded storm water run-off study being conducted by the Wisconsin Department of Natural Resources in conjunction with an inclusive battery of analytical chemistry tests. This study is not complete and is continuing for the next two years. SMP technology was evaluated two years ago in a USGS study at the Green Bay municipal waste water treatment facility. Results in the form of an extensive detailed report are available. Currently the company is conducting a development contract with Waste Management to evaluate SMP technology as a toxicity test on the effluent of a Superfund landfill leachate treatment system in Wisconsin. The goal is to install a continuous toxicity testing unit that reports results to a remote monitoring location.

Comments : While SMP toxicity test gives results in less than 30 minutes and costs less than \$25 per test instead of one week for the more traditional whole organism tests at a cost of \$500 to \$1,000 per test, it does not provide results that quantify the amount of toxicity or contaminants. Toxicity tests are a general measure of contaminant's impact on the animal kingdom and the environment as a whole.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Mobile Environmental Mass Spectrometer

Application : On-site

Brief Description : The Mobile Environmental Mass Spectrometer (MEM) is a fully developed electron impact ionization quadrupole Mass Spectrometer designed specifically to be rugged and flexible for on-site analysis of organic compounds. It is tolerant to extreme changes of environmental conditions allowing for a wide range of Data Quality Objectives to be completed. This all-in-one system simplifies sample preparation techniques yielding rapid qualitative and quantitative results on a real-time basis with field uptime better than 95 percent.

Company Name/POC: Bruker Instruments, Inc./J. Wronka

Address : 19 Fortune Drive/Manning Park/Billerica, MA 01821

Phone Number : 508 667-9580

Fax Number : 508 667-599

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

The MEM is successfully being used by the U.S. Army, state agencies, fire brigades, and environmental management firms for a wide variety of applications which include emergency response, site screening and assessment, and clean up monitoring of air, water and soil samples. References: U.S. Army CRDEC, D. Durst, (410) 671 2129; Del State DNREC, J. Rogers, (302) 323 4542; Env. Res Mngmt, D. Gallis, (215) 524 3786; SiteWorks, Inc., Albert J. Robbat, Jr., (617) 627-3474.

Comments : The MEM is designed for simple operation. A one-week training course covering instrument operation, hardware components, and methodologies will enable personnel to successfully complete analytical measurements. Automatic routines simplify operation, and an internal diagnostic routine continuously monitors instrument performance and warns the operator of potential problems with calibration, temperature, power, and electronic malfunctions. Data interpretation requires some knowledge in mass spectroscopy to determine data integrity. The technology for characterizing environmental pollutants on-site is fully developed and readily available. The problem which exists is convincing people that, when implemented properly, the rapid generation of data which field analysis provides results in a dramatic savings of time and cost in comparison to conventional techniques of chemical detection.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Ultra-Sonic Ranging and Data Systems (USRADS)

Application : Non-intrusive

Brief Description : USRADS automates the tracking and mapping of field survey data. It uses ultrasonics to locate the surveyor each second to +/-6", radio-frequency to transmit field data for each location, and micro-computers to record, display, and analyze the data in real-time. USRADS replaces the conventional gridding, manual reading and recording, and related data input/reduction tasks. Its advantages include more data per \$, less time, fewer errors, and quality graphics. USRADS is independent of the detection package and is designed for ease of changing detectors while at a site.

Company Name/POC: Chemrad Tennessee Corporation/Chuck Flynn

Address : 739 Emory Valley Road/Oak Ridge, Tennessee 37830

Phone Number : 615 481-2511

Fax Number : 615 483-952

Technology Maturity : Commercial use experience

Performance History : Numerous jobs have been successfully completed for DOE and DOD projects. Objectives include: mapping radioactive contamination and dose rates over several hundred acres, mapping unexploded ordnance at abandoned and active test ranges, mapping underground burial trenches, and identifying heavy metal contamination in surface soils.

Comments : Training requires a minimum of one week. Proficient deployment and optimum productivity is reached within 4 to 6 weeks by new hires working along-side experienced operators. Tight spaces such as alleys or hallways that are only 3' in separation between walls require careful deployment. Extremely noisy environments can raise the ultrasonic noise floor such that USRADS operating range is reduced. USRADS is not yet user-friendly. Proper operation is dependent on trained operators and access to qualified experts. However, implementation through USRADS is immediate. USRADS needs vehicle support for deployment to and operation on the site, liaison to technical staff or data reporting, and USRADS supply maintenance support.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Instrumented Cone Penetrometer

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : A series of instrumented cone penetrometers, Depth to 60m; measures ph, conductivity, redox potential, moisture, etc.; being developed for VOC's

Company Name/POC: Delft Geotechnics/Mr. Viergever

Address : #2, Stieltjesweg, P.O. Box 69/2600 AB 2628CK Delft, Netherlands

Phone Number : 011 31 152 693500

Fax Number : 011 31 152 610 821

Technology Maturity : Commercial use experience

Performance History : Delft Geotechnics performs over 700 jobs a year in which this technology is used routinely.

Comments : Limitations are depths > 80m, rocky soil. The specific technology can be adapted to meet a DOE need for rapid, semi-intrusive analysis.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : D Tech BTEX Test

Application : On-site

Brief Description : These test kits are available for determining the presence of benzene, ethylbenzene, toluene, xylene, and explosive compounds in water and soil. Analyses of concentrations as low as parts per billion are performed in the field by addition of a color-developing solution. The color is compared to a standard chart to determine the concentration present. Sensitive to 600 ppb BTEX in H₂O; sensitive to 2.5 ppm BTEX in soil.

Company Name/POC: EM Science/Bruce Crane

Address : 480 Democrat Road/Gibbstown, New Jersey 08027

Phone Number : 800 222-0342

Fax Number : 609 423-438

Technology Maturity : Commercial use experience

Performance History : Immunoassay has become an increasingly useful method for on-site environmental sample screening. Immunossay methods have been accepted in EPA SW-846 method drafts for publication.

Comments : Test is specifically designed to detect BTEX. Up to four tests can be run in less than 25 minutes.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Environmental Enzyme-Linked ImmunoSorbant Assay (ELISA)

Application : On-site

Brief Description : ELISA technology is used to screen for selected contaminants in soil and water. EnSys products detect pentachlorophenol <0.5 ppm, petroleum hydrocarbons 100 ppm, and polychlorinated biphenyl to <1 ppm. The test employs antibodies to detect contaminants and provide a colorimetric result. A test to detect Polynuclear Aromatic Hydrocarbons (PAHs) has a sensitivity appropriate to regulatory needs. All tests correlate to accepted USEPA Methods at levels of 85 percent or greater.

Company Name/POC: EnSys Environmental Products, Inc./Kevin Carter, PhD

Address : P.O. Box 14063/Res. Triangle Park, North Carolina 27709

Phone Number : 800 242-7472

Fax Number : 919 941-5519

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

ELISA technology has been used for site assessment at over 300 sites. The numbers of samples run at sites ranged from 1 to 1,200. Some of the parties which have used the kits are listed as follows: ATEC, Bechtel, Chem Waste Management, CH2M Hill, Ecology & Environment, Florida Power & Light, General Electric, Gas Research Institute, Geraghty & Miller, IT Corp., Jacobs Eng., & Roy F. Weston. A full list is available. Sample homogeneity can cause problems.

Comments : The test requires minimal skills which include basic reading comprehension and good manual handling skills. All materials are prepackaged and sample manipulations are minimized. Minimal training will allow an inexperienced operator to run tests quickly and correctly. The tests have a shelf life of 3 to 5 months at 75 degrees Fahrenheit and must be used between 40 degrees Fahrenheit and 90 degrees Fahrenheit. The tests are extremely easy to implement. The tests allow for a rapid turnaround time of sample results. This on-site information allows investigators to place other samples more effectively, saving further time and expenditures. There is no infrastructure required to run the tests, increasing its ease of implementation. The test has received, effective 7/13/92 USEPA Methods approval for field screening.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Toxicity & Genotoxicity Screening

Application : On-site Ex-situ.

Brief Description : Company manufactures and sells a range of field testing kits for the screening of environmental samples (water, soil, sediment, sludges, etc.) for both acute toxicity, and genotoxicity and mutagenicity. Technology uses genetically engineered strains of bacteria to produce distinct color changes in the media being tested to determine biological effect endpoints.

Company Name/POC: Environmental Biodetection Products Inc./Dr. Ran Lifshitz

Address : 14 Abacus Road/Brampton, Ontario, Canada L6T 5B7

Phone Number : 905 794-2325

Fax Number : 905 794-233

Technology Maturity : Commercial use experience

Performance History : Performance Data are Available.

1. Survey of contaminated sediments and sludges around the Great Lakes basin. High correlation with much more costly comparable technologies. Contact: Dr. Barney Dutka, Canada Centre for Inland Waters, Environment Canada (905-336-4923; Fax 905-336-4989).
2. Survey of Rhine and Oder Rivers and North Sea sediments. Very favorable comparison with much more expensive and complex research technologies. Contact: Dr. Peter Hansen, Professor, Ecotoxicology, Technical University of Berlin (011-49-30-31421586; Fax 011-49-30-838113).

Comments : Full instructions provided with products. One-half day of practice for technologist is useful to become familiar with tests. Method details vary with parameter being measured. General procedure involves: (1) rehydration of freeze-dried bacteria; (2) placing the rehydrated testing bacteria into contact with a slurry of the material to be tested and allowing the mixture to incubate for one to two hours; and (3) reacting the bacterial test mixture with a chromogenic substrate and recording a color change as the biological effect endpoint. Tests have been designed to be easy to use. Quality control is done to a high degree in manufacturing, leaving little chance for variability in use resulting in a high degree of reproducibility. Tests are highly flexible for use in all types of test slurries and waters. A small (~\$300.00) 120V or 12V incubator is required for several tests. All consumable items come in the test kit. Kits are couriered to the site within two weeks of receipt of a purchase order.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Geoprobe/Mobile Lab

Application : In-situ (vadose zone) Ex-situ
 In-situ (saturated zone)

Brief Description : Mobile Lab for rapid, low-cost analysis of soil gas, soil and groundwater samples for VOC's using a temperature programmed GC with PID-FID detectors operated in series. Soil and groundwater samples are analyzed semi-quantitatively using the manual static headspace method. Performs very well for preliminary site evaluation work. On-site analysis (screening) allows real-time interactive sampling decisions and minimizes the number of samples requiring more expensive off-site analysis. Eliminates down time waiting for analytical results from off-site laboratories.

Company Name/POC: Enviroscan Corp./Doug Shubring**Address :** 303 West Military Rd./Rothschild, Wisconsin 54474**Phone Number :** 715 359-7226**Fax Number :** 715 355-3221**Technology Maturity :** Commercial use experience

Performance History : The Mobile Lab is used primarily to provide on-site VOC analysis of samples collected with the Geoprobe soil gas, soil, and groundwater sampling unit. Numerous projects have been completed throughout the midwest. Most projects range in size from one day to one week. The Geoprobe sampling system and Mobile Lab are generally successful at most sites. Sampling depth limited to about 15 ft., analysis limited to a select list of VOC's. The Mobile Lab and Geoprobe system are operated by trained and experienced Enviroscan personnel. Mobile Lab requires chemistry and GC experience.

Comments : Mobile Lab GC is set-up for relatively short (15-20 min) run time. To accommodate rapid analysis, early eluting compounds, such as vinyl chloride are usually not detected or quantitated. GC operating conditions and column type can be modified to meet project specific requirements. Certain types of geology and buried obstacles may limit use. Certification and approval requirements for Mobile Lab services may vary from state to state and from user to user. Service cost and lead time would be impacted if certification/approval requirements are substantial. Project specific QA/QC requirements will also affect cost and on-site productivity. Radioactive contamination of personnel and equipment is of great concern to the vendor. Enviroscan has no experience in handling this type of material.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : "Non-Drilling" Hydraulic Probe Sampling and Mobile Lab Analysis

Application : In-situ (vadose zone) Ex-situ
 In-situ (saturated zone)

Brief Description : Combined "non-drilling" sampling technology for unconsolidated soils and field laboratory analysis of VOCs using lab-grade gas chromatography equipment. Rapid sample collection (soil-gas, soil and water) with minimal investigation-derived waste generation (e.g., no cutting or purge water), and real-time field analysis with a high level of QA/QC (e.g., HAZWRAP "Level B" DQO equiv.). Cost-effective, time efficient complement to traditional drill rig sample collection in unconsolidated sediment. No waste is generated and probe equipment is very safe to operate. Real-time analytical results (primarily headspace techniques) permit rapid decision-making and "one time" thorough site assessments.

Company Name/POC: EnviroSurv, Inc./Hunt Chapman

Address : 2800 C Dorr Ave./Fairfax, Virginia 22031

Phone Number : 703 204-3580

Fax Number : 703 204-358

Technology Maturity : Commercial use experience

Performance History : DOE Contact: Dr. Robert Siegrist, Oak Ridge National Lab.

Comments : Technology application requires experienced field chemists and hydrogeologists. The data generated equals, or exceeds, fixed lab quality. But the CLP bias must be overcome; namely the perception that such information is always superior to field analytical results. The field results can be self supporting in terms of spikes, duplicates, calibration data and supporting documentation. Probing equipment is limited to unconsolidated sediments. Also, technique is not amendable to continuous coring, or borehole logging. Large sample throughput is primarily limited to VOCs. Fewer analyses per day are possible when extractions are required. Analysis is "efficiency" limited to 10-15 target compounds. Full scan VOCs analyses are less cost-effective and time efficient. Rapid mobilization, equipment set-up and use by experienced personnel. Only a 2-person field team required for sample acquisition and on-site analysis. Flexibility for all media sample collection and analysis (soil-gas, soil and water). Regulatory agency awareness of data quality; overcoming the "fixed-lab bias." Acceptable as a complement to the traditional drill rig/fixed lab approach to environmental site characterization. The quality of data generated depends on the experience and knowledge of field personnel. Widespread technology use will increase as more people become aware of the sample quality problems associated with handling, shipment and delayed analysis.

Source of Information : TechCon

CONTAMINANTS :				
☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants	
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant	
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A		

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name : Gamma Ray/Neutron/X-Ray Detection Systems

Application :	On-site	Ex-situ
	Off-site	

Brief Description : The company provides x-ray, gamma ray and neutron detection in the gamma energy spectrum of 1KeV to 3MeV, with detection of radiation from 1 microR/hr. Equipment has capabilities of both spectral and total count detection; detector sizes range from 4.5 cu inches to 8800 cu inches. Detection is facilitated by a plastic scintillator medium and/or sodium iodine. Fixed, portable, vehicle mounted and airborne systems are available.

Company Name/POC: Exploranium G.S. Limited/Stan Boyington

Address : 264 Watline Ave./ Mississauga, Ontario, Canada L4Z 1P4

Phone Number : 905 712-3100

Fax Number : 905 712-3105

Technology Maturity : Commercial use experience

Performance History : More than 200 GR-110 gamma ray scintillometers are currently in service. Approximately 40 GR-820 airborne multichannel gamma ray spectrometers with a variety of detector packs (ranging in size from 1024 cu. in. to 3840 cu. in.) are operating in both helicopter and fixed wing aircraft. List of operators is available on request.

Comments : Temperature ranges for Model GR-110: operating -24 C to + 50 C; Storage -30 C to + 70 C.
Temperature ranges for model GR-820: detectors -20 C to + 40 C; Console: -10 C to +40 C.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Portable Measuring System For Dose Rate with GPS and GIS Integration

Application : On-site Ex-situ
 Off-site

Brief Description : Measurement of dose/dose rate and determination of natural radioactivity due to an extremely high detector sensitivity (measurement of other radiation components possible). Satellite based determination of the actual geographical position by involving GPS and data listing related to position coordinates. Mapping of the measured values and integration into a GIS for further project related processing. Measurements for large-surface mapping of radioactive contamination. Control of radioactive contamination with respect to old neglected deposits in mining areas, etc. Support of decision making processes in the industrial and commercial business. Stationary system with ODL and weather sensors and possible integration into local data networks or remote inquiry.

Company Name/POC: FPM Space Sensor GmbH/Michael Kandler**Address :** Am St. Niclas Schacht 13/D-09599 Freiberg/Sa./Germany**Phone Number :** 49 3731 781 225**Fax Number :** 49 3731 781 22**Technology Maturity :** Commercial use experience

Performance History : In-situ measurements in uranium - mining areas and old neglected radioactive deposits in East Germany (e.g., WISMUT areas). Measurements by order from local authorities, like Jandesant fur Umwelt and Geologic Sachseu.

Comments : The measuring system is a joint development of three partners in Saxony:
 FPM Space Sensor GmbH, Freibert
 AMC Analytic and MeBtechnik GmbH, Chemnitz
 VACUTEC MeBtechnik, Dresden
 For detailed product description, please contact FPM Space Sensor GmbH.
 AMC Analytic and MeBtechnik GmbH Chemnitz contact person: Dr. Frank Neubert/Stollberger
 Str. 4A/D-09119 Chemnitz/49 37 1300 114

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Rapid Field Analysis of Mercury (RFA/Hg)

Application : On-site Ex-situ

Brief Description : Contaminant identified as Mercury.

Method for rapidly determining mercury concentrations in solids. Mercury is extracted from solids and concentration determined in solution at ppm level using electrochemical method in less than 1 hour.

Company Name/POC: General Electric, Corp. R&D/Mark Sneeringer

Address : P.O. Box 8, K1-3C3, Schenectady, New York 12301

Phone Number : 518 387-5334

Fax Number : 518 387-7611

Technology Maturity :

Bench scale testing, only

Performance History : Performance data are available.

Laboratory development.

Comments :

The removal of mercury from environmental samples is a particularly difficult challenge. Mercury may be found in a myriad of species including the volatile, liquid elemental form, the very inert and insoluble sulfide, and deadly organic derivatives. In addition, mercury can interconvert between all of these forms in nature. Mercury also binds very tightly to soil, especially to the organic fraction. An aqueous extractant has been identified to remove all forms of mercury from soil as well as other media by oxidizing the contaminant, and converting it to a highly water soluble form. The extractant has a high affinity for mercury, but has little interaction with indigenous metals such as calcium, magnesium or iron. The result is that mercury is preferentially removed from the soil and other media. No acids or bases are required and thus the extractant has little reaction with the media. Through the optimization of processing parameters, a set of conditions has been developed to rapidly (in less than 30 minutes) and thoroughly remove mercury from solids. With the mercury in solution, analysis by traditional methods becomes a viable means of determining the extent of mercury contamination in environmental samples.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : MetPAD and MetPLATE Heavy Metal Toxicity Test Kits

Application : ☒ On-site ☒ Ex-situ

Brief Description : MetPAD and MetPLATE are rapid qualitative and quantitative microbial assays that are specific to heavy metal toxicity. The technological basis of the kits is the inhibition of a bacterial enzyme by toxic heavy metals in environmental samples. The sensitivity of these kits to heavy metals is generally higher than MICROTOX and is of the same order or better than Daphnia and fish bioassays. The MetPAD and MetPLATE greatly reduce the costs associated with determining toxicity characteristics. Using either the MetPAD and MetPLATE concurrent with other general toxicity assays would help determine the nature of chemicals causing toxicity.

Company Name/POC: Group 206 Technologies, Inc./J. Craig Watts

Address : 6705 NW 24th Place/Gainesville, Florida 32606

Phone Number : 800.869-8729

Fax Number : 904 376-913

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

The MetPAD and MetPLATE have proved successful by research groups in the public and private sector. Oscar Pancorbo (State of MA, DEP, 508 682 5237) has used and is planning to use these kits for toxicity screening and identification at several sites throughout Massachusetts. These kits have been evaluated by at least two independent research groups. Rochelle Rabidue (3M, 612 778 7065) and Rosalind Wei (In Vitro, 714 851 8356) have performed separate evaluations of these kits with results supporting the Company's claims.

Comments :

The MetPAD and MetPLATE are small, lightweight test kits; however, a portable incubator is required to complete either test. The MetPAD and MetPLATE test kits are designed to detect and measure toxic heavy metals in the ppm range. These kits will not detect heavy metals that carry a negative charge, e.g., cyanide and arsenic and will not differentiate among the various heavy metals found within a sample. The kits must be stored under refrigeration and must not be exposed to direct sunlight. The MetPAD and MetPLATE are simple to use and portable; flexible in the sense that it can be used on several types of samples (e.g., soils, sludge, water and wastewater). Each kit comes with easy-to-follow instructions.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : MetSOIL Direct Heavy Metal Toxicity Assay for Soils

Application : On-site Ex-situ

Brief Description : MetSOIL is a direct toxicity assay for soils, sediments, and sludges which is specific for heavy metal toxicity. In the test protocol, bacteria are exposed to the solids, then provided with an enzyme substrate. Absorbance of the reaction mixture is used as a measure of enzyme activity, thus toxicity. MetSOIL greatly reduces the high cost associated with determining toxicity characteristics. The MetSOIL minimizes the dilution of extractable heavy metals. MetSOIL incorporates a quantitative and repeatable means of controlling the interaction between the solid matrix and the enzyme substrate reaction. This is in contrast to the complex approach employed in the MICROTOX solid phase assay.

Company Name/POC: Group 206 Technologies, Inc./J. Craig Watts

Address : 6705 NW 24th Place/Gainesville, Florida 32606

Phone Number : 800 869-8729

Fax Number : 904 376-9135

Technology Maturity :

Bench scale testing, only

Performance History : The MetSOIL technology has not been used outside the laboratory setting; however, the MetSOIL test kit is based on the same technology found in the proven MetPAD and MetPLATE. Until now, the inventors and their associates have been the only people to use the MetSOIL technology (Dr. Gaby Bitton, University of Florida. 904 392 4409).

Comments :

The MetSOIL is a small, lightweight test kit. A portable incubator is required to complete the test. The MetSOIL test kit is designed to detect and measure toxic heavy metals in the ppm range. These test kits will not detect heavy metals which carry a negative charge (e.g., cyanide and arsenic). This test kit will not differentiate among the various heavy metals found within a sample. This test kit must be stored under refrigeration and must not be exposed to direct sunlight. The MetSOIL test kit, upon completion, will provide advantages over expensive and time-consuming laboratory procedures. The MetSOIL makes it possible to screen soil, sediments, or sludge samples for heavy metal toxicity. The MetSOIL is ideal for either laboratory or field use. Final MetSOIL packaging issues are being resolved for commercialization.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : CPT Continuous Soil Gas Sampling

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Continuous soil gas sampling and analyzing with depth using modified CPT-rig, analyzing for VOC, CH₄, CO₂, O₂, continuously plus GC-PID analyses at specific depth directly on location. Maximum depth of penetration ~100 feet depending on geology. Maximum pressure 15 ton. Possible to add gamma log, electric log and soil and groundwater sampling at specific depth. Soil gas sampling works even below groundwater table due to special filter; performs very well - used on hundreds of sites. Hole is packed with bentonite after measurement.

Company Name/POC: Kampeax Geodan/Connie D. Johnsen

Address : Stamholmen 112/DK 2650 Hvidovre, Denmark

Phone Number : 45 36390737

Fax Number : 45 3677231

Technology Maturity : Commercial use experience

Performance History : Has been running very well the last 3 years. Used on hundreds of sites - mainly in Denmark; but also Sweden, Poland, and Germany. Only problem may be difficulties in penetrating soil due to large stones; very compacted sand etc.; but that counts for all penetrating methods, including drilling.

Comments : The truck is four wheel drive, but needs a fairly stable terrain. Different geology may limit depth; very low permeability soil may slow down the measured speed.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Ellog with Level-Specific Gas and Water Sampling**Application :** On-site Ex-situ

Brief Description : The Ellog auger drilling method provides a precise electrical and gamma log while drilling, which is interpreted into a very detailed lithology. The spectral gamma log analyzer makes it possible to detect both clay layers and radioactive pollutants. The analyzer measures the energy level of the radiation, thus making it possible to identify the radioactive elements. The undisturbed level-specific gas and water sampling gives an unseen opportunity to investigate the soil, gas, and groundwater while actively drilling. The gas and groundwater samples are pumped to the surface in a closed system preventing pollution of the samples and the surroundings. While drilling, the measuring equipment can be removed from the drilling stem allowing soil samples and placement of monitoring pipes through the hollow drilling stem. Ellog drilling replaces the use of traditional drilling techniques in depths less than 100 meters.

Company Name/POC: Kampeax Geodan/Connie D. Johnsen**Address :** Stamholmen 112/DK 2650 Hvidovre, Denmark**Phone Number :** 45 36390737**Fax Number :** 45 36772310**Technology Maturity :** Commercial use experience

Performance History : The Ellog method has been used in Denmark for 7 years, and in that period it has produced approximately 20,000 m of log, and approximately 4,000 water samples have been taken. The Ellogs have given new and unseen details about lithology and groundwater chemistry in Denmark.

Comments : The deepest drilling depth is approximately 100 m with existing equipment. The auger drill method is used solely in unconsolidated material. The drilling equipment can be mounted on almost any rotation drill rig. The system is very flexible and can easily be moved around the USA in an ordinary shipping container. The transportation of radioactive soil to the surface can be avoided, because it is possible to detect the radiation in-situ with the radiation analyzer. Then the drilling process can be stopped or the crew can protect themselves. Only about 20 liters (drilling meters) of material is transported to the surface. The actual drilling can be performed by any skilled driller, while the measurements must be done by a trained geophysicist or engineer. The logs must be interpreted by a trained geophysicist.

Source of Information : International TechCon

CONTAMINANTS:

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name: On Line Gamma Monitoring Systems

Application: On-site Ex-situ

Brief Description: On line gamma monitoring systems for discrimination of radioactively contaminated and uncontaminated materials.

Company Name/POC: KEMA Nederland B.V./J. van der Steen

Address: P.O. Box 9035 NL-6800 ET/ARNHEM The Netherlands

Phone Number: 31 26 356 6104

Fax Number: 31 26 351 5835

Technology Maturity: Field demo complete

Performance History: Contact company for performance history data.

Comments: High gamma background might present some problems with the detection limit. The system has been developed for the cleanup of disposal areas for low level radioactive waste at KEMA. It proved to be a quick and reliable system, which accelerated the cleanup operation considerably.

Source of Information: International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Alpha Track Etch Detectors**Application :** Non-intrusive

Brief Description : Detectors using alpha track technology have been in widespread use for the past 15 years. These detectors are composed of a very pure and specific form of CR-39 type polycarbonate plastic. The material is not sensitive to interference from beta or gamma radiation and exhibits a 70 percent efficiency to alpha particles. The detectors are deployed. Alpha particles will penetrate the detector surface forming damage sites which, when etched in a caustic bath, are enhanced and visible under magnification. Evaluation of etched detectors will quantify levels of alpha contamination and characterize its distribution. Alpha track detectors have a nominal thickness of 1.0 mm and can be laser cut to various dimensions. Conventional radiation survey instruments employ probes which are large and cannot access irregular surfaces or crevices which may hold alpha contaminated material. It is questionable that conventional instrumentation can accurately measure the low levels of alpha contamination permitted under existing release levels.

Company Name/POC: Landauer, Inc./Sue Morrow**Address :** 2 Science Road/Glenwood, Illinois 60425**Phone Number :** 708 755-7000**Fax Number :** 708 755-7016**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.

Although the alpha track technology has been commercially available since 1978, its application to characterization of alpha contamination is new and the application's development effort has been conducted jointly with ORNL. Pilot tests have involved deployment inside crevices, valve and flange surfaces, contaminated floors, under hot cell/glove boxes. (Dr. Richard Gammage, Martin Marietta Energy Systems, Inc., (615) 574 6256). Initial tests have been completed to characterize the level of contamination gradients and form of suspension in ground water. (Dr. John McCarthy, ORNL (615) 576 6606).

Comments :

A technician could deploy individual detectors at hundreds of site locations in a day with retrieval on the same or following day. Little additional training is required beyond that already common to a person trained in taking radiation measurements. Specific etching and detector evaluation training require few basic skills beyond that of a high school graduate with general chemistry or physics background. Landauer's proprietary Lantrak (registered name) detector material and optimized processing protocols permit a low detection level and precise data. Technology is likely not appropriate for 100 percent monitoring of large surface areas of when live-time data is a prerequisite. It is expected that statistical sampling of surfaces with contamination levels at or below the regulatory release level will be a main value of this technology. Landauer, Inc., now processes some 1,000,000 detectors per month of various types including the alpha track type, and offers this service on a commercial basis. In situations where on-site processing is required, a satellite laboratory can be readily established using commercially available etching and analysis equipment. Landauer maintains current training and QC protocols for this technology.

Source of Information : TechCon.

CONTAMINANTS: ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name: Rapid Optical Screening Tool (ROST-TM)

Application: In-situ (vadose zone)
In-situ (saturated zone)

Brief Description: The Rapid Optical Screening Tool (ROST) is a transportable, state-of-the-art Laser Induced Fluorescence (LIF) system for soil and groundwater hydrocarbon analysis. ROST is used with a cone penetrometer test (CPT) vehicle. The ROST system employs laser-induced fluorescence spectroscopy for in-situ analysis of petroleum hydrocarbons. ROST can differentiate petroleum fuel types by acquiring a wavelength time matrix (WTM) during a short pause (one minute) in the CPT push. WTM's are especially useful for determining whether multiple sources of contamination are present. Through correlation of ROST intensity with a small number of laboratory-analyzed soil samples from a site, it is possible to build calibration curves that give ROST correlation, in mg/kg, with conventional EPA methodologies.

Company Name/POC: Loral Defense Systems - Eagan/David A. Bohne

Address: PO Box 64525/ St Paul MN 55164-0525

Phone Number: 612 456-2339

Fax Number: 612 456-309

Technology Maturity: Commercial use experience

Performance History: The ROST system has been successfully demonstrated and/or applied to environmental investigations at over 30 sites that include oil refineries, air force bases (domestic and foreign), abandoned coal gasification plants, gas stations and three EPA Superfund sites. Loral has integrated the ROST system with all major cone penetrometer test systems available worldwide, and has worked with environmental regulatory agencies at the federal, state and local levels to obtain support and regulatory acceptance of the LIF/CPT technology for field screening purposes.

Comments: ROST is easily installed in a cone penetrometer test vehicle in either a temporary or permanent configuration. The ROST system uses UV excitation to generate the fluorescence spectra. Even the best fiber optic cable has high loss in the UV. This limits the push depth to approximately 50 meters. The limits of detection established for ROST for total petroleum hydrocarbons is 10-20 mg/kg (ppm).

Source of Information: TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Mobil Radiological Analysis Laboratory (MRAL)**Application :** On-site Ex-situ

Brief Description : The Mobile Radiological Analysis Laboratory was conceived to provide both qualitative and quantitative radioanalytical services for field operations. The system was designed to utilize commercially available technology, integrated with both standard and modified analytical procedures, to meet the specific needs of the customers. Los Alamos National Laboratory currently has two units in operation that have been supporting field operations for two years. Two additional mobile laboratories were to be in place for the field sampling season of fiscal year 1994. The advantages include proximal real-time analysis and reporting of samples at a fraction of the cost of fixed-base labs and high sample through-put. Disadvantages include higher detection limits and some non-specific analysis.

Company Name/POC: Los Alamos National Laboratory/George Brooks**Address :** P.O. Box 1663/TSD-9/MS-K494/Los Alamos, New Mexico 87545**Phone Number :** 505 665-2583**Fax Number :** 505 665-5982**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.

The Mobile Radiological Analysis Laboratories (two currently in operation) have been supporting the Environmental Restoration Program since March of 1992. They have supported approximately 15 separate Operable Projects for site characterization within LANL. Support is expanding to include equipment release programs. Total samples analyzed within the mobile laboratories for the above-mentioned programs exceed 3000, with each of the samples requiring up to as many as 10 separate analyses.

Comments :

The Mobile Radiological Analysis Laboratory should not be utilized/deployed when the analytical requirements of the project cannot be met from the data generated from the lab.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Release Measurement (RM)

Application : On-site Ex-situ

Brief Description : Total gamma-measurement for release of large amounts of (very) low level residual materials for conventional reutilization of materials or disposal. The technology is designed for disclosure of hidden gamma-emitters.

Company Name/POC: NIS Ingenieurgesellschaft mbH/Ludwig Seyfferth

Address : Donaustraße 23/D-63452 Hanau/Germany

Phone Number : 49 181 185 159

Fax Number : 011 49 6181 1200 3

Technology Maturity : Commercial use experience

Performance History : The development of the concept was sponsored within the R&D program of the European Commission. The first facility application was in 1988 for material from the dismantling of a nuclear power plants (NPP) in Niederaichbach. The mobilized version is being used for release measurements at operating NPP. Another facility has been installed at the NPP Greifswald for the dismantling program of 5 NPP units.

Comments : The technology is suitable for gamma-emitting radionuclides only. The concept can be adapted to specific requirements (e.g., size, specialized for specific material, other local requirements). So far the technology has not been applied in the U.S. The facility could be delivered directly or through a partner in the U.S. (e.g. NUS Corp). The existing facility achieves an average throughput of 10 t/d (depending on the kind of material). For application within the Wismut restoration program a facility for about 100 t/d is in the planning and licensing stage. A modified concept is being used for monitoring of trucks and railroad cars.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Petrex Passive Soil Vapor Surveys**Application :** In-situ (vadose zone)

Brief Description : The technology defines hazardous VOC and SVOC source areas, migration pathways, and contaminant boundaries by passive collection of contaminant vapors emanating from subsurface sources onto PETREX samplers. Samplers are analyzed by mass spectrometry to provide qualitative contaminant identification at each sampling point. Data is presented in compound specific isopleth maps. The method has successfully detected and defined known and unknown contaminant boundaries in leaking tank, landfill, solvent pit, and pipeline studies. Groundwater patterns and lithological information often can be inferred from the maps.

Company Name/POC: Northeast Research Institute, Inc./Fred DiBattista**Address :** P.O. Box 859/270 Farmington Ave./Suite 128/Farmington, Connecticut 06034-0859**Phone Number :** 203 677-9666**Fax Number :** 203 677-7008**Technology Maturity :** Commercial use experience

Performance History : Approximately 900 jobs in the past 5 years; average size \$10K, ranging from \$2K-\$150K/site. Recent comparative evaluations of the PETREX method reported very good success with few problems. Reports from DOE, GRI and Union Carbide are included in the SOQ.

Albert Lamarre, Lawrence Livermore National Lab (510) 422-0757

Janet Blake, California Water Quality Control Board (916) 657-1033

Tracy Hooper, Corps of Engineers-Nashville (615) 736-7122

Comments :

As with all soil vapor collection and analysis methods, the PETREX technology will not detect non-volatile compounds (metals, salts, etc.) or highly water soluble compounds from groundwater sources. Very deep groundwater studies may require a feasibility test. Due to the field residence time of the samplers, ranging from 24 hours to 3 weeks, this technology is best suited for non-emergency response situations. The PETREX technology has been designed so that field sampling is simple. A PETREX sampler is placed at the bottom of a 1.5x12-18 inch deep hole. This simple process allows flexibility in terms of the field staff qualifications, areas that can be surveyed, and in manpower usage (i.e., multiple surveys can occur simultaneously). Analysis, data interpretation, and mapping are completed by highly qualified specialists in NERI's laboratories. Users need to incorporate time early in the site investigation for the soil vapor survey, before scheduling drilling and other invasive field activities. The technology has been successfully used in clay soils, swamps, frozen or snow-covered grounds and underwater; hand-held meters and active soil vapor sampling methods fail to perform under these conditions.

Source of Information : TechCon

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name: Contaminated Land Measurements

Application: Non-intrusive

Brief Description: In-situ high resolution gamma spectrometry is used to perform large area radiological clearance surveys and plant inventory measurements. Characterization and quantification of gamma emitting nuclides are typically possible to well below UK de minimis standards (400 Bq/kg). Measurements of total dose rates from spectral determinations at less than 0.05 microSv/h are routine. By use of high resolution gamma spectrometry in large area surveys, adequate limits of detection can be confidently obtained with short count times enabling many points to be surveyed in a working day.

Company Name/POC: Nuclear Electric plc/Dr. R. Clayton

Address: Littlebrook Complex/Littlebrook Manorway/Dartford Kent DA1 5PY; UK

Phone Number: 44 1322 28 2800

Fax Number: 44 1322 28 281

Technology Maturity: Commercial use experience

Performance History: Many internal measurements on Nuclear Electric plant and site, experience in foreign plant measurements (PWRs in Spain and Belgium). Site surveys have been carried out, inter alia, at British Rail railheads and around the Trawsfynydd lake. Internal confidential reports may be made available on request.

Comments: On site supply to liquid nitrogen and electricity supply point for battery charging is required. Measurements are restricted to gamma emitting isotopes. However, the results are routinely extrapolated to non gamma-emitters by use of fingerprinting and radiochemistry techniques. Easy to use with minimal local support requirements.

Source of Information: International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Nuclear Magnetic Resonance (NMR)**Application :** On-site Ex-situ

Brief Description : Determines the structure and type of molecules in solution based on nuclear spin of component atoms using spectrographic techniques applied at radio frequencies. Method can be very sensitive (ppm detection), mainly used on organics, suffers signal to noise problems for low concentration measurements, not all atoms have nuclear spins. Solid state NMR is possible. NMR can potentially replace wet analysis. NMR systems are being developed that could be deployed in the field to continuously monitor a small volume in a large multiphase background volume.

Company Name/POC: Oxford Instruments UK Ltd./W. Proctor**Address :** Osney Mead/Oxford OX2 ODX U.K.**Phone Number :** 18 6526 9500**Fax Number :** 18 6526 9501**Technology Maturity :**

Bench scale testing, only

Performance History : NMR is well established in the laboratory (1,000 units). It is also widely used in medicine (Magnetic Resonance Imaging). The technology is under development for a range of industrial measurement situations. Oxford Instruments is developing magnet and radio frequency systems for underground operation (oil) and stand alone support of cryogenic magnets.

Comments : Technology is supported by the supplier in software to transform NMR data into concentrations of identified species. Data can be recorded as in a well logging situation. Technicians need electromechanical skills and training in general measurement techniques.

NMR scientific measurements are well established - underground measurements are not. Technology needs to be developed. Nearly all elements have isotopes that can provide a NMR signal and many organic complexes are now characterized. Signal to noise limits detection sensitivity which can make detection of species of low abundance take many hours. NMR is being developed for underground use by the oil industry to characterize fluids on the basis of proton chemistry. For field deployment, self-contained probes will be operated remotely using electronic data gathering. In concept, probe and base station operation is straightforward. Interpretation methods are being researched.

The main challenge is to deploy probes that have enough field strength to enable targeted spectrometry experiments. This requires the support of high field magnets (possible cryogenic) which it is thought could be done using new materials or compact (military) coolers. It is believed that spectrometry could be carried out in bore holes down to 100 metres using coolers or new magnetic materials, but this contention needs to be proved. Ground penetration to a depth of 2m may be possible using distributed arrays of magnets and radio frequency coils.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☒ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Differential DIE Away For Induced Fission Using NeuSight

Application : Non-intrusive

Brief Description : Intense pulsed neutron source for use in induced fission characterization of waste through differential DIE away technique and neutron radiography (matrix correction). Excellent pulsing characteristic with negligible DAR current and intensity at least x10 nearest alternative transportable source (D-T Tube) significantly improved detection levels due to improved signal to noise.

Company Name/POC: Oxford Instruments/Nigel Boulding

Address : Accelerator Technology Group/Osney Mead/ Oxford OX2 ODX, UK

Phone Number : 44 1865 269500

Fax Number : 44 1865 26950

Technology Maturity : Commercial use experience

Performance History : Accelerator is already a proven product in medical and nuclear applications in fixed sites.

Comments : Lower limits of detection of fissile material yet to be determined. Can be configured as a mobile source/system for use at various sites. Minimal infrastructure requirements. Delivery of system within one year. Can collaborate with Rolls-Royce and could jointly provide x-ray/neutron interrogation systems for waste drum characterization.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Ion Mobility Spectrometry**Application :** On-site Ex-situ**Brief Description :** Real-time measurement of trace chemicals in laboratory or field (ppm to ppb and smaller).**Company Name/POC:** PCP, Inc./Martin J. Cohen**Address :** 2155 Indian Road/West Palm Beach, Florida 33409-3287**Phone Number :** 407 683-0507**Fax Number :** 407 683-0507**Technology Maturity :** Commercial use experience**Performance History :** Contact company for performance history.**Comments :**

The instrument is designed to be operated by a skilled technician. Interpretation of data depends on the sophistication of the application. Gross contamination (>ppm) will overload the instrument; however, proper sample preparation can overcome this problem. The instrumentation can be battery operated but its operating time will depend on the life of the battery. Batteries can be rechargeable and a charger is provided with the instrument. Remote sensor (18 lbs) with gas supply (9 lbs). Need computer for readout. Computer can also be portable. Detection of trace quantities easily accomplished in the field. Identification of unknowns requires more massive equipment not readily portable. Can be used in connection with a gas chromatograph or liquid chromatograph. Available coupled to a quadruple mass spectrometer for identification. Chemical library available.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Germanium Sonde Operation

Application : On-site Ex-situ

Brief Description : The germanium "cryoprobe" or "cryosonde" uses a high purity Ge spectrometer cooled by a solid cryogen to make high resolution logs of gamma activity. The method is unsurpassed sensitivity and selectivity. The technology alternative is coring and lab assay.

Company Name/POC: Princeton Geophysical Services, Inc./J. Baicker

Address : P.O. Box 900/Rocky Hill, New Jersey 08553

Phone Number : 609 921-7061

Fax Number : 609 921-713

Technology Maturity : Commercial use experience

Performance History : Logged more than 100,000 feet in holes totaling more than 1.2 million feet. Clients include most uranium mining companies.

Comments : Operators are provided. Limited to gamma rays >60KeV. Logging trucks are available. No general challenges except quantitative calibration in DOE environments.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** AB-5 Radiation Detector**Application :**

On-site Ex-situ

Brief Description : An industry accepted standard for the measurement of radon gas in air, water and soil; working level; surface contamination of alpha and beta particles; gamma detection - using various probes such as zinc sulphide, scintillation cells, disks. Sensitivities range between 1 to 23 cpm/pCi/L depending on accessory use.

Company Name/POC: Pylon Electronics Inc./Fran Higginson**Address :** 147 Colonnade Rd/Ottawa, Ontario K2E 7L9**Phone Number :** 613 226-7920**Fax Number :** 613 226-8195**Technology Maturity :** Commercial use experience

Performance History : Number and size of jobs have been varied over the years. AB-5 used by DOE contractors (50), EPA offices and HP physicists (10) for various application. Ref. Doug Daniels/Fermco 513 738-6088

Comments : 8 digit display: information may be dumped on printer or retrieved via PC or obtained manually. Condensing humidity is a limitation. -10 degrees C to 50 degrees C operating temperature. AB-5 is delivered ready for use in the field; manual provides operating instructions on day to day operation. QA includes verifying background of cell and electronic noise; plateau curve and all efficiency may be verified annually using a standard. Initial use of equipment may be challenging, but manual describes fully the use and changing of accessories for various applications.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : EMFLUX

Application : In-situ (vadose zone)
 In-situ (saturated zone)

Brief Description : Passive, non-invasive soil-gas sampling method for locating and identifying subsurface contamination (volatile and semi-volatile organic compounds) in groundwater and/or subsurface soil. EMFLUX evaluation on EPA Test Bed reported 91% correlation with actual contamination at depth; reportedly the best to date on the Test Bed. EMFLUX data allows accurate site investigations to be conducted with fewer wells and core borings, thus saving substantial dollars by reducing the cost of drilling.

Company Name/POC: Quadrel Services, Inc./Bruce R. Tucker

Address : 1896 Urbana Pike/Suite 20/Clarksburg, MD 20871

Phone Number : 301 874-5510

Fax Number : 301 874-556

Technology Maturity : Commercial use experience

Performance History : EMFLUX has been employed successfully on 32 sites in 17 states. Jobs have ranged from 10 to 250 sample points, covering a fraction of an acre to a hundred acres/study. No significant problems encountered on any site. Reference: Mr. Carl Nardin, U.S. Army Corps of Engineers, Omaha District; phone number (402) 221-7774.

Comments : One hour training, comprised of hands-on field practice. Personnel must possess good mechanical skills and ability to work outdoors, but no formal education or training is required to correctly deploy and retrieve EMFLUX devices. Different absorbents used for different applications, thus cannot sample PAHs and light aromatics at same time, for instance. Must have 6" holes cut through asphalt or concrete so EMFLUX devices can rest on bare soil. Analysis limited to offsite GC/MC. Extremely easy to use by 2-person team in field with minimum of training. Field team supported by offsite equipment preparation and analytical laboratory (GC/MS) facilities in place and in daily commercial use. Level of field QA/QC is a function of the care with which EMFLUX devices are emplaced and (later) retrieved.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Prompt Gamma Neutron Activation Analysis (PGNAA)**Application :** In-situ (vadose zone) Ex-situ**Brief Description :** PGNAA performs a non-invasive characterization of concentration profiles of hazardous or radioactive elements; can be used in-situ in the natural environment, within isolated packages or objects, or, as appropriate, in process monitoring control. Sensitivity down to "clean" levels is generally achievable, and the technique applies throughout the periodic table. It leaves no residual radioactivity.**Company Name/POC:** Scientific Ecology Group, Inc./C.P. Keegan**Address :** 1501 Ardmore Boulevard/Pittsburgh, Pennsylvania 15221**Phone Number :** 412 247-6255**Fax Number :****Technology Maturity :**

Field demo complete

Performance History : Bench scale testing and calibration for buried uranium.
Other elements in process.
Field application with uranium-contaminated soil (in-situ).**Comments :** Limited to penetration of a few feet in packed soil for in situ environmental application (approximately 1-4 feet, depending upon contaminant sought).**Source of Information :** TechCon

CONTAMINANTS: ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name: SIGNATURE Gamma Radionuclide Detection and Analysis System

Application: On-site Ex-situ

Brief Description: Provides spectral analysis of a radioactive sample using sodium iodide scintillation detectors with greater efficiency than high purity germanium, and without complex and expensive cooling systems. Uses sophisticated digital signal processing techniques to provide measurement resolution comparable with high purity germanium at reduced cost of ownership. Original concept applied to reactor on-line fission product monitoring, further developed for environmental monitoring. Has undergone trials using blind and mixed radionuclide sources. Identification and quantification of component radionuclides has been achieved down to levels of a few becquerels. Use of sodium iodide well detector and automated sample changing will give further benefits. Suitable for initial evaluation of contamination or confirmation of satisfactory decontamination.

Company Name/POC: Siemens Environmental Systems Ltd./Dr. W.E. Croydon

Address: Sopers Lane, Poole/Dorset, BH 17 7ER/England

Phone Number: 44 1202 782648

Fax Number: 44 1202 78215

Technology Maturity:

Field demo complete

Performance History: Performance Data are Available.

Trial systems monitoring reactor coolant have been installed on three UK power stations, both AGR and MAGNOX, and on other PWR nuclear plant. A 2 out of 4 voted hardware trip mode is available to shut down the reactor in the event of a significant increase of specific fission products. Typical measurements are of ~50 kBq/kg Kr-88 in a mixed power spectrum of ~50 MBq/kg N-16 and other isotopes, and agree with grab sample measurements made with a high purity germanium system to within 10 percent. A trial system for environmental monitoring has been configured to detect atmospheric contamination, suitable for the UK national RIMNET2 emergency response system. Laboratory evaluation has detected radionuclides at levels of a few Becquerels. Further improvements are under consideration.

Comments:

Limited by detector characteristics, which must be designed for the particular application e.g., operating temperature, mechanical shock, weight of background radiation shielding. Flexible system which can be tailored to meet the needs of a specific application. Stand alone or connected to network for remote operation. Challenges are in optimization of system for ease of calibration and extension to variable geometries. Discussions are underway with the Geosciences Advisory unit at Southampton University, UK with a view to combining a sodium iodide well detector and automated sample changing stage with the SIGNATURE analysis system. This would provide improved automated equipment for analysis of radionuclide contamination for either field or laboratory use, and with low cost of ownership. Alternative detector systems could be designed to address other monitoring requirements. Trials have been carried out involving the following isotopes: Eu-155, Mn-54, Ba-133, Na-22, Zn-65, Am-241, Co-60, Cs-134, Cs-137, Eu-152, Ru-106, Co-58, Co-57, Sr-85, I-131, K-40, Gd-153, Sc-46, Tb-160, Ru-103, Cd-109, Ce-139, Sn-113, Y-88, Ra-226, Pb-214, Bi-214, Kr-88, N-16, O-19, Ar-41, Ir-192, Hg-203. However, the system is not limited to available test isotopes but should detect any gamma emitting radionuclide through the use of library emission data.

Source of Information: International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Rapid Screening Field Measurements of Organic Contaminants**Application :** On-site Ex-situ**Brief Description :** Provide rapid screening (5-10 min/sample) and more quantitative analysis (20-30 min/sample) for EPA listed VOCs and semi-VOCs including explosives. Conducted studies with Argonne National Laboratory, EPA (EMSL-Las Vegas) RSKERL - Ada; ERL - Narragansette Region 1) Tenneco, Navy and Army.**Company Name/POC:** SiteWorks, Inc./Dr. L. John Hoover**Address :** Suite 363/11160-F South Lakes Drive/Reston, Virginia 22091**Phone Number :** 703 385-1549**Fax Number :** 703 385-3658**Technology Maturity :** Commercial use experience**Performance History :** Performance Data are Available.

Tufts University/Site Works
 Argonne National Laboratory; Candace Rose; Dr. Jacqueline Burton 1-708-252-8795
 Currently providing service in support of VOC analysis

Army/2 months Fort Devens
 Navy/3 weeks San Diego Harbor
 Tenneco/1 month pipeline
 4 EPA projects

Comments :

Sample throughput dependent on sample matrix TDGC/MS. Analysis of full range of EPA listed organics reduces sample throughput; nonetheless, 2 times faster than fixed laboratory. Can have instruments ready for operation in 4 hrs including calibration. Personnel and mobile unit available to provide service immediately. Can analyze soil gas, direct and extracted soil, air and aqueous media.

3 publications have appeared in the peer-reviewed journals Analytical Chemistry and Journal of Chromatography. Conducted successful field validation studies with EPA, DOE, Army, Navy and private sector documenting data quality and cost/benefit.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Mapping of Soil/Groundwater Pollution

Application : On-site Ex-situ

Brief Description : Mobile laboratory,

Company Name/POC: Steins Laboratorium A/S/Viggo Larsen

Address : Olof Palmes Alle 13a/8200 Aarhus N/Denmark

Phone Number : 45 86 10 80 70

Fax Number : 45 86 10 88 8

Technology Maturity : Commercial use experience

Performance History : During the last 5 years Steins Laboratory has analyzed 4,000 samples for organic and inorganic elements and compounds. The mobile laboratory has been fully operational for 150 working hours during the last 2 years.

Comments : Easy to move and transport. Flexible 24-hour operation.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Ion Trap Mass Spectrometer**Application :** On-site Ex-situ**Brief Description :** The Teledyne MEC (TMEC) Ion Trap Mass Spectrometer is one of the most sensitive mass spectrometers of its size in the world. It is designed to be transportable, rugged, and automated to minimize operator intervention. It is ideal for field evaluation of toxic contaminants. The TMEC Ion Trap Mass Spectrometer will permit field measurements of environmental contaminants in lieu of laboratory analysis.**Company Name/POC:** Teledyne MEC/Mort Cohen**Address :** 1274 Terra Bella Ave./P.O. Box 7244/Mountain View, California 94039-7244**Phone Number :** 415 962-6989**Fax Number :** 415 967-4353**Technology Maturity :** Field demo complete**Performance History :** Field evaluations of the TMEC Ion Trap Mass Spectrometer are underway by the U.S. Army for military applications to detect chemical and biological toxins. Initial evaluation are positive. Point of contact is Dave Sickenberger, U.S. Army Chemical Research, Development, Engineering Center, (410) 671-5533.**Comments :** Instrument is designed for direct sampling, or GC/LC input. The mass range is approximately 20 to 2,000 amu. It is highly sensitive (parts per billion to parts per trillion) and is excellent in isolating coeluting compounds in complex mixtures. It can be used for field evaluation, laboratory analysis, or fence post monitoring applications. The TMEC instrument is designed for ease of use. It can be powered by AC or DC (battery). It can be configured to operate with a PC-based data system, or as a stand alone device with display and data printout. The system is highly automated to minimize operator intervention, and can be easily configured for direct sampling or interface with gas or liquid chromatograph. There are no infrastructure considerations other than availability of prime power (about 1 KW). The TMEC ion trap mass spectrometer was specifically designed for field evaluation applications to measure very low levels of toxic contaminants. The original instrument was developed for the U.S. Army for military applications and to measure chemical and biological contaminants in the field. Approximately \$13M have been allocated for the R&D of this instrument. Initial field evaluations of the demonstration units are currently underway. Teledyne MEC is also developing, under an internal R&D program, an ion trap instrument for commercial applications related to real-time measurement of environmental contaminants. Initial demo units will be available by mid-1993. TMEC has filed for 8 patents on its ion trap technology, two of which have been allowed and will soon be issued. The other 6 filings are still under review by the U.S. Patent Office.**Source of Information :** TechCon

CONTAMINANTS: ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name: Segmented Gate System for the Remediation of Radiologically Contaminated Soil

Application: On-site Ex-situ

Brief Description: Thermo Nuclear's Segmented Gate System uses arrays of sensitive radiation detectors coupled with sophisticated computer software developed by Eberline Instrument Corp. to identify and track the location of radiological contamination from a supply of feed material on moving conveyor belts. The proprietary software controls small diversion chutes that move forward on pistons to divert only the contaminated portion of material from the ongoing feed supply. This results in a substantial volume reduction of the contaminated material.

Company Name/POC: Thermo Nuclear Services/Nels Johnson
Address: 5635 Jefferson, N.E./Albuquerque, NM 87109

Phone Number: 505 345 9931 **Fax Number:** 505 761-541

Technology Maturity: Commercial use experience

Performance History: Performance Data are available.

References: Dr. Edward T. Bramlitt, Defense Nuclear Agency, Kirtland AFB, NM. After processing coral soil contaminated with Pu/Am at Johnston Atoll in the mid-Pacific, the volume of contaminated material that would otherwise have required special, expensive handling, packaging and disposal as radioactive waste, has been successfully reduced by 98%. By mid-January 1994, radioactively contaminated soil had been physically separated from the feed using the SGS, and QC sampling showed no radioactivity above release criteria.

Comments: Material must be free from metallic chunks or debris and sized to approximately 3/4" minus, depending upon the radioactive contaminant. The material must be able to be conveyed on moving belts under radiation detectors and must pass through the segmented gates for maximum volume reduction. However, material can be simply assayed (as for waste stream determinations only) without sorting for volume reduction. The radioactive contaminant must be able to be directly measured by radiation detectors, or be in a known or quantifiable ratio to detectable radionuclides. The Segmented Gate System technology melds sophisticated radioanalytical capabilities with material handling, based on sand-and-gravel plant technology. TMA supplies trained personnel with the equipment for an all-inclusive weekly cost (excluding transportation, travel, and personnel per diem).

Source of Information: TechCon

CONTAMINANTS :

Pesticides/Herbicides

Heavy Metals

PCB

Explosives/Propellants

Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

■ Nonhalogenated VOC

■ Halogenated VOC

■ N/A

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name : X-Ray Fluorescence

Application :

On-site

Ex-situ

Brief Description :

A quick, on-site determination of elemental inorganic contaminants in soils or other matrices. The results are qualitative and quantitative. Detection limits range from 5 to 90 parts per million. There are two instruments: one portable (Spectrace 9000), one transportable (Spectrace 6000). These instruments can handle samples of soil, sludge, powders, liquids, solids, or dust. Elements analyzed range from sodium to uranium on the periodic table.

Company Name/POC: TN Technologies/Spectrace Instruments/Rick Booth

Address : 2555 N. Interstate 35/Round Rock, Texas 78664

Phone Number : 512 388-9100

Fax Number : 512 388-9200

Technology Maturity : Commercial use experience

Performance History : EPA's Environmental Response Team
Many Jobs
Contact: Mark Bernick
Roy F. Weston
(908) 225-3990

Wright Patterson AFB

Clean Up

Contact: Mike Radi

Engineering Sciences
(615) 481-0451

Comments :

Limitations of this technology include:

Inhomogeneous samples affect results.

Spectrace 9000 requires ambient air temperature not exceed 120 degrees Fahrenheit and 105 degrees Fahrenheit for storage.

Spectrace 6000 must have AC power.

Weighing just 19 lbs, Spectrace 9000 is battery-operated with a field pack; this system accommodates almost any environment. The system does not require liquid nitrogen and yet provides very high resolution. The software interface and fundamental parameter analysis technique results in operator ease-of-use that is unparalleled. Spectrace 6000 can be installed in a mobile lab and provides laboratory SRF resolution and results on-site. Spectrace 6000 also has fundamental parameter software and menu driven user interfaces. The only challenge, in terms of field screening, is the required action levels for certain contaminants which may be lower than this technology can accommodate.

Source of Information : TechCon

CONTAMINANTS: ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name: Chlorinated Hydrocarbon Monitor

Application: On-site Ex-situ

Brief Description: This unique rare-earth sensor detects and measures contaminants such as carbon tetrachloride, trichloroethylene, perchloroethylene, dichloromethane, and other chlorinated solvents commonly used in nuclear weapons production. The sensor has no interference from methane, gasoline, paint thinner, and other non-chlorinated compounds.

Company Name/POC: TRANSDUCER RESEARCH, INC./William J. Buttner

Address: 600 N. Commons Dr./Suite 117/Aurora, Illinois 60504

Phone Number: 708 978-8802

Fax Number: 708 978-885

Technology Maturity: Commercial use experience

Performance History: DOE - Hanford/Site Characterization/Cary Martin/Westinghouse 509 376-2648
 DOE - Hanford/Carbon Tetrachloride Removal (Vacuum Extraction Process)/Randy Coffman/Westinghouse/509 376-4263
 DOE - Hanford/Safety, Extraction Well Drilling/Tom Lazarski/Kaiser Engineering/509 373-4791
 Eastman - Kodak/Wastewater Treatment (Dichloropropane, Dichloromethane)/Tom Walton/Eastman
 Kodak/716 477-1633

Comments: This instrument detects and measures chlorinated hydrocarbon vapors only. It does not speciate (responds to all chlorinated hydrocarbons). It requires vapor dilution for concentrations above 50 ppm. Model MP-1 Gas Diluter is available from Transducer Research as separate product. Sensor life is inversely proportional to exposure concentration and exposure time. Model 2001-05 is currently being used for site characterization, safety monitoring, and clean-up process applications. Transducer Research is currently improving sensor performance through automatic dilution and pre-concentration modules. Real-time monitoring capability permits quick analysis of contamination situation. Instrument is less expensive to purchase, operate, and maintain than alternate technologies. Real-time measurement allows determination whether work can be continued. Unit can be used to monitor changes in safety conditions. Selective measurement of chlorinated solvents simplifies operating procedures and speeds up the decision process.

Source of Information: TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Gas Chromatograph/Mass Spectrometer (Field GC/MS)

Application : On-site Ex-situ

Brief Description : Transportable GC/MS used to detect and identify complex mixtures of environmental pollutants and toxic substances in trace amounts. Based on Hewlett-Packard's 5971A mass selective detector, Viking's field GC/MS uses miniaturized components to achieve laboratory-grade results on-site in real-time. Features of the instrument include: a heated membrane separator made from dimethyl silicone for air sampling, internal cryofocusing options for analysis of light volatiles, and high-temperature ramping for analysis of semi-volatiles with higher boiling points. Field GC/MS analysis shortcuts the current process of collecting environmental samples, sending them to a lab for analysis, and waiting weeks for results.

Company Name/POC: Viking Instruments Corporation/Thomas J. Kuehn

Address : 3800 Concord Parkway/Suite 1500/Chantilly, Virginia 22021

Phone Number : 703 758-9339

Fax Number : 703 968-0101

Technology Maturity : Commercial use experience

Performance History : Viking's GC/MS has been field-proven by a number of large industrial firms and government agencies, including Tennessee Eastman, Martin Marietta, the EPA, the FBI, and the U.S. Army, for a variety of applications. The DOE, in conjunction with Sandia National Labs, uses the instrument for emergency response and on-site testing. Steve Thornberg is Viking's reference contact within the DOE (505) 846-8829.

Comments : Use of the instrument requires an operator who is skilled as a lab or field chemical technician and has completed Viking's Field GC/MS Introductory Training Course. The field GC/MS has many unique features designed into the system specifically to provide for flexibility and ease of use. Its rugged transport case, for example, permits operation in virtually any location that is accessible by jeep or plane. Once at a site, the field GC/MS can be unpacked and operational in about 15 minutes. The instrument also offers a number of sample inlet options for air, water, and soil gas and a user-friendly, Windows-based operating system. Finally, service contracts and telephone support are available with every instrument.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : On-Line Gas Chromatograph/Mass Spectrometer for Continuous Emission Monitoring

Application : On-site Ex-situ

Brief Description : On-line continuous emission monitor (CEM) used to detect and identify complex mixtures of environmental pollutants and toxic substances, specifically in air. Based on Hewlett-Packard's 5971A mass selective detector, Viking's CEM includes on-line analysis software, multi-port sampling valves, remote control, and networking capability. The CEM delivers laboratory-grade performance on site in real time. On-line continuous emission monitoring consolidates the barrage of single-purpose instruments currently in use to ensure worker safety and comply with legislative reporting requirements. More important, the new Clean Air Act Amendments make on-line GC/MS monitoring the only practical and cost-effective means of tracking regulated toxins.

Company Name/POC: Viking Instruments Corporation/Thomas J. Kuehn

Address : 3800 Concord Parkway/Suite 1500/Chantilly, Virginia 22021

Phone Number : 703 758-9339

Fax Number : 703 968-010

Technology Maturity : Commercial use experience

Performance History : Although the on-line CEM is ready for commercial production, its predecessor, the Viking Field GC/MS, has experienced great success. Current users of the field GC/MS include Tennessee Eastman, 3M, Martin Marietta, the EPA, FBI, U.S. Army and Sandia National Laboratory.

Comments : Use of the instrument requires an operator who is skilled as a lab technician and has completed Viking's On-Line CEM Introductory Training Course. Viking's on-line CEM is specifically designed for flexibility and ease of use. Its rugged housing, for example, can withstand outdoor use as a fence-line monitor or a long lifetime on the factory floor. The instrument itself offers a number of sample inlet options for air, water and soil gas, and a user-friendly, Windows-based operating system. Finally, service contracts and telephone support are available with every instrument.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** LAPS Probe for Detection of Radionuclides in Soil

Application :

On-site Ex-situ

Off-site

Brief Description : This hand-held instrument can be used by non-scientific personnel to give a very quick (few minutes) and accurate measurement of activity in soil samples in the field. It dramatically reduces the time taken for samples to be analyzed in the laboratory.

Company Name/POC: WASTECHEM Ltd/Dr. M.G. Down**Address :** Earl Road/Stanley Green/Wilmslow/Cheshire, SR93RL, UK**Phone Number :** 161 485 8231**Fax Number :** 161 482 8137**Technology Maturity :** Commercial use experience**Performance History :** Successfully used on 14 acre remediation project.

Comments : Requires NaI gamma spectroscopy for calibration check. Measures total - no discrimination of species. Highly flexible, designed specifically for use by non-technical staff. WasteChem, in collaboration with the Radiation Protection Advisory Service, has produced a novel prototype instrument specifically designed to substantially reduce the cost of analysis. The instrument detector is a thin large area plastic scintillator (LAPS). The LAPS has three modes of operation: (a) It can analyze 2kg soil samples placed in special trays in near contact with the detector, (b) The detector can be mounted on a transport system and moved directly over the contaminated land surface to assess the radioactivity in each square meter of land to a depth of 50 cm, (c) The instrument can be placed 100 cm from the side of a 200 liter drum of contaminated waste to assess the activity for disposal purposes. The instrument is currently being used successfully in the remediation of a large radium-contaminated site in the UK. Using the LAPS in mode a) the specific activity of contaminated soil samples is being promptly and accurately measured in a matter of minutes, on-site, by non-scientific staff. In mode b) non scientific staff can scan a large area in a matter of hours and obtain a reasonably accurate assessment of the contamination distribution over the whole site, and in mode c) non-scientific staff can accurately assess the waste's activity prior to transfer to half iso containers, compulsorily required by the disposal authorities. The LAPS significantly reduces the time delay and costs of analysis using traditional on-site and off-site methods.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Vacuum Permeability (VacPerm)

Application : In-situ (vadose zone)

Brief Description : In situ leakage/permeability characterization of concrete, soils/rocks.
 Vacuum pumping of packed-off section of a borehole.
 Permeable fissures located within plus or minus 2 cm; permeabilities measured down to <20 micro darcy; field precision <10 percent.

[Contact numbers for Waterloo Hydrogeologic (905) 880-2886 Office; (905) 880-2887 Fax]

Company Name/POC: WISMUT GmbH/A. T. Jakubick [Waterloo Hydrogeologic/Thomas Franz]

Address : 09117 Chemnitz/Jagdschanken-strabe 29/WATERLOO HYDROGEOLOGIC/19 McCauley Dr.
 /Bolton, Ontario, Canada L7E 5B8

Phone Number : 49 371 8120 112

Fax Number : 49 371 8120 10

Technology Maturity : Commercial use experience

Performance History : Denison and Rio Algom Mines, Elliot Lake, Canada
 PCS potash mine, Saskatchewan, Canada
 Water intake tunnel, Darlington Nucl. Gen. Station Ontario Hydro, Canada
 Oil storage facility, Kushikino, Hyushu, Japan
 Underground Research Laboratory (URL), Manitoba, AECL, Canada
 Size of jobs: approx \$1000K

Comments : Cannot be used in media saturated above field capacity.
 At permeabilities <20 micro darcy, measurements become long (10-15 hours per 1 section).
 With higher altitudes, the available pressure gradient decreases.

Both surface and subsurface use is possible. Its regularly used in 1 1/2 and 3 inch holes. However, straddle packers can be adjusted to other borehole sizes. Space of approx. 2 x 1 m is needed to set up instrumentation. Regular electric outlet required. The speed of testing could be increased by use of pneumatic packers (instead of mechanical). This would, however, increase the size of equipment and number of pieces. The vacuum permeability method provides a new approach to assessment of permeability in the near-field of rock excavations. The method, which resembles leak testing of vacuum lines, is based on the measurement and interpretation of the pneumatic response to evacuation of the medium. As the induced drainage area is in the order of meters, the method is particularly suitable on the scale of 0.1 to 10 m. The data can be evaluated either analytically or numerically. The evaluation is similar to the approach used in the analysis of drill stem tests in gas wells. Experiments on large scale laboratory models corroborated the validity of the method and the evaluation procedure. Field tests were conducted at a wide range of geomechanical conditions. The collected data indicate that there are three characteristic types of permeability distributions in the excavation damaged zone.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Laboratory Analysis*

Technology Name : Characterization for Physical Separation (Soil Washing)

Application : On-site Ex-situ

Brief Description : Laboratory characterization procedures are used to assess the potential for reducing the volumes of contaminated material requiring downstream treatment, or disposal, by separating contaminated particles and coatings from the uncontaminated bulk. The procedures are based on using particle separation techniques to quantify the differential distribution of the contaminated and non-contaminated particles by using methods based on differences in grain size, abrasion, settling velocity, specific gravity, surface chemical properties, magnetic susceptibility and solubility/leachability. The results from the procedures can then be used to design a separation circuit where the characteristics of the contaminants and the soil can be matched to appropriate physical separation equipment (soil washing). Most soil washing laboratory characterization tests are not as detailed and do not provide as much information for eventual process circuit design. Many laboratory tests carried out by particular vendors are geared to their separation equipment and experience rather than determining the most appropriate separation route and commercial equipment for the task.

Company Name/POC: AEA Technology/Dr. Mark Neville

Address : Building 429, Harwell Lab/Near Didcot/Oxon, OX11 0RA, U.K.

Phone Number : 44 1235 432252

Fax Number : 44 1235 432278

Technology Maturity : Field demo complete

Performance History : (1) UK Department of the Environment: Contact: Judith Denner Tel: 44 71 276-8348. Research programs over years 1990-1994 into the physical separation of contaminants from a number (8) of contaminated soils. (2) US Environmental Protection Agency: Contact: Norma Lewis Tel: (513) 569-7665, Mary Stinson Tel: (908) 321-6683. Research program 1991-1994 using techniques from the mineral processing industry for the treatment of soil from a former gasworks. Contaminants included heavy metals, PAH and cyanide. (3) European Commission: Reprocessing of Beral Mineral Tailings. (4) Other projects: commercially in confidence but include work with contaminated soils and dredged harbour sediment.

Comments : The test procedures need to be carried out in a well equipped laboratory. The results can indicate that differential particle separation can produce a low contaminant bulk and a concentrate but the bulk may not reach the required clean-up target. The concentrate requires further processing or disposal. No real problems in using the actual characterization methods as the tests have been developed from mineral processing tests that have been developed over the past 30 years. Individual soils may pose problems such as in the choice of suitable chemical for attrition scrubbing, froth flotation or flocculation. From the knowledge of the exploitable features it is possible to: (1) assess whether the appropriate target concentration of the cleaned material can be met. Where this is not possible the tests can be used with other treatment tests to ascertain whether a treatment train involving some physical separation can meet the desired target concentration; and/or (2) to configure a treatment circuit based on readily available separation equipment from the minerals processing industry. It is likely that this first circuit is a small throughput pilot scale demonstration circuit. The products from this circuit could also be characterized to monitor the performance in terms of sample heterogeneity, machine performance and to provide data for modification prior to designing the full scale plant.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Laboratory Analysis*

Technology Name : SMP (Sub Mitochondrial Particles)

Application : On-site

Brief Description : The technology utilizes submitochondrial particles (SMP) and is based on the mammalian enzyme complex that mediates cellular electron transport. These bioassays have broad application wherever rapid, inexpensive information about acute toxicity of aquatic or soil samples is needed. SMP-based bioassay products will complement analytical chemistry analysis and whole-organism bioassays by speeding the flow of information and lowering the overall cost of environmental monitoring. SMP tests were designed to provide a means for rapid inexpensive bioassay of harmful materials in environmental samples such as wastewater effluents, landfill leachates, or soil extracts. These tests can be used as a prescreening tool to select samples of concern for further analysis. Based on results of SMP prescreening, follow-up analysis may be carried out using analytical chemistry or whole-organism bioassays (e.g. USEPA's fathead minnow survival test or Ceriodaphnia magna reproduction tests). The SMP tests take less than thirty minutes to perform. In comparison, the whole-organism bioassays require 7 days.

Company Name/POC: Biorenewal Technologies, Inc./Alan J. Dines

Address : 2800 S. Fish Hatchery Rd./Madison, Wisconsin 53711

Phone Number : 608 276-8980

Fax Number : 608 273-698

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

This technology has been used in round robin EPA toxicity tests several times during the past three years. Results are available upon request. The test is currently being used in an EPA funded storm water run-off study being conducted by the Wisconsin Department of Natural Resources in conjunction with an inclusive battery of analytical chemistry tests. This study is not complete and is continuing for the next two years. SMP technology was evaluated two years ago in a USGS study at the Green Bay municipal waste water treatment facility. Results in the form of an extensive detailed report are available. Currently the company is conducting a development contract with Waste Management to evaluate SMP technology as a toxicity test on the effluent of a Superfund landfill leachate treatment system in Wisconsin. The goal is to install a continuous toxicity testing unit that reports results to a remote monitoring location.

Comments : While SMP toxicity test gives results in less than 30 minutes and costs less than \$25 per test instead of one week for the more traditional whole organism tests at a cost of \$500 to \$1,000 per test; it does not provide results that quantify the amount of toxicity or contaminants. Toxicity tests are a general measure of contaminant's impact on the animal kingdom and the environment as a whole.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Laboratory Analysis***Technology Name :** Microwave Sample Digestion**Application :**

On-site

Off-site

Brief Description : The CEM Microwave Sample Preparation System, MDS-2000 series, combines the speed of microwave heating with proprietary sealed vessel technology to significantly reduce the sample preparation (acid digestion) process time. For environmental samples, the process time is reduced by a factor of 8-10. In addition to time savings, the technology provides performance (measure by elemental analysis), safety and cost advantages over traditional hot plate techniques.

Company Name/POC: CEM Corporation/Gregory N. LeBlanc**Address :** 3100 Smith Farm Rd./P.O. Box 200/Matthews, N.C. 28105-200**Phone Number :** 800 726-3331**Fax Number :** 704 821-7894**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.**Comments :**

There are over 3000 Microwave Sample Preparation Systems in use worldwide. The systems are typically used for acid digestion of a variety of matrices for subsequent elemental analysis. It cuts across all industries. Its widest use is for environmental applications. It has proven highly successful as measured by its acceptance in the worldwide marketplace.

Skills associated with a chemical laboratory are all that is required to operate the system. Training can be completed in <2 hours. Complete procedures are supplied with the purchase of the instrument. The system can be set up and running within 1 hour of removal from the shipping box. It can be used in a mobile lab and a standard laboratory. The system operates on 115 vac. (No special requirements). It is applicable to a wide variety of sample types encountered in remediation efforts. A fume hood is not required.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Laboratory Analysis*

Technology Name : Cold Trap Inlet System for GC

Application : Off-site

Brief Description : The cold trap inlet system is used to first cryofocus organic samples (as a frozen plug) and then rapidly deliver the sample to a capillary column for a high speed separation. The cold trap is continuously cooled with a stream of cold gas. Typical trapping temperatures range from -50 degrees Celsius to -150 degrees Celsius. After the sample is cryofocused on the metal coated trap, the trap tube is electrically heated which rapidly vaporizes the frozen sample and delivers it to the mouth of the separation column as a small vapor plug. The cold trap inlet works extremely well for compounds with volatilities as high as pentane. This technology will replace inlet systems used in conventional Gas Chromatography. This will allow for reduction in analysis times from tens of minutes to tens of seconds as compared to conventional chromatography.

Company Name/POC: Chromatofast, Inc./Robin Risser

Address : 912 N. Main Street, Suite 14/Ann Arbor, Michigan 48104

Phone Number : 313 662-3410

Fax Number : 313 662-346

Technology Maturity :

Bench scale testing, only

Performance History : The cold trap inlet system has been utilized through a development contract from private industry for a speciation instrument to analyze automotive exhaust gases. The device has been successfully applied towards cryofocusing a gas sample over several minutes, this proving a means to concentrate the sample and improve detectability within the system.

Comments : The device, when combined with equipment for high-speed gas chromatography will require a single technician with familiarity in using a conventional gas chromatograph. The majority of the operation is automated. The only required procedure would be a method of sample introduction, i. e., syringe injection. The current system employs LN2-cooled N2 gas to achieve the necessary trapping temperatures. While this is satisfactory for a research instrument, alternative cooling is desirable for a commercial instrument. Additionally, smaller more portable ovens capable of quicker temperature programming need to be constructed. For the final instrument, all components must be rugged and packaged into a portable case. Computer software for acquisition and analysis along with appropriate digital displays will also be incorporated.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Laboratory Analysis*

Technology Name : Gas Valve Inlet System for GC

Application : Off-site

Brief Description : The gas valve inlet system is used for extremely fast injections which are required for high-speed gas chromatography. A sample gas travels through an injection tube which is positioned inside a metal block. A small hole in the tube continuously leaks sample gas. The tube is traversed perpendicularly to the capillary separation column so that the leak of sample gas will pass directly over the column opening, thus accomplishing sample introduction. The gas valve inlet system works well for gas sample streams where extremely small injection band widths are desired. This technology will replace inlet systems used in conventional Gas Chromatography. This will allow for reduction in analysis times from tens of minutes to tens of seconds as compared to conventional chromatography.

Company Name/POC: Chromatofast, Inc./Robin Risser

Address : 912 N. Main Street, Suite 14/Ann Arbor, Michigan 48104

Phone Number : 313 662-3410

Fax Number : 313 662-3462

Technology Maturity : Bench scale testing, only

Performance History : The gas valve inlet system is currently being used as a research device at the University of Michigan. It can provide analysis time as short as 2 seconds with very good reproducibility. It has been operated tens of thousands of times with no sign of wear. Project directed under Dr. Richard Sacks, Professor, (313) 764 7373.

Comments : The device, when combined with equipment for high-speed gas chromatography will require a single technician with familiarity in using a conventional gas chromatograph. The majority of the operation is automated. The current gas valve inlet system requires a pressurized sample stream. Techniques need to be developed in order to apply the inlet system to a wider range of samples and media. The device is currently implemented on conventional gas chromatographs modified for high speed operation. Steps for ruggedization of the instrument must be developed.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Laboratory Analysis*

Technology Name : High Speed Capillary Column for GC

Application : Off-site

Brief Description : Capillary column strategies for high-speed gas chromatography are techniques which are used to increase the performance or resolution of a high-speed separation as overall resolution is decreased as compared to conventional gas chromatography. Techniques include serial coupled columns which can shift unresolved pairs of peaks into open areas of a chromatogram, and high-speed column switching, which employs high-speed hardware used for multidimensional techniques. The techniques perform with a good level of precision and accuracy as they all incorporate high speed components.

Company Name/POC: Chromatofast, Inc./Robin Risser

Address : 912 N. Main Street, Suite 14/Ann Arbor, Michigan 48104

Phone Number : 313 662-3410

Fax Number : 313 662-346

Technology Maturity : Bench scale testing, only

Performance History : The Column Strategies technology has been utilized through a development contract from private industry for a speciation instrument to analyze automotive exhaust gases and in a fast, direct non-methane hydrocarbon analyzer development contract from a State of Michigan grant for automotive exhaust analysis. The speciation project was a 1 year contract providing \$525,000 of funds and the non-methane hydrocarbon project was a year contract providing \$75,000 of funds. A mid-point backflush procedure has been developed which reduces the cycle time of the instrument by a factor of 2.

Comments : The device, when combined with equipment for high-speed gas chromatography will require a single technician with familiarity in using a conventional gas chromatograph. The majority of the operation is automated.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Laboratory Analysis***Technology Name :** Intact Subsurface Block Technology

Application : On-site Ex-situ
 Off-site

Brief Description : ISB technology is a testing apparatus which enables in situ remediation techniques to be realistically tested at the laboratory scale. Over the last 4 years the company has performed between 20 - 40 experiments for clients to examine the fate and mobility of contaminants. Surpasses small scale laboratory testing. Can replace (or supplement) field-scale testing of proposed remediation strategies.

Company Name/POC: Danish Geotechnical Institute/Rachel O'Brien**Address :** Maglebjergvej 1/DK-2800 Lyngby, Denmark**Phone Number :** 0045 4588 4444**Fax Number :** 0045 4588 1240**Technology Maturity :** Commercial use experience

Performance History : Have been awarded more than 10 contracts involving ISB technology with the Danish EPA, the Strategic Environmental Research Programs, the Danish Technical University, the Danish Geological Survey and the University of Waterloo (Canada).

Comments : Current design allows for fully saturated groundwater conditions or "field capacity" saturation. Cannot systematically desaturate a sample yet. Very simple to operate. There is almost no limit to the types of testing that can be performed with the cell. Although ISM was conceived of for use in glacial deposits, any natural or man-made sediment can be tested. Consolidated rock (or a synthetic material) can also be installed in the cell. Sludge or tailings can also be installed in the cell for leaching or decontamination tests.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Laboratory Analysis*

Technology Name : On-Line Microwave Digestion

Application : Ex-situ

Brief Description : Continuous preparation of samples for analysis by AA, Fluorescence ICP, ICP-MS. Ideal for "Hot" samples. Replaces batch systems and robotics which are labor intensive and cumbersome.

Company Name/POC: Questron Corporation/Angelo Grillo

Address : 4044 Quakerbridge, RD./Mercerville, New Jersey 08619

Phone Number : 609 587-6898

Fax Number : 609 587-051

Technology Maturity : Bench scale testing, only

Performance History : Technology is presently at the stage where beta site units will be manufactured. A DOE site would be ideal for such an evaluation.

Comments : The system can operate at high pressure, and high temperature. It would be applicable for all but some high temperature refractory materials. Analysis has reached a high degree of automation. Sample preparation is still relatively tedious. This system would allow the sample preparation to match the speed and degree of automation of the analyzer. All of the developmental work has been completed. The remaining challenges deal with actual speed in a real environment, range of applicable samples, reliability in an adverse environment, and applicability to use in a mobile lab. This product is being developed for the Canadian Ministry of Environment by Questron with the assistance of Dr. F. Salin's group at the Chemistry Department of McGill University.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Laboratory Analysis*

Technology Name : Ion Trap Mass Spectrometer

Application : On-site Ex-situ

Brief Description : The Teledyne MEC (TMEC) Ion Trap Mass Spectrometer is one of the most sensitive mass spectrometers of its size in the world. It is designed to be transportable, rugged, and automated to minimize operator intervention. It is ideal for field evaluation of toxic contaminants. The TMEC Ion Trap Mass Spectrometer will permit field measurements of environmental contaminants in lieu of laboratory analysis.

Company Name/POC: Teledyne MEC/Mort Cohen

Address : 1274 Terra Bella Ave./P.O. Box 7244/Mountain View, California 94039-7244

Phone Number : 415 962-6989

Fax Number : 415 967-4353

Technology Maturity : Field demo complete

Performance History : Field evaluations of the TMEC Ion Trap Mass Spectrometer are underway by the U.S. Army for military applications to detect chemical and biological toxins. Initial evaluation are positive. Point of contact is Dave Sickenberger, U.S. Army Chemical Research, Development, Engineering Center, (410) 671-5533.

Comments : Instrument is designed for direct sampling, or GC/LC input. The mass range is approximately 20 to 2,000 amu. It is highly sensitive (parts per billion to parts per trillion) and is excellent in isolating coeluting compounds in complex mixtures. It can be used for field evaluation, laboratory analysis, or fence post monitoring applications. The TMEC instrument is designed for ease of use. It can be powered by AC or DC (battery). It can be configured to operate with a PC-based data system, or as a stand alone device with display and data printout. The system is highly automated to minimize operator intervention, and can be easily configured for direct sampling or interface with gas or liquid chromatograph. There are no infrastructure considerations other than availability of prime power (about 1 KW). The TMEC ion trap mass spectrometer was specifically designed for field evaluation applications to measure very low levels of toxic contaminants. The original instrument was developed for the U.S. Army for military applications and to measure chemical and biological contaminants in the field. Approximately \$13M have been allocated for the R&D of this instrument. Initial field evaluations of the demonstration units are currently underway. Teledyne MEC is also developing, under an internal R&D program, an ion trap instrument for commercial applications related to real-time measurement of environmental contaminants. Initial demo units will be available by mid-1993. TMEC has filed for 8 patents on its ion trap technology, two of which have been allowed and will soon be issued. The other 6 filings are still under review by the U.S. Patent Office.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Laboratory Analysis*

Technology Name : Accelerator Mass Spectroscopy (AMS)

Application : ☒ On-site ☒ Ex-situ
☒ Off-site

Brief Description : This instrument measures the relative abundance of carbon 14/12, Iodine 129/122, etc. to better than 1 part in 1E15.

Company Name/POC: Triumph/Phillip Gardner

Address : 4004 Wesbrook Mall/Vancouver, B.C, Canada, V6T 2A3

Phone Number : 604 222-1047

Fax Number : 604 222-107

Technology Maturity : Commercial use experience

Performance History : AMS is a well known analytical technique worldwide - J.Vogel, L.L.B.L., CA, USA - E. Litherland, U. Toronto, Ont., Canada

Comments: AMS is only appropriate for elements that make negative ions only. Positive ions must be done in conventional E-M mass spec.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Decision Support Tools*

Technology Name : Characterization for Physical Separation (Soil Washing)

Application : On-site Ex-situ

Brief Description : Laboratory characterization procedures are used to assess the potential for reducing the volumes of contaminated material requiring downstream treatment, or disposal, by separating contaminated particles and coatings from the uncontaminated bulk. The procedures are based on using particle separation techniques to quantify the differential distribution of the contaminated and non-contaminated particles by using methods based on differences in grain size, abrasion, settling velocity, specific gravity, surface chemical properties, magnetic susceptibility and solubility/leachability. The results from the procedures can then be used to design a separation circuit where the characteristics of the contaminants and the soil can be matched to appropriate physical separation equipment (soil washing). Most soil washing laboratory characterization tests are not as detailed and do not provide as much information for eventual process circuit design. Many laboratory tests carried out by particular vendors are geared to their separation equipment and experience rather than determining the most appropriate separation route and commercial equipment for the task.

Company Name/POC: AEA Technology/Dr. Mark Neville

Address : Building 429, Harwell Lab/Near Didcot/Oxon, OX11 0RA, U.K.

Phone Number : 44 1235 432252

Fax Number : 44 1235 432278

Technology Maturity : Field demo complete

Performance History : (1) UK Department of the Environment: Contact: Judith Denner Tel: 44 71 276-8348. Research programs over years 1990-1994 into the physical separation of contaminants from a number (8) of contaminated soils. (2) US Environmental Protection Agency: Contact: Norma Lewis Tel: (513) 569-7665; Mary Stinson Tel: (908) 321-6683. Research program 1991-1994 using techniques from the mineral processing industry for the treatment of soil from a former gasworks. Contaminants included heavy metals, PAH and cyanide. (3) European Commission: Reprocessing of Beralit Mineral Tailings. (4) Other projects: commercially in confidence but include work with contaminated soils and dredged harbour sediment.

Comments : The test procedures need to be carried out in a well equipped laboratory. The results can indicate that differential particle separation can produce a low contaminant bulk and a concentrate but the bulk may not reach the required clean-up target. The concentrate requires further processing or disposal. No real problems in using the actual characterization methods as the tests have been developed from mineral processing tests that have been developed over the past 30 years. Individual soils may pose problems such as in the choice of suitable chemical for attrition scrubbing, froth flotation or flocculation. From the knowledge of the exploitable features it is possible to: (1) assess whether the appropriate target concentration of the cleaned material can be met. Where this is not possible the tests can be used with other treatment tests to ascertain whether a treatment train involving some physical separation can meet the desired target concentration; and/or (2) to configure a treatment circuit based on readily available separation equipment from the minerals processing industry. It is likely that this first circuit is a small throughput pilot scale demonstration circuit. The products from this circuit could also be characterized to monitor the performance in terms of sample heterogeneity, machine performance and to provide data for modification prior to designing the full scale plant.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Decision Support Tools*

Technology Name : Site Planner

Application :

Other Application

Brief Description : Workstation-based software for decision support in site assessment and remediation. Site Planner replaces slow, low-productivity manual data management and visualization techniques and point solution software systems.

Company Name/POC: ConSolve Inc./David Barber

Address : 70 Westview St./Lexington, MA 02173

Phone Number : 508 358-8061

Fax Number : 508 358 806

Technology Maturity : Commercial use experience

Performance History : Site Planner is currently deployed on about 20 projects including use by four DOE laboratories.

Comments : Two days on-site training required. Limited by normal computer hardware limitations. System runs on stand-alone Unix workstations.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☒ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Decision Support Tools*

Technology Name : Radwaste Cementation and Process Control

Application :

☐ On-site	☐ Ex-situ
☐ Off-site	

Brief Description : The quality of cemented waste has to be proven. Process control is preferable to end control. The advantage of process control is that during operation the system can be improved. Various on-line measuring techniques have been developed to check the mechanical, chemical and radiological properties during the cementation process.

Company Name/POC: KEMA Nederland B.V./H.A.W. Cornelissen

Address : P.O. Box 9035, NL-6800 ET/ARNHEM, The Netherlands

Phone Number : 31 26 356 6104

Fax Number : 31 26 351 5835

Technology Maturity : Field demo complete

Performance History : During a four year European project, measurement techniques and procedures were developed and validated at a radwaste campaign at a BWR power plant.

Comments : None.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Decision Support Tools*

Technology Name : Lynx Geoscience Modeling Software

Application :

Other Application

Brief Description : Lynx is a complete software system that characterizes subsurface geology. Lynx simplifies 3-D characterization of the subsurface through the use of advanced integrated raster and vector modeling of algorithms. The coil volume modeling technology allows interactive interpretation of complex geological conditions, integrated with advanced geostatistical prediction algorithms.

Company Name/POC: Lynx Geosystems Inc./Mike Mitton

Address : #400, 322 Water St./Vancouver, B.C., Canada V6B 1B6

Phone Number : 604 682-5484

Fax Number : 604 669-365

Technology Maturity : Commercial use experience

Performance History : Performance data are available. Over 230 clients world wide. Yucca Mountain, McClellan AFB. Reference: Jim Burnett, Mitre Corp., 703 883-6523.

Comments : Open-ended design and data standards facilitate smooth links with in-house software and third party; products such as CAD, GIS and spreadsheet systems. A preface to software and hardware standards ensures platform portability and compatibility using peripheral devices, protecting the investment in hard work and training.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Decision Support Tools*

Technology Name : Optimizing Separation

Application : On-site Ex-situ

Brief Description : What: Optimizing the separation of clean vs non-clean soil through optimizing the performance of hydrocyclones for the specific soil and the contamination present by changing the shape and the operation of the hydrocyclones.
How: Run tests with plant (300-500 ton) for the different locations. Make information available for large scale operation (process data, efficiency, quantities clean and non-clean).
How well: Because of full-scale operation and "large" quantities, reliable answers are generated. The advantage of this technology is that the performance of existing soil cleaning technologies can be optimized.

Company Name/POC: Promeco B.V./ A.J. M. Broeders

Address : P.O. Box 94/5741 OAB/Beek En Donk, The Netherlands

Phone Number : 31 49 29 63 903

Fax Number : 31 49 24 65 025

Technology Maturity : Commercial use experience

Performance History : Contact Promeco for list of references.

Comments : Contaminants that stick to coarse material cannot be concentrated in the fines. Reduction of waste volumes are accomplished by optimization of the separation. In cooperation with KEMA hydrocyclones are very often used as part of a wet cleaning operation for contaminated soils. The efficiency of hydrocyclones is a very important part of the total efficiency of wet soil cleaning. The requirements for the most efficient removal of the contaminations must be met by looking for the desired cut point in the particles size separation. Particle size-distributions vary by site, and distribution of the contaminants. Choosing the cut point of the separation is a strategic decision for the cleaning strategy for each project. Searching the right cut point can only be done at a processing scale of 1:1, with relative high quantities. Once the optimum is found, the performance of hydrocyclones can be changed easily to meet the requirements of separation.

Source of Information : International TechCon

CONTAMINANTS :		☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
	☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant	
	☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A		

TECHNOLOGY TYPE : *Decision Support Tools*

Technology Name : Visual Airflow 3-D Gas FlowModelling - Airflow

Application :

☐ On-site	☐ Ex-situ
☐ Off-site	

Brief Description :

- Prediction of migration of gas (vapor) through unsaturated zone.
- Calculation of pressures, velocities and pathlines.
- Calculation of remedial scenarios (e.g. vapor extraction).
- Graphical visualization of input data and results.

[Contact numbers for Waterloo Hydrogeologic (905) 880-2886 Office; (905) 880-2887 Fax]

Company Name/POC: WISMUT GmbH/A. T. Jakubick [Waterloo Hydrogeologic/Thomas Franz]

Address : 09117 Chemnitz/Jagdschanken-strabe 29/WATERLOO HYDROGEOLOGIC/19 McCauley Dr.
/Bolton, Ontario, Canada L7E 5B8

Phone Number : 49 371 8120 112 **Fax Number :** 49 371 8120 10

Technology Maturity : Commercial use experience

Performance History : Underground Research Laboratory (URL), Manitoba, Ontario Hydro, Canada
IKI Chemicals, Wisconsin
Approximately 50 users of software in U.S.

Comments :

- Software operates only IBM or compatible PCs (486 or better) with at least 8 MB RAM, large hard drive (500 MB or greater). Requires hydrogeological characterization of unsaturated zone; does not explicitly describe fractured rock conditions; assumes that water in unsaturated zone is immobile. Easy to use; menu-driven graphical software. Requires modelling specialist; model calibration is often difficult due to lack of appropriate data (moisture content as a spatial distribution, intrinsic permeability distribution, knowledge of fractures, etc.). Modeling of vapor migration allows the prediction of impacts; technique allows the evaluation of remedial scenarios; the model is extremely user-friendly and interactive; implementation of mass transport model is in preparation.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Geophysics/Hydrogeologic Measurements*

Technology Name : Crosshole Seismic Scanning System

Application : Non-intrusive

Brief Description : Technology characterizes subsurface rocks and fractures by measuring the velocity of rock between two boreholes and preparing velocity tomograms. The technology sends a seismic signal from one borehole and measures the arrival time at another borehole. The data collected are inverted as geophysical tomograms. The technology performs very well for velocity tomograms and developments are under way for amplitude tomography.

Company Name/POC: AECL Research/C. A. McDowall

Address : Whiteshell Laboratories/ Pinawa Manitoba, Canada R0E 1L0

Phone Number : 204 753-2311

Fax Number : 204 753-2922

Technology Maturity : Commercial use experience

Performance History : CHARTS - a project for the AECL Research waste management program involving successful site characterization for high level waste. MINI CHARTS - a successful project for the AECL Research waste management program and for ANDRA of France: Jan Marie Potier (Project Manager)/Tel: 33 1 46 54 98 17.

Comments : A 1-3 month training period for a professional geophysicist with a background in seismic methods is required. The boreholes must have a diameter greater than 56 millimeters. The technology is easy to use for 2-3 people in existing boreholes with diameters greater than 56 millimeters. Amplitude tomography is already in the R&D stage and reflection tomography is at the R&D planning stage. This is a non-intrusive technique (it doesn't damage the borehole walls). The technology characterizes rocks and fracture joints between boreholes up to separations of 400 meters in crystalline rock.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Geophysics/Hydrogeologic Measurements*

Technology Name : High Resolution Shear & Compressional Reflection Seismic

Application : Non-intrusive

Brief Description : Utilizes compressional (P-) and shear (S-) reflection seismology to map/delineate subsurface lithostratigraphy and to delineate or discriminate clay aquicludes from saturated sand aquifers. Uses the principle that P-wave propagation through porous materials is controlled by the properties of the fluid in the pore spaces while S-wave propagation is not. Provides depth resolution of approximately 1 foot or less to depths of 250 feet and lateral resolution in the range of 2 to 5 feet.

Company Name/POC: Bay Geophysical Associates, Inc./John Clark

Address : 868 Robinwood Ct./Traverse City, Michigan 49686

Phone Number : 616 941-7660

Fax Number : 616 941-741

Technology Maturity : Field demo complete

Performance History : Performance Data are Available.

Field demonstration of technology was completed at Cooke Crossroads, SC in Oct. 91. Excellent resolution was obtained (vertical 1 ft; horizontal approx. 3 ft). The primary problem encountered was that correlation of the P- and S-wave seismic sections is not possible without detailed P- and S-velocity information from a nearby borehole. Data quality and resolution far exceeded expectations. Contact: Dr. Mitchell D. Erickson, Argonne National Laboratory (708) 252-7772. Contract is currently under negotiation to utilize shear wave reflection seismology alone to delineate mine workings in an abandoned mine in Illinois. Approximately 300-ft of line is to be acquired.

Comments : Technology benefit: (1) Noninvasive; therefore safer if subsurface contaminants are suspected. For large areas, provides much more subsurface information than drilling alone. Subsurface information for large area can provide continuous profile information, which borehole data cannot. (2) Potential collaboration with ARA using ECPT to obtain subsurface P- and S-Wave velocity information. Additionally, potential use of ARA truck as seismic source.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Geophysics/Hydrogeologic Measurements*

Technology Name : Ground Penetrating Radar

Application : Non-intrusive

Brief Description : Ground Penetrating Radar (GPR) is a generally well known technology. Where ground conditions are favorable, the method provides the highest resolution of any geophysical technique commercially available today. Real-time subsurface profiles can be obtained with the method, making this tool very cost-effective. The main problem with the GPR method is interpretation. Our research has placed emphasis on improving its interpretability through 3-dimensional analysis. The method reduces the need for intrusive sampling of the shallow subsurface and allows for a more focused program of exploration.

Company Name/POC: D'Appolonia Environmental Service, Inc./William J. Johnson, Dave Leitze

Address : 275 Center Rd./Monroeville, Pennsylvania 15146-1451

Phone Number : 412 856-9440

Fax Number : 412 856-9535

Technology Maturity : Field demo complete

Performance History : GPR is a commonly applied technique. What D'Appolonia has done is to use commercial equipment and software to improve the method through the acquisition and interpretation of 3D data sets. We have conducted this work as research in association with Michigan Technological University and as a field demonstration for Ames Laboratory's first expedited site characterization (ESC) conducted at the Marshalltown Former Manufactured Gas site in Iowa. Contact David Wonder at Ames - 515 294 1780 for additional information.

Comments : The method requires that soil conditions allow for penetration of the GPR signal. Dry, sandy soils are best. Wet clayey soils are worst. Although some clay was encountered at the Marshalltown, Iowa ESC, we achieved a penetration in excess of 75 feet in a common midpoint profile experiment, but this was exceptional. The method is easy to deploy in the field and can be operated out of the back of a van. Data processing can now be conducted in the field.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Geophysics/Hydrogeologic Measurements*

Technology Name : S-Wave Seismic Reflection

Application : Non-intrusive

Brief Description : The seismic reflection technique is one of the most powerful geophysical methods available for deriving images of the ground that can be directly related to subsurface geology. Through research conducted with ANL, we have applied the method using S-waves to greatly improve subsurface resolution for groundwater investigations, and have subsequently used the method to map quaternary faults and to locate caves. The method is now commercially applied.

Company Name/POC: D'Appolonia Environmental Service, Inc./William J. Johnson, Dave Leitze

Address : 275 Center Rd./Monroeville, Pennsylvania 15146-1451

Phone Number : 412 856-9440

Fax Number : 412 856-953

Technology Maturity : Commercial use experience

Performance History : After our ANL work (contract No. 02112405), we have seen commercial application to locate quaternary faults in California, map subsurface layers in the M-Area of SRS (contact Dr. Carol Eddy-Dilek at 803-275-5190) and locate caves in a Superfund investigation in Kentucky (contact Don Johnson at CH2M Hill 414-272-2426).

Comments : The method needs to be applied in a layered sedimentary environment. It is not cost-effective to use the method to map subsurface features at depths ~<30-50 feet. The method can be operated out of a van or truck. Data processing can be conducted from a motel room in the field, but our experience has been that this does not replace the need for the use of a professional processing firm. Rough terrain can be a significant limitation to the effectiveness of the method.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Geophysics/Hydrogeologic Measurements*

Technology Name : Electrostatic automatic mapping system (ELSAM)

Application : Non-intrusive

Brief Description : ELSAM is a recently developed geophysical technology. ELSAM provides a fast continuous recording of resistivity in "non conductive soils": a mobile electrostatic quadrupole is pulled along, or on, the surface (soil) to be investigated. ELSAM allows quick mapping of large areas for detection of subsurface variations, or buried materials. ELSAM gives similar results to traditional resistivity surveys (plugging spikes into the ground) but daily production is increased 20 fold. Also provides results similar to conventional EM equipment. But ELSAM is not disturbed by aerial metal masses (allows surveys with automotive vehicles).

Company Name/POC: Geomega - SARL/Sophie Geraads

Address : 139 Chemin des Bassins/F94035 Creteil Cedex - France

Phone Number : 33-1 49 56 00 78

Fax Number : 33-1 49 56 00 82

Technology Maturity : Commercial use experience

Performance History : Applications already performed include: airport landing strip survey for investigation of subsurface heterogeneities; investigation of contaminant leakages on a chemical plant premises; subsurface reconnaissances prior to utility cables and pipes layout (with trenches or for a no-dig approach).

Comments : GEOMEGA uses in-house trained geophysicists for field recording and compilation of results. Interpretation often requires integration of other geophysical or geotechnical data. ELSAM provides very useful results on non conductive ground (dry soil) on solid concrete (without rebar) and on pavement. Penetration is limited to approximately 12 meters. Resolution decreases with increasing depth of investigation. Does not provide an accurate description of the actual shape of subsurface structure or materials. Equipment can be installed on a cart and pulled by any automotive vehicle, at a speed of two to thirty miles/hour, according to prospect's nature, and type of equipment used.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Geophysics/Hydrogeologic Measurements*

Technology Name : Geophysics

Application : Ex-situ

Brief Description : Acoustic borehole televiewer.

Company Name/POC: Geosys GmbH/Hausmann

Address : Bautzmann Str. 67/D-04347 Leipzig, Germany

Phone Number : 49 341 2421632

Fax Number : 49 341 242152

Technology Maturity : Commercial use experience

Performance History : BLM GmbH Leizlitz 49 347 2323032

Oil and Gas Company, Russia

Comments : None.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Geophysics/Hydrogeologic Measurements***Technology Name :** Electromagnetic Interpretation Technique (EMIT)**Application :** Non-intrusive

Brief Description : The electromagnetic interpretation technique allows greater vertical resolution of layered earth response, such as in plume/leak detection, than present available time-domain electromagnetic (TDEM) methods. EMIT is applied to the high frequency portion of the spectrum collected during in-situ impedance spectroscopy (IIS) surveys. Interpretation and modeling are performed on personal computers. EMIT may replace TDEM methods in areas where cultural interference is not great. EMIT allows higher vertical resolution of earth layers and better resolution of layer parameters. The advantage is that lower-frequency impedance spectroscopy data may be extracted from the spectrum, which TDEM cannot detect.

Company Name/POC: hydroGEOPHYSICS/Dr. James B. Fink**Address :** 5865 S. Old Spanish Trail, Tucson, AZ 85747**Phone Number :** 520 647-3315**Fax Number :** 520 647-3428**Technology Maturity :** Commercial use experience

Performance History : EMIT was proven viable at Exxon Production Research by J.B. Fink during the late 1970s. Personal computer programs have subsequently been developed to improve modeling but more should be done. EMIT has documented success in academic research (J.B. Fink PhD dissertation). EMIT has been successfully applied in proprietary industry research programs.

Comments : Requires highly skilled technicians to collect, process, and interpret data. Field data collection has the most difficulty because of multi-path and cross-talk interference. Equipment is available off-the-shelf. Although equipment is available off-the-shelf, special purpose equipment should be built based on current technology and specific requirements. The method is difficult to implement in the field because of the myriad problems encountered with conductive cultural features and electromagnetic interference with presently available equipment.

Source of Information : TechCon

CONTAMINANTS:

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Geophysics/Hydrogeologic Measurements***Technology Name:** High-Res 3-D Resistivity**Application:** Non-intrusive

Brief Description: High-resolution 3-D resistivity uses existing technology to electrically map the Earth's surface using a 2-D grid allowing 3-D interpretation. Its advantage is greater lateral resolution (in a 2-D sense) than linear arrays. Interpretation is straightforward and can be performed on higher-powered personal computers. It is not restricted to any particular instrument, however, it would be advantageous to assemble personal-computer-based data collection platforms using off-the-shelf components. Large amounts of data allow the use of digital image processing techniques for extended interpretation.

It is very applicable to shallow, plume/leak problems, and may be used in high density culture. It does not eliminate the cultural problems, but high density measurements allow precise discrimination between culture and target. It also permits fracture and fault detection and mapping.

Company Name/POC: hydroGEOPHYSICS/Dr. James B. Fink**Address:** 5865 S. Old Spanish Trail/Tucson, AZ 85747**Phone Number:** 520 647-3315**Fax Number:** 520 647-342**Technology Maturity:** Commercial use experience

Performance History: High-resolution resistivity has been neglected over the decades because of the lack of convenient methods to collect large amounts of data. The method has been successfully applied on a point-by-point basis for medium-sized grids. Time requirements and manpower costs have been the main drawbacks. Existing micro-computer capabilities for multichannel data collection have significantly decreased the time and manpower requirements.

Comments: Data collection is technician level work. Subsequent data quality control, processing and interpretation require some degree of expertise in conventional resistivity methods. Modeling may be done on personal computers.

The method is ready to go today and can be performed on a point-by-point basis, immediately. Multichannel data collection platforms need only be assembled with off-the-shelf components.

The biggest challenge for high-resolution resistivity to overcome is the industry attitude toward a low-tech, simple-to-use, well understood method.

Source of Information: TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Geophysics/Hydrogeologic Measurements*

Technology Name : In-Situ Impedance Spectroscopy (IIS)

Application : Non-intrusive

Brief Description : IIS measures the combined inductive and conductive electrical and electromagnetic response of the earth over a broad spectrum using grounded transmitting and receiving dipoles. It is nearly equivalent to Spectral Complex Resistivity or Spectral Induced Polarization with special emphasis on obtaining a smooth and complete spectrum. The electromagnetic portion of the spectral response may be modeled to determine the underlying earth geometry more accurately than other electrical methods. The lowest frequencies (<10 Hz) may be used to determine presence of clays in aquifers up to 15% content, beyond which saturation occurs. Under ideal conditions, particle size information may be obtained. Applications are strongly site dependent.

Company Name/POC: hydroGEOPHYSICS/Dr. James B. Fink

Address : 5865 S. Old Spanish Trail/Tucson, AZ 85747

Phone Number : 520 647-3315

Fax Number : 520 647-3428

Technology Maturity : Pilot plant testing

Performance History : IIS has seen limited use because of the limited understanding and availability of necessary interpretation aids. It has been used successfully approximately a dozen times under strict proprietary research. It has been informally published in a 1989 PhD dissertation after previous successful uses. Most significant drawback is interference from existing culture, such as wire fences, pipelines, and other grounded conductive materials.

Comments : Field data collection requires highly skilled personnel from the standpoint of solving multi-path and cross-talk problems. Actual operation of the equipment is relatively straightforward and can be performed at the technician level. Since few groups attempt to collect full-spectrum data, there are few geophysicists with adequate skills. Because the method depends on both inductive and conductive electrical paths, there is a multitude of interferences in highly developed areas. The method is probably best applied in open fields away from dense, conductive culture. Good electrical ground contact is essential, which hampers, but does not exclude, data collection in frozen ground. The method is easy to use (with the aforementioned caveats). It is extremely flexible and can be used for very small scale measurements (soil studies) to extremely large measurements (crustal studies). Appropriate equipment has been developed and is available off-the-shelf. Interpretation software is very limited and represents the weakest aspect. The biggest challenge in using IIS is necessary understanding of multi-path and cross-talk problems that typically occur during collection. Newer instrumentation should be developed that is more amenable to collecting the broad range of frequencies necessary.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Geophysics/Hydrogeologic Measurements*

Technology Name : Pulled Array Continuous Vertical Electrical Sounding (PA-CVES)

Application : Non-intrusive

Brief Description : The PA-CVES method is a new development of the well known electrical profiling method and the vertical electrical sounding. The PA-CVES method has electrodes mounted on a tail and the measurements are performed while pulling the tail. Eight different electrode spacings or more can be mounted on a tail. Depending on the tail used, the resistivity of the subsurface to a depth of approximately 30 meters is measured. The method can produce more than 10 kilometers of continued recorded profile a day and the data is interpreted into detailed earth models. Due to the continuous recordings, the reliability of the measurements and the models is very high. The PA-CVES method replaces the use of any other electrical measurements describing the near surface resistivity distribution.

Company Name/POC: Kampeax Geodan/Connie D. Johnsen

Address : Stamholmen 112/DK 2650 Hvidovre, Denmark

Phone Number : 45 36390737

Fax Number : 45 3677231

Technology Maturity : Commercial use experience

Performance History : The PA-CVES method has produced more than 4,000 km of profiles in Denmark in the last 5 years. The profiles have been used in determining the vulnerability of aquifers, as a geotechnical tool in road and railway construction when making geological models for determining groundwater flow, and when prospecting for raw materials. This method has given geoelectrical investigations renewed focus in Denmark.

Comments : In very arid areas it can be difficult to make the necessary galvanic contact between the electrodes and the ground. The equipment is lightweight and can be pulled by any terrain truck. In Denmark the equipment is pulled by a very small caterpillar. The equipment can be transported in any ordinary van. There is no equipment in the USA at the present time.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Geophysics/Hydrogeologic Measurements*

Technology Name : Radio Imaging Method (RIM)

Application : Non-intrusive

Brief Description : The technology is based on the principle of mapping electrical conductivity. It is a minimally intrusive characterization and monitoring method for detection and quantification of subsurface waste forms including metals, acids, LNAPLs, aqueous plumes. It uses a 2" diameter tool, 14 feet in length, which is lowered down each borehole with fiber optic cable. Under proper conditions data can be correlated to stratigraphic profile, plume definition and plume migration, and trench boundary delineation. RIM can be applied between paired vertical, horizontal or slant boreholes and between a borehole and the surface. Data can be used with tomographic inversion software to produce subsurface images. Borehole-to-borehole imaging can be conducted at significant depths. Spacing between boreholes can be on the order of 10X the size of the object or feature to be mapped. Repeated surveys over time can give an accurate picture of contaminant movement. RIM is effective whenever there is a measurable difference in electrical conductivities between the host media and the object or feature to be mapped.

Company Name/POC: New Mexico State University/Greg Moran

Address : Physical Science Lab/P.O. Box 30002/Las Cruces, New Mexico 88003-8002

Phone Number : 505 522-9276

Fax Number : 505 522-9434

Technology Maturity : Commercial use experience

Performance History : The technology has been commercially applied in the coal mining industry, for >10 years, to delineate mining hazards. Subsurface geology and chromic acid plume definition at 1m resolution has been successfully field demonstrated at Sandia National Laboratory Chemical Waste Landfill. [David Borns (505) 844-7333]. Mapping of fluid flow through fractured media has recently been demonstrated for the USGS. Delineation of LNAPL plumes has been successfully field demonstrated at a major refinery and former paint factory. Sensitivity to trench boundaries has been successfully demonstrated at the Rocky Flats Plant. Demonstrations for monitoring of injected grout barrier performance at Fernald and for tank monitoring applications at Hanford are planned [Susan Eberlein (509) 373-6595].

Comments : Field operation is straightforward and well developed. Two-to-three technicians are required to run the field survey. Data collection is accomplished via van-mounted computer. Final data reduction and image production is performed at the laboratory or office. At least one borehole is needed; borehole cannot be cased in a metal or conducting material. Other electromagnetic systems cannot be operated at the same time. The baseline is not sensitive to organic contamination unless high-frequency radio signals are used. Technology is ready for environmental applications. Desirable advancements being explored include (1) 3-D subsurface imaging, (2) automated data collection capability for long-term monitoring programs, (3) coupling of instrumentation with cone penetrometer, (4) surface-to-surface surveys for environmental applications.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Geophysics/Hydrogeologic Measurements*

Technology Name : Diffraction Tomography and Maximum Likelihood Estimations

Application : Non-intrusive

Brief Description : This technology uses a crosshole imaging method employing seismic or radar waves to locate known objects in the subsurface.

Company Name/POC: Norwave Development A.S./Ingvid Johansen

Address : Gjerdrums vei 12, N-0486 /Oslo, Norway

Phone Number : 47 22 95 10 26

Fax Number : 47 22 18 16 5

Technology Maturity : Commercial use experience

Performance History : Contact company for performance history data.

Comments : Physical limitations in wave penetration distance.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Geophysics/Hydrogeologic Measurements*

Technology Name : Ground Penetrating Radar (GPR)

Application : Non-intrusive

Brief Description : GPR is used to non-destructively map subsurface or structural features. Depths range from a few inches to hundreds of feet depending on material conductivities.

Company Name/POC: Sensors & Software Inc./Steve Cosway

Address : 1091 Brevik Place/Mississauga, ON L4W 3R7 Canada

Phone Number : 905 624-8909

Fax Number : 905 624-9365

Technology Maturity : Commercial use experience

Performance History : Used by many consulting engineers, geophysical and educational institutions world wide.

Comments : Data collection requires very little skill.

Data interpretation requires some training and experience.

The higher the resistivity of the material you are trying to penetrate the better the results.

One person can operate; very portable and easy to use.

Operates using a PC computer (notebook).

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Geophysics/Hydrogeologic Measurements*

Technology Name : Vacuum Permeability (VacPerm)

Application : In-situ (vadose zone)

Brief Description : In situ leakage/permeability characterization of concrete, soils/rocks.
 Vacuum pumping of packed-off section of a borehole.
 Permeable fissures located within plus or minus 2 cm; permeabilities measured down to <20 micro darcy; field precision <10 percent.

[Contact numbers for Waterloo Hydrogeologic (905) 880-2886 Office; (905) 880-2887 Fax]

Company Name/POC: WISMUT GmbH/A. T. Jakubick [Waterloo Hydrogeologic/Thomas Franz]

Address : 09117 Chemnitz/Jagdschanken-strabe 29/WATERLOO HYDROGEOLOGIC/19 McCauley Dr.
 /Bolton, Ontario, Canada L7E 5B8

Phone Number : 49 371 8120 112

Fax Number : 49 371 8120 10

Technology Maturity : Commercial use experience

Performance History : Denison and Rio Algom Mines, Elliot Lake, Canada
 PCS potash mine, Saskatchewan, Canada
 Water intake tunnel, Darlington Nucl. Gen. Station Ontario Hydro, Canada
 Oil storage facility, Kushikino, Hyushu, Japan
 Underground Research Laboratory (URL), Manitoba, AECL, Canada
 Size of jobs: approx \$1000K

Comments : Cannot be used in media saturated above field capacity.
 At permeabilities <20 micro darcy, measurements become long (10-15 hours per 1 section).
 With higher altitudes, the available pressure gradient decreases.

Both surface and subsurface use is possible. Its regularly used in 1 1/2 and 3 inch holes. However, straddle packers can be adjusted to other borehole sizes. Space of approx. 2 x 1 m is needed to set up instrumentation. Regular electric outlet required. The speed of testing could be increased by use of pneumatic packers (instead of mechanical). This would, however, increase the size of equipment and number of pieces. The vacuum permeability method provides a new approach to assessment of permeability in the near-field of rock excavations. The method, which resembles leak testing of vacuum lines, is based on the measurement and interpretation of the pneumatic response to evacuation of the medium. As the induced drainage area is in the order of meters, the method is particularly suitable on the scale of 0.1 to 10 m. The data can be evaluated either analytically or numerically. The evaluation is similar to the approach used in the analysis of drill stem tests in gas wells. Experiments on large scale laboratory models corroborated the validity of the method and the evaluation procedure. Field tests were conducted at a wide range of geomechanical conditions. The collected data indicate that there are three characteristic types of permeability distributions in the excavation damaged zone.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Remote Sensing*

Technology Name : Model 4350 Depth Moisture/Density Gauge

Application : In-situ (vadose zone)

Brief Description : The Model 4350 probe uses neutron moderation to measure hydrogen content (moisture) and gamma ray attenuation to measure density. These readings are typically taken in a non-perforated polyethylene pipe installed during initial construction beneath a waste disposal facility (landfill, lagoon, etc.) to determine the presence of a leak through the bottom liner. The probe has been shown to detect volumetric moisture changes of 1 pound per cubic foot. Gamma attenuation for density measurements is used in conjunction with the moisture measurements to determine if the detected moisture is inside or outside the pipe. Moisture inside the pipe would be due to a leak in the pipe. The Model 4350 probe reduces or eliminates the need for leak detection lysimeters beneath the bottom liner. It also reduces the size and expense of the groundwater monitoring program at a site. Use of the Model 4350 is superior to GW monitoring because it detects a leak before it reaches the groundwater. The access tubing also offers promise for future sampling and remediation activities at the site by providing a means of access to the underside of the line.

Company Name/POC: Troxler Electronic Laboratories/Eric Dunlap

Address : P.O. Box 12057/Research Triangle Park, North Carolina 27709

Phone Number : 919 549-8661

Fax Number : 919 549-0761

Technology Maturity : Commercial use experience

Performance History :

- (a) Used successfully on two different occasions at a municipal waste landfill in Calaveras County, CA. During a test in 11/91 the probe discovered a large moisture concentration at this site. Movement of probe through pipe was limited by an inadequate winching system. A new winch transport system has since been developed. Contact: Dr. Lorne Everett, Geraghty & Miller, Santa Barbara, CA 805 893-2887 or John Kramer, U of CA, Santa Barbara, CA 805 893-8441 for further information.
- (b) The probe is being tested by Sandia National Labs to determine its application for that facility's specific needs. Results are incomplete. Contact: Dr. Robert Knowlton, DOE SNL 505 848-0425.
- (c) The probe has been used for downhole density measurements of household waste at an inactive municipal waste landfill in Illinois. The actual density of the waste is still being determined. This will resolve whether the Model 4350 can be used for this application. This application is for a private concern so no references can be given.

Comments : The Model 4350 is designed for use in the vadose zone. Because of the neutron moderation technology that is used to detect changes in moisture content, the probe cannot be used in conditions that would bring it within one (1) foot of the groundwater table. This requirement greatly reduces the possibility of a false positive condition by minimizing detected moisture from high groundwater. Without large improvements in the accuracy of horizontal drilling techniques, the Model 4350 can only be utilized in new waste disposal construction due to installation of the access pipe beneath the bottom liner. With an access tube and a permanent towing cable installed during construction, the model 4350 probe and its winching system can be readied for daily operation in one hour by one technician. One 2000 foot access tube can be monitored in an 8-hour day. At a waste containment facility with the required infrastructure installed, the Model 4350 will be capable of immediate implementation. However, the access tube must be installed such that sharp changes in direction are avoided and in such a way that the pipe follows the underside contour of the bottom liner.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Remote Sensing*

Technology Name : Prompt Fission Neutron Logging

Application : In-situ (vadose zone)
 In-situ (saturated zone)

Brief Description : Detects presence of and quantity of thermal neutron fissionable radionuclides in situ.

Company Name/POC: Uranium Resources Inc. (URI)/Dick Clement

Address : 12750 Merit Drive, Suite 1020, LB 12/ Dallas, Texas 75251

Phone Number : 214 387-7777

Fax Number : 214 387-7777

Technology Maturity : Commercial use experience

Performance History : The PFN tool has been successfully utilized several times by Total Minerals Corp. as well as URI to measure, quantitatively, uranium deposits in-situ in Texas and Wyoming. There have been no problems and all parties concerned have expressed satisfaction with tool's performance. Can contact Albert McNeil, Total Minerals at (512) 747-5401 for reference.

Comments : The PFN logging tool can detect the presence of any isotope with thermal neutron fission cross section. The PFN logging tool requires a borehole penetrating the material below the water table to be evaluated. Calibration of the PFN tool is achieved with nine (9) calibration pits. Operation of the tool is straightforward as it comes with a vehicle outfitted with the required reel, sensing devices, and recording equipment and on-board computer and plotter. The basic challenge is to place a borehole in the proximity of the fissionable material to be detected and measured below the water table. Dry sediments and pure aqueous solutions may be accurately assayed but calibration models fairly identical to those conditions must be designed. The PFN logging tool can be used in place of coring at a greatly reduced cost in dollars, time, and effort. Under most conditions with known formation densities, borehole fluid, and diameter, assays should be accurate within 5 to 10%.

Source of Information : TechCon

Process Water

Characterization

Process Water

Characterization

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Physical Sampling*

Technology Name : Groundwater/Sludge Borehole Pumps

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Draws water/sludge for analysis, at variable, pre-determined rates, including abrasive solids/contaminants, & various temperatures. Ability to overcome system deficiencies, and specification to handle overout liquids.

Company Name/POC: H2O Waste-Tec/Mr. I. Hallows

Address : Horsfield Way, Bredbury Industrial Park/Stockport, SK6 2SU UK

Phone Number : 0161 406 7111

Fax Number : 0161 406 7222

Technology Maturity : Commercial use experience

Performance History : 1000's of unit installed worldwide for water, sludge abstraction.

Comments : 3,000m borehole depth; 100 degrees C temperature; sludges above 10% dissolved solids. H2O Waste-Tec water is a major part of the Dresser Group with US wide commitment to product support throughout USA.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Energy Dispersive X-Ray Fluorescence - Thin Film

Application : On-site

Brief Description : The EDXRF does lab quality elemental analysis (Na to Pu) using proprietary technology that can meet EPA minimum detection requirements in near realtime; low ppb analysis of trace elements in solutions, low ppm for soils/solids (sub ppm with digestions) for an exceptional range of "total unknown" sample types (soils, ores, wastes, water, etc.) and concentrations (ppm to wt percent for solids). All done in one instrument with no prior knowledge of sample.

Company Name/POC: Advanced Analytical Products & Services/Jim Wrigley

Address : 1753 Cape Aston Court/San Jose, California 95133-1128

Phone Number : 408 926-4057

Fax Number : 408 926-405

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Small jobs mainly (10 to 50 samples). Exceptionally low detection levels and very good corroboration where available; customers report accuracy is better than CLP. References: Dr. Paul LaMothe, U.S. Geol. Survey 415 329 5258; Mrs. BiShia King, U.S. Geol. Survey 415 329 5288; Dr. Bill Walker, Walsh Associates 916 737 7240; Mr. Bill Cole, Lockheed Eng. Svc. 702 897 3226; Mr. Eric Lindgren, Sandia Nat. Lab 505 844 3820.

Comments : Sample prep is simple for solutions and soil/solid samples. Soils must be dried and ground (to about 300 mesh), then prepared as a thin film. The skill needed for EDXRF spectroscopy is quite high. Therefore, the company is offering a service, not an instrument. Later they will develop an "expert system" to overcome this. Detects elements Na to Pu, but not H to F. Doesn't determine compounds. With digestions, can do some speciation (e.g., soluble chromates Cr+6 distinguished from total chrome) and get excellent results (.3-.5 ppm). Mobile, not portable. Two person team recommended for field operations, but can be done with one. The cost reduction implications for field operations are quite significant.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Mobile Laboratory for Chemical Weapons, Explosives and Propellants**Application :** On-site Ex-situ**Brief Description :** Mobile laboratory with all necessary chemical and physical equipment to detect and analyze chemical weapons, explosives, propellants and other toxic materials.**Company Name/POC:** Alba Industrie Umweltschutz Service GmbH/Dr. K. Faber**Address :** Rehrhoferweg 160/D29625 Munster/Germany**Phone Number :** 051 92 96 3212**Fax Number :** 051 92 96 3311**Technology Maturity :** Commercial use experience**Performance History :** In use for two years, e.g., in Russia and also in Germany.**Comments :** None.**Source of Information :** International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Monitoring of Chemical Weapons in Soil, Water, Air, Buildings

Application : ☒ On-site ☒ Ex-situ

Brief Description : Monitors all relevant parameters, like concentrations of chemical weapons in air, soil, water, and buildings.

Company Name/POC: Alba Industrie Umweltschutz Service GmbH/Dr. K. Faber

Address : Rehrhoferweg 160/D29625 Munster/Germany

Phone Number : 051 92 96 3212

Fax Number : 051 92 96 3311

Technology Maturity : Commercial use experience

Performance History : Refer to POC for performance history.

Comments : None.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : SMP (Sub Mitochondrial Particles)

Application : On-site

Brief Description : The technology utilizes submitochondrial particles (SMP) and is based on the mammalian enzyme complex that mediates cellular electron transport. These bioassays have broad application wherever rapid, inexpensive information about acute toxicity of aquatic or soil samples is needed. SMP-based bioassay products will complement analytical chemistry analysis and whole-organism bioassays by speeding the flow of information and lowering the overall cost of environmental monitoring. SMP tests were designed to provide a means for rapid inexpensive bioassay of harmful materials in environmental samples such as wastewater effluents, landfill leachates, or soil extracts. Tests can be used as a prescreening tool to select samples of concern for further analysis. Based on results of SMP prescreening, follow-up analysis may be carried out using analytical chemistry or whole-organism bioassays. SMP tests take less than thirty minutes to perform. In comparison, the whole-organism bioassays require 7 days.

Company Name/POC: Biorenewal Technologies, Inc./Alan J. Dines

Address : 2800 S. Fish Hatchery Rd./Madison, Wisconsin 53711

Phone Number : 608 276-8980

Fax Number : 608 273-6989

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

This technology has been used in round robin EPA toxicity tests several times during the past three years. Results are available upon request. The test is currently being used in an EPA funded storm water run-off study being conducted by the Wisconsin Department of Natural Resources in conjunction with an inclusive battery of analytical chemistry tests. This study is not complete and is continuing for the next two years. SMP technology was evaluated two years ago in a USGS study at the Green Bay municipal waste water treatment facility. Results in the form of an extensive detailed report are available. Currently the company is conducting a development contract with Waste Management to evaluate SMP technology as a toxicity test on the effluent of a Superfund landfill leachate treatment system in Wisconsin. The goal is to install a continuous toxicity testing unit that reports results to a remote monitoring location.

Comments : While SMP toxicity test gives results in less than 30 minutes and costs less than \$25 per test instead of one week for the more traditional whole organism tests at a cost of \$500 to \$1,000 per test, it does not provide results that quantify the amount of toxicity or contaminants. Toxicity tests are a general measure of contaminant's impact on the animal kingdom and the environment as a whole.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Mobile Environmental Mass Spectrometer

Application : On-site

Brief Description : The Mobile Environmental Mass Spectrometer (MEM) is a fully developed electron impact ionization quadrupole Mass Spectrometer designed specifically to be rugged and flexible for on-site analysis of organic compounds. It is tolerant to extreme changes of environmental conditions allowing for a wide range of Data Quality Objectives to be completed. This all-in-one system simplifies sample preparation techniques yielding rapid qualitative and quantitative results on a real-time basis with field uptime better than 95 percent.

Company Name/POC: Bruker Instruments, Inc./J. Wronka

Address : 19 Fortune Drive/Manning Park/Billerica, MA 01821

Phone Number : 508 667-9580

Fax Number : 508 667-599

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

The MEM is successfully being used by the U.S. Army, state agencies, fire brigades, and environmental management firms for a wide variety of applications which include emergency response, site screening and assessment, and clean up monitoring of air, water and soil samples. References: U.S. Army CRDEC, D. Durst, (410) 671 2129; Del State DNREC, J. Rogers, (302) 323 4542; Env. Res Mngmt, D. Gallis, (215) 524 3786; SiteWorks, Inc., Albert J. Robbat, Jr., (617) 627 3474.

Comments :

The MEM is designed for simple operation. A one-week training course covering instrument operation, hardware components, and methodologies will enable personnel to successfully complete analytical measurements. Automatic routines simplify operation, and an internal diagnostic routine continuously monitors instrument performance and warns the operator of potential problems with calibration, temperature, power, and electronic malfunctions. Data interpretation requires some knowledge in mass spectroscopy to determine data integrity. The technology for characterizing environmental pollutants on-site is fully developed and readily available. The problem which exists is convincing people that, when implemented properly, the rapid generation of data which field analysis provides results in a dramatic savings of time and cost in comparison to conventional techniques of chemical detection.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Microwave Sample Digestion**Application :**

On-site

Off-site

Brief Description :

The CEM Microwave Sample Preparation System, MDS-2000 series, combines the speed of microwave heating with proprietary sealed vessel technology to significantly reduce the sample preparation (acid digestion) process time. For environmental samples, the process time is reduced by a factor of 8-10. In addition to time savings, the technology provides performance (measure by elemental analysis), safety and cost advantages over traditional hot plate techniques.

Company Name/POC: CEM Corporation/Gregory N. LeBlanc**Address :** 3100 Smith Farm Rd./P.O. Box 200/Matthews, N.C. 28105-200**Phone Number :** 800 726-3331**Fax Number :** 704 821-7894**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.**Comments :**

There are over 3000 Microwave Sample Preparation Systems in use worldwide. The systems are typically used for acid digestion of a variety of matrices for subsequent elemental analysis. It cuts across all industries. Its widest use is for environmental applications. It has proven highly successful as measured by its acceptance in the worldwide marketplace.

Skills associated with a chemical laboratory are all that is required to operate the system. Training can be completed in <2 hours. Complete procedures are supplied with the purchase of the instrument. The system can be set up and running within 1 hour of removal from the shipping box. It can be used in a mobile lab and a standard laboratory. The system operates on 115 vac. (No special requirements). It is applicable to a wide variety of sample types encountered in remediation efforts. A fume hood is not required.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : On-line Water Monitoring

Application : In-situ (saturated zone)

Other Application

Brief Description : In-situ on-line measurement of nitrate, chloride, pressure, conductivity, diss. oxygen, redox, turbidity in ground / raw / potable water, rivers, lakes. Also applicable for monitoring of water supply areas and leakages from waste deposits. Radioactivity, ammonia, triazines/herbicides, TNT will be integrated in 1996. Probes are able to initiate an alarm in case a hazard is encountered. Performs very reliably with an excellent accuracy. Heavy metals and organics will also be integrated in 1996.

Company Name/POC: Daimler-Benz Aerospace Ag. Valx/Hermann Hack

Address : P.O. Box 80 11 49/81663 Munich/Germany

Phone Number : 0049 89 607 25112

Fax Number : 0049 89 607 2017

Technology Maturity : Commercial use experience

Performance History : Field trials: Munich municipal water supply (water quality monitoring)
 extreme Nuremburg water supplies authority (groundwater quality) monitoring with
 nitrate concentrations (Agricultural)
 Switzerland: waste deposit leakage monitoring
 Gilching near Munich: water quality monitoring during pump trial

Comments : Operation in corrosive environments can be adapted under certain circumstances. Probes can be submerged in a borehole/river for example and be operated almost instantly. Also usable for short term measurements; needs almost no infrastructure; easy to use; Windows software available; delivery on scheduled date.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** D Tech BTEX Test**Application :** On-site

Brief Description : These test kits are available for determining the presence of benzene, ethylbenzene, toluene, xylene, and explosive compounds in water and soil. Analyses of concentrations as low as parts per billion are performed in the field by addition of a color-developing solution. The color is compared to a standard chart to determine the concentration present. Sensitive to 600 ppb BTEX in H₂O; sensitive to 2.5 ppm BTEX in soil.

Company Name/POC: EM Science/Bruce Crane**Address :** 480 Democrat Road/Gibbstown, New Jersey 08027**Phone Number :** 800 222-0342**Fax Number :** 609 423-4389**Technology Maturity :** Commercial use experience

Performance History : Immunoassay has become an increasingly useful method for on-site environmental sample screening. Immunossay methods have been accepted in EPA SW-846 method drafts for publication.

Comments : Test is specifically designed to detect BTEX. Up to four tests can be run in less than 25 minutes.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Reflectoquant System

Application : On-site

Brief Description : Hand-held instrument which reads a series of ion-specific test strips on a parts-per-million level. The ion-specific test strips are impregnated with various chemicals which react with the analyte in question to produce a color. The RQflex meter then reads the reflected light which is proportional to the sample concentration. The sample concentration is displayed via LCD usually in terms of ppm. For example, to measure copper: the RQflex meter is programmed using the copper bar code supplied with the Reflectoquant copper test strips. The test strip is dipped into the sample, allowed to develop over a period of time, and then inserted into the meter. The sample concentration appears on the LCD display. Each type of test strip has two reaction pads. The instrument reads both pads and the result on the display is actually the average of the two independent readings. Accuracy is generally within 10 percent of the actual, but in many cases has been found to be under 5 percent.

Company Name/POC: EM Science/Bruce Crane

Address : 480 Democrat Road/Gibbstown, New Jersey 08027

Phone Number : 800 222-0342

Fax Number : 609 423-438

Technology Maturity : Commercial use experience

Performance History : Larry Waters, ORNL 615 571 4969 for Cr (VI), Pb, NO₃; Donna So, Chevron 310 615 5622 for NO₃, NO₂, inactivated sludge; Jim Scott, Santa Clara Valley Water District, 408 265 2607 x2113, groundwater-metals/inorganics; Bob Morgan, US Army Waterways Experiment Station at Vicksburg MS, 601 634 3575 (residual peroxide inactivated sludge).

Comments : Sample preparation may be required if analysis is being used for solid/semi-solid samples. In addition, sample preparation may be required to produce species in ionic form. Very easy to use with user immersing strip in the sample, then inserting the strip into the instrument to obtain reading.

Source of Information : TechCon

CONTAMINANTS :

- ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Environmental Enzyme-Linked ImmunoSorbant Assay (ELISA).

Application : On-site

Brief Description : ELISA technology is used to screen for selected contaminants in soil and water. EnSys products detect pentachlorophenol <0.5 ppm, petroleum hydrocarbons 100 ppm, and polychlorinated biphenyl to <1 ppm. The test employs antibodies to detect contaminants and provide a colorimetric result. A test to detect Polynuclear Aromatic Hydrocarbons (PAHs) has a sensitivity appropriate to regulatory needs. All tests correlate to accepted USEPA Methods at levels of 85 percent or greater.

Company Name/POC: EnSys Environmental Products, Inc./Kevin Carter, PhD

Address : P.O. Box 14063/Res. Triangle Park, North Carolina 27709

Phone Number : 800 242-7472

Fax Number : 919 941-5519

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Comments :

ELISA technology has been used for site assessment at over 300 sites. The numbers of samples run at sites ranged from 1 to 1,200. Some of the parties which have used the kits are listed as follows: ATEC, Bechtel, Chem Waste Management, CH2M Hill, Ecology & Environment, Florida Power & Light, General Electric, Gas Research Institute, Geraghty & Miller, IT Corp., Jacobs Eng., & Roy F. Weston. A full list is available. Sample homogeneity can cause problems.

The test requires minimal skills which include basic reading comprehension and good manual handling skills. All materials are prepackaged and sample manipulations are minimized. Minimal training will allow an inexperienced operator to run tests quickly and correctly. The tests have a shelf life of 3 to 5 months at 75 degrees Fahrenheit and must be used between 40 degrees Fahrenheit and 90 degrees Fahrenheit. The tests are extremely easy to implement. The tests allow for a rapid turnaround time of sample results. This on-site information allows investigators to place other samples more effectively, saving further time and expenditures. There is no infrastructure required to run the tests, increasing its ease of implementation. The test has received, effective 7/13/92 USEPA Methods approval for field screening.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Toxicity & Genotoxicity Screening

Application : On-site Ex-situ

Brief Description : Company manufactures and sells a range of field testing kits for the screening of environmental samples (water, soil, sediment, sludges, etc.) for both acute toxicity, and genotoxicity and mutagenicity. Technology uses genetically engineered strains of bacteria to produce distinct color changes in the media being tested to determine biological effect endpoints.

Company Name/POC: Environmental Biodetection Products Inc./Dr. Ran Lifshitz

Address : 14 Abacus Road/Brampton, Ontario, Canada L6T 5B7

Phone Number : 905 794-2325

Fax Number : 905 794-233

Technology Maturity : Commercial use experience

Performance History : Performance Data are Available.

1. Survey of contaminated sediments and sludges around the Great Lakes basin. High correlation with much more costly comparable technologies. Contact: Dr. Barney Dutka, Canada Centre for Inland Waters, Environment Canada (905-336-4923; Fax 905-336-4989).
2. Survey of Rhine and Oder Rivers and North Sea sediments. Very favorable comparison with much more expensive and complex research technologies. Contact: Dr. Peter Hansen, Professor, Ecotoxicology, Technical University of Berlin (011-49-30-31421586; Fax 011-49-30-838113).

Comments :

Full instructions provided with products. One-half day of practice for technologist is useful to become familiar with tests. Method details vary with parameter being measured. General procedure involves: (1) rehydration of freeze-dried bacteria; (2) placing the rehydrated testing bacteria into contact with a slurry of the material to be tested and allowing the mixture to incubate for one to two hours; and (3) reacting the bacterial test mixture with a chromogenic substrate and recording a color change as the biological effect endpoint. Tests have been designed to be easy to use. Quality control is done to a high degree in manufacturing, leaving little chance for variability in use resulting in a high degree of reproducibility. Tests are highly flexible for use in all types of test slurries and waters. A small (~\$300.00) 120V or 12V incubator is required for several tests. All consumable items come in the test kit. Kits are couriered to the site within two weeks of receipt of a purchase order.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** pH Optrode-based Measurement System**Application :** On-site Ex-situ

Brief Description : The measurement system consists of a pH optrode (fiber optic sensor), a support opto-electronics interface (PC compatible), a personal computer and software. It measures the pH in contact with a small sensing region by monitoring the ratio of absorbed light at two wavelengths. The system presently operates over the range of pH 3.5 to 8.0. It provides a .1 pH resolution over this range. Glass electrodes are commonly used for pH measurements. The optrode-based measurement system provides much improved stability in low ionic strength solutions, such as typical groundwater.

Company Name/POC: GEO-CENTERS, Inc./Bruce Nelson**Address :** 7 Wells Avenue/Newton Centre, Massachusetts 02159**Phone Number :** 617 964-7070**Fax Number :** 617 527-7592**Technology Maturity :** Commercial use experience

Performance History : pH measurement systems have been utilized to monitor the pH of nutrient solutions of NASA plant growth experiments at NASA Kennedy Space Flight Center. They have undergone evaluations during plant growth cycles (2-3 months on in-situ measurements). Contact: Dr. John Sager, NASA KSC 407 853-5142. They have been extensively evaluated in the laboratory. They are about to undergo extensive beta site-testing at a water-treatment facility in the UK.

Comments : Color (dyes, etc.) of aqueous solutions can impact use. Systems can operate successfully with significant biofouling and fouling. Limited use at high temperatures (most operations at < 65 degrees celsius). The only requirement is electrical power at the location of measurement. The optrode is connected to the optoelectronics interface housed in the PC; the PC is turned on and the software is executed. The system is then ready for measurement/data logging/etc. The pH measurement system is the first optrode-based system that GEO-CENTERS has made available for commercial sale. Sensors for the measurement of NH₃ will be available next, H₂O (moisture) sensors will follow shortly. Sensors to monitor hydrazines, BTX, ethylene, CO and CO₂ have been demonstrated. The technology is also applicable for the detection of heavy metals (total), halogenated compounds, and other hazardous organics. The unique element of GEO-CENTERS systems is the use of porous polymer-based sensing elements in which the sensing reagent is chemically bound to the polymer matrix. This provides superior stability in the optrode. Additionally, this technique provides enhanced effective surface areas in small length (<3mm) sensing elements.

Source of Information : TechCon

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name: MetPAD and MetPLATE Heavy Metal Toxicity Test Kits

Application: On-site Ex-situ

Brief Description: MetPAD and MetPLATE are rapid qualitative and quantitative microbial assays that are specific to heavy metal toxicity. The technological basis of the kits is the inhibition of a bacterial enzyme by toxic heavy metals in environmental samples. The sensitivity of these kits to heavy metals is generally higher than MICROTOX and is of the same order or better than Daphnia and fish bioassays. The MetPAD and MetPLATE greatly reduce the costs associated with determining toxicity characteristics. Using either the MetPAD and MetPLATE concurrent with other general toxicity assays would help determine the nature of chemicals causing toxicity.

Company Name/POC: Group 206 Technologies, Inc./J. Craig Watts

Address: 6705 NW 24th Place/Gainesville, Florida 32606

Phone Number: 800 869-8729

Fax Number: 904 376-913

Technology Maturity: Commercial use experience

Performance History: Performance data are available.

The MetPAD and MetPLATE have proved successful by research groups in the public and private sector. Oscar Pancorbo (State of MA, DEP, 508 682 5237) has used and is planning to use these kits for toxicity screening and identification at several sites throughout Massachusetts. These kits have been evaluated by at least two independent research groups. Rochelle Rabidue (3M, 612 778 7065) and Rosalind Wei (In Vitro, 714 851 8356) have performed separate evaluations of these kits with results supporting the Company's claims.

Comments:

The MetPAD and MetPLATE are small, lightweight test kits; however, a portable incubator is required to complete either test. The MetPAD and MetPLATE test kits are designed to detect and measure toxic heavy metals in the ppm range. These kits will not detect heavy metals that carry a negative charge, e.g., cyanide and arsenic and will not differentiate among the various heavy metals found within a sample. The kits must be stored under refrigeration and must not be exposed to direct sunlight. The MetPAD and MetPLATE are simple to use and portable; flexible in the sense that it can be used on several types of samples (e.g., soils, sludge, water and wastewater). Each kit comes with easy-to-follow instructions.

Source of Information: TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Mobil Radiological Analysis Laboratory (MRAL)**Application :** On-site Ex-situ

Brief Description : The Mobile Radiological Analysis Laboratory was conceived to provide both qualitative and quantitative radioanalytical services for field operations. The system was designed to utilize commercially available technology, integrated with both standard and modified analytical procedures, to meet the specific needs of the customers. Los Alamos National Laboratory currently has two units in operation that have been supporting field operations for two years. Two additional mobile laboratories were to be in place for the field sampling season of fiscal year 1994. The advantages include proximal real-time analysis and reporting of samples at a fraction of the cost of fixed-base labs and high sample through-put. Disadvantages include higher detection limits and some non-specific analysis.

Company Name/POC: Los Alamos National Laboratory/George Brooks**Address :** P.O. Box 1663/TSD-9/MS-K494/Los Alamos, New Mexico 87545**Phone Number :** 505 665-2583**Fax Number :** 505 665-5982**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.

The Mobile Radiological Analysis Laboratories (two currently in operation) have been supporting the Environmental Restoration Program since March of 1992. They have supported approximately 15 separate Operable Projects for site characterization within LANL. Support is expanding to include equipment release programs. Total samples analyzed within the mobile laboratories for the above-mentioned programs exceed 3000, with each of the samples requiring up to as many as 10 separate analyses.

Comments : The Mobile Radiological Analysis Laboratory should not be utilized/deployed when the analytical requirements of the project cannot be met from the data generated from the lab.

Source of Information : TechCon

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name: Contaminated Land Measurements

Application:

Non-intrusive

Brief Description:

In-situ high resolution gamma spectrometry is used to perform large area radiological clearance surveys and plant inventory measurements. Characterization and quantification of gamma emitting nuclides are typically possible to well below UK de minimis standards (400 Bq/kg). Measurements of total dose rates from spectral determinations at less than 0.05 microSv/h are routine. By use of high resolution gamma spectrometry in large area surveys, adequate limits of detection can be confidently obtained with short count times enabling many points to be surveyed in a working day.

Company Name/POC: Nuclear Electric plc/Dr. R. Clayton

Address:

Littlebrook Complex/Littlebrook Manorway/Dartford Kent DA1 5PY, UK

Phone Number: 44 1322 28 2800

Fax Number: 44 1322 28 281

Technology Maturity: Commercial use experience

Performance History: Many internal measurements on Nuclear Electric plant and site, experience in foreign plant measurements (PWRs in Spain and Belgium). Site surveys have been carried out, inter alia, at British Rail railheads and around the Trawsfynydd lake. Internal confidential reports may be made available on request.

Comments:

On site supply to liquid nitrogen and electricity supply point for battery charging is required. Measurements are restricted to gamma emitting isotopes. However, the results are routinely extrapolated to non gamma-emitters by use of fingerprinting and radiochemistry techniques. Easy to use with minimal local support requirements.

Source of Information: International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Nuclear Magnetic Resonance (NMR)**Application :** Ex-situ

Brief Description : Determines the structure and type of molecules in solution based on nuclear spin of component atoms using spectrographic techniques applied at radio frequencies. Method can be very sensitive (ppm detection), mainly used on organics, suffers signal to noise problems for low concentration measurements, not all atoms have nuclear spins. Solid state NMR is possible. NMR can potentially replace wet analysis. NMR systems are being developed that could be deployed in the field to continuously monitor a small volume in a large multiphase background volume.

Company Name/POC: Oxford Instruments UK Ltd./W. Proctor**Address :** Osney Mead/Oxford OX2 ODX U.K.**Phone Number :** 18 6526 9500**Fax Number :** 18 6526 9501**Technology Maturity :** Commercial use experience

Bench scale testing, only

Performance History : NMR is well established in the laboratory (1,000 units). It is also widely used in medicine (Magnetic Resonance Imaging). The technology is under development for a range of industrial measurement situations. Oxford Instruments is developing magnet and radio frequency systems for underground operation (oil) and stand alone support of cryogenic magnets.

Comments : Technology is supported by the supplier in software to transform NMR data into concentrations of identified species. Data can be recorded as in a well logging situation. Technicians need electromechanical skills and training in general measurement techniques.

NMR scientific measurements are well established - underground measurements are not. Technology needs to be developed. Nearly all elements have isotopes that can provide a NMR signal and many organic complexes are now characterized. Signal to noise limits detection sensitivity which can make detection of species of low abundance take many hours. NMR is being developed for underground use by the oil industry to characterize fluids on the basis of proton chemistry. For field deployment, self-contained probes will be operated remotely using electronic data gathering. In concept, probe and base station operation is straightforward. Interpretation methods are being researched.

The main challenge is to deploy probes that have enough field strength to enable targeted spectrometry experiments. This requires the support of high field magnets (possible cryogenic) which it is thought could be done using new materials or compact (military) coolers. It is believed that spectrometry could be carried out in bore holes down to 100 metres using coolers or new magnetic materials, but this contention needs to be proved. Ground penetration to a depth of 2m may be possible using distributed arrays of magnets and radio frequency coils.

Source of Information : International TechCon

CONTAMINANTS: ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name: Differential DIE Away For Induced Fission Using NeuSight

Application: Non-intrusive

Brief Description: Intense pulsed neutron source for use in induced fission characterization of waste through differential DIE away technique and neutron radiography (matrix correction). Excellent pulsing characteristic with negligible DAR current and intensity at least x10 nearest alternative transportable source (D-T Tube) significantly improved detection levels due to improved signal to noise.

Company Name/POC: Oxford Instruments/Nigel Boulding

Address: Accelerator Technology Group/Osney Mead/ Oxford OX2 ODX, UK

Phone Number: 44 1865 269500

Fax Number: 44 1865 26950

Technology Maturity: Commercial use experience

Performance History: Accelerator is already a proven product in medical and nuclear applications in fixed sites.

Comments: Lower limits of detection of fissile material yet to be determined. Can be configured as a mobile source/system for use at various sites. Minimal infrastructure requirements. Delivery of system within one year. Can collaborate with Rolls-Royce and could jointly provide x-ray/neutron interrogation systems for waste drum characterization.

Source of Information: International TechCon

CONTAMINANTS :

Pesticides/Herbicides

Heavy Metals

PCB

Explosives/Propellants

■ Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

Halogenated VOC

■ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Germanium Sonde Operation

Application :	On-site	Ex-situ

Brief Description : The germanium "cryoprobe" or "cryosonde" uses a high purity Ge spectrometer cooled by a solid cryogen to make high resolution logs of gamma activity. The method is unsurpassed sensitivity and selectivity. The technology alternative is coring and lab assay.

Company Name/POC: Princeton Geophysical Services, Inc./J. Baicker

Address : P.O. Box 900/Rocky Hill, New Jersey. 08553

Phone Number : 609 921-7061

Fax Number: 609 921-7132

Technology Maturity : Commercial use experience

Performance History : Logged more than 100,000 feet in holes totaling more than 1.2 million feet. Clients include most uranium mining companies.

Comments : Operators are provided. Limited to gamma rays >60KeV. Logging trucks are available. No general challenges except quantitative calibration in DOE environments.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : AB-5 Radiation Detector

Application : On-site Ex-situ

Brief Description : An industry accepted standard for the measurement of radon gas in air, water and soil; working level; surface contamination of alpha and beta particles; gamma detection - using various probes such as zinc sulphide, scintillation cells, disks. Sensitivities range between 1 to 23 cpm/pCi/L depending on accessory use.

Company Name/POC: Pylon Electronics Inc./Fran Higginson

Address : 147 Colonnade Rd/Ottawa, Ontario K2E 7L9

Phone Number : 613 226-7920

Fax Number : 613 226-819

Technology Maturity : Commercial use experience

Performance History : Number and size of jobs have been varied over the years; AB-5 used by DOE contractors (50), EPA offices and HP physicists (10) for various application. Ref. Doug Daniels/Fermco 513 738-6088

Comments : 8 digit display: information may be dumped on printer or retrieved via PC or obtained manually. Condensing humidity is a limitation. -10 degrees C to 50 degrees C operating temperature. AB-5 is delivered ready for use in the field; manual provides operating instructions on day to day operation. QA includes verifying background of cell and electronic noise; plateau curve and all efficiency may be verified annually using a standard. Initial use of equipment may be challenging, but manual describes fully the use and changing of accessories for various applications.

Source of Information : International TechCon

CONTAMINANTS:

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

■ Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

■ **Halogenated VOC**

■ **N/A**

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name : Prompt Gamma Neutron Activation Analysis (PGNAA)

Application : In-situ (vadose zone)

Ex-situ

Brief Description : PGNAAs perform a non-invasive characterization of concentration profiles of hazardous or radioactive elements; can be used in-situ in the natural environment, within isolated packages or objects, or, as appropriate, in process monitoring control. Sensitivity down to "clean" levels is generally achievable, and the technique applies throughout the periodic table. It leaves no residual radioactivity.

Company Name/POC: Scientific Ecology Group, Inc./C.P. Keegan

Address : 1501 Ardmore Boulevard/Pittsburgh, Pennsylvania 15221

Phone Number : 412 247-6255

Fax Number :

Technology Maturity :	Field demo complete

Performance History : Bench scale testing and calibration for buried uranium.
Other elements in process.
Field application with uranium-contaminated soil (in-situ).

Comments : Limited to penetration of a few feet in packed soil for in situ environmental application (approximately 1-4 feet, depending upon contaminant sought).

Source of Information : TechCon

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name: SIGNATURE Gamma Radionuclide Detection and Analysis System

Application: On-site Ex-situ

Brief Description: Provides spectral analysis of a radioactive sample using sodium iodide scintillation detectors with greater efficiency than high purity germanium, and without complex and expensive cooling systems. Uses sophisticated digital signal processing techniques to provide measurement resolution comparable with high purity germanium at reduced cost of ownership. Original concept applied to reactor on-line fission product monitoring, further developed for environmental monitoring. Has undergone trials using blind and mixed radionuclide sources. Identification and quantification of component radionuclides has been achieved down to levels of a few becquerels. Use of sodium iodide well detector and automated sample changing will give further benefits. Suitable for initial evaluation of contamination or confirmation of satisfactory decontamination.

Company Name/POC: Siemens Environmental Systems Ltd./Dr. W.E. Croydon

Address: Sopers Lane, Poole/Dorset, BH 17 7ER/England

Phone Number: 44 1202 782648

Fax Number: 44 1202 78215

Technology Maturity: Field demo complete

Performance History: Performance Data are Available.

Trial systems monitoring reactor coolant have been installed on three UK power stations, both AGR and MAGNOX, and on other PWR nuclear plant. A 2 out of 4 voted hardware trip mode is available to shut down the reactor in the event of a significant increase of specific fission products. Typical measurements are of ~50 kBq/kg Kr-88 in a mixed power spectrum of ~50 MBq/kg N-16 and other isotopes, and agree with grab sample measurements made with a high purity germanium system to within 10 percent. A trial system for environmental monitoring has been configured to detect atmospheric contamination, suitable for the UK national RIMNET2 emergency response system. Laboratory evaluation has detected radionuclides at levels of a few Becquerels. Further improvements are under consideration.

Comments: Limited by detector characteristics, which must be designed for the particular application e.g., operating temperature, mechanical shock, weight of background radiation shielding. Flexible system which can be tailored to meet the needs of a specific application. Stand alone or connected to network for remote operation. Challenges are in optimization of system for ease of calibration and extension to variable geometries. Discussions are underway with the Geosciences Advisory unit at Southampton University, UK with a view to combining a sodium iodide well detector and automated sample changing stage with the SIGNATURE analysis system. This would provide improved automated equipment for analysis of radionuclide contamination for either field or laboratory use, and with low cost of ownership. Alternative detector systems could be designed to address other monitoring requirements. Trials have been carried out involving the following isotopes: Eu-155, Mn-54, Ba-133, Na-22, Zn-65, Am-241, Co-60, Cs-134, Cs-137, Eu-152, Ru-106, Co-58, Co-57, Sr-85, I-131, K-40, Gd-153, Sc-46, Tb-160, Ru-103, Cd-109, Ce-139, Sn-113, Y-88, Ra-226, Pb-214, Bi-214, Kr-88, N-16, O-19, Ar-41, Ir-192, Hg-203. However, the system is not limited to available test isotopes but should detect any gamma emitting radionuclide through the use of library emission data.

Source of Information: International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Rapid Screening Field Measurements of Organic Contaminants**Application :** On-site Ex-situ**Brief Description :** Provide rapid screening (5-10 min/sample) and more quantitative analysis (20-30 min/sample) for EPA listed VOCs and semi-VOCs including explosives. Conducted studies with Argonne National Laboratory, EPA (EMSL-Las Vegas) RSKERL - Ada; ERL - Narragansette Region 1) Tenneco, Navy and Army.**Company Name/POC:** SiteWorks, Inc./Dr. L. John Hoover**Address :** Suite 363/11160-F South Lakes Drive/Reston, Virginia 22091**Phone Number :** 703 385-1549**Fax Number :** 703 385-3658**Technology Maturity :** Commercial use experience**Performance History :** Performance Data are Available.

Tufts University/Site Works
 Argonne National Laboratory; Candace Rose; Dr. Jacqueline Burton 1-708-252-8795
 Currently providing service in support of VOC analysis

Army/2 months Fort Devens
 Navy/3 weeks San Diego Harbor
 Tenneco/1 month pipeline
 4 EPA projects

Comments :

Sample throughput dependent on sample matrix TDGC/MS. Analysis of full range of EPA listed organics reduces sample throughput; nonetheless, 2 times faster than fixed laboratory. Can have instruments ready for operation in 4 hrs including calibration. Personnel and mobile unit available to provide service immediately. Can analyze soil gas, direct and extracted soil, air and aqueous media.

3 publications have appeared in the peer-reviewed journals Analytical Chemistry and Journal of Chromatography. Conducted successful field validation studies with EPA, DOE, Army, Navy and private sector documenting data quality and cost/benefit.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : BioTector - On-line Analyser for Total Organic Carbon

Application : On-site Ex-situ

Brief Description : TOC analysers especially designed to perform reliably in industrial on-lieu applications. No filtration required. Long term stable operation experienced. No interference from chloride.

Company Name/POC: Skinstument A/S Pollution Control/Tor Anders Petteroe

Address : Trykkeriveien 8/N-1653 Sellebark/Norway

Phone Number : 47 69 36 32 90

Fax Number : 47 69 36 32 9

Technology Maturity : Commercial use experience

Performance History : First prototype developed in 1990, and tested in pulp and paper water in Temiscamin, Canada among other places. The instrument had too long response time, and too many component errors. New oxidation method was developed together with a team of German and French scientists, and the current version of the Bio Tector was launched in 1993/94. Approximately 50 units are installed in various applications, mainly industrial effluent. Main application is control of water going into the biological treatment plants in industries to control the addition of nutrients. Best reference will be Mr. Hans Dufva, Instrumental Engineer, and responsible for the purchase, installation and operation of the Bio Tector at the chemical plant AKZO NOBEL, Stenungssund, Sweden. He has analytical experience and a high request for quality in his own and other's work and equipment.

Comments : Sample must be available, or made available max. 3 meters below the analyser. Oxygen flask with reduction valve must be present. A room free from direct sunlight or direct rain must be available. Max. ambient temp 35 degrees centigrade. Temp. must be above freezing point. The Bio Tector has not been installed in clean water installations, and below 3-4 mg-C/L the accuracy is not documented. Can be used as a stand alone piece of equipment. Included in the analyser is a system for data collection and presentation that stores all data for one year, and can present these on screen, paper or diskette. The Bio Tector TOC analyser is made of high quality components and materials. All cabinets are made of stainless steel. Unlike most TOC analysers, the built-in CO2 detector is a non drifting device. To avoid variations in the gas flow through the system a computer controlled mass flow controller is implemented instead of the manual rotameter used in most TOC analysers. All operations are made by step by step menus presented on a touch screen.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Ion Trap Mass Spectrometer

Application : On-site Ex-situ

Brief Description : The Teledyne MEC (TMEC) Ion Trap Mass Spectrometer is one of the most sensitive mass spectrometers of its size in the world. It is designed to be transportable, rugged, and automated to minimize operator intervention. It is ideal for field evaluation of toxic contaminants. The TMEC Ion Trap Mass Spectrometer will permit field measurements of environmental contaminants in lieu of laboratory analysis.

Company Name/POC: Teledyne MEC/Mort Cohen

Address : 1274 Terra Bella Ave./P.O. Box 7244/Mountain View, California 94039-7244

Phone Number : 415 962-6989

Fax Number : 415 967-4353

Technology Maturity : Field demo complete

Performance History : Field evaluations of the TMEC Ion Trap Mass Spectrometer are underway by the U.S. Army for military applications to detect chemical and biological toxins. Initial evaluation are positive. Point of contact is Dave Sickenberger, U.S. Army Chemical Research, Development, Engineering Center, (410) 671-5533.

Comments : Instrument is designed for direct sampling, or GC/LC input. The mass range is approximately 20 to 2,000 amu. It is highly sensitive (parts per billion to parts per trillion) and is excellent in isolating coeluting compounds in complex mixtures. It can be used for field evaluation, laboratory analysis, or fence post monitoring applications. The TMEC instrument is designed for ease of use. It can be powered by AC or DC (battery). It can be configured to operate with a PC-based data system, or as a stand alone device with display and data printout. The system is highly automated to minimize operator intervention, and can be easily configured for direct sampling or interface with gas or liquid chromatograph. There are no infrastructure considerations other than availability of prime power (about 1 KW). The TMEC ion trap mass spectrometer was specifically designed for field evaluation applications to measure very low levels of toxic contaminants. The original instrument was developed for the U.S. Army for military applications and to measure chemical and biological contaminants in the field. Approximately \$13M have been allocated for the R&D of this instrument. Initial field evaluations of the demonstration units are currently underway. Teledyne MEC is also developing, under an internal R&D program, an ion trap instrument for commercial applications related to real-time measurement of environmental contaminants. Initial demo units will be available by mid-1993. TMEC has filed for 8 patents on its ion trap technology, two of which have been allowed and will soon be issued. The other 6 filings are still under review by the U.S. Patent Office.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : X-Ray Fluorescence

Application : On-site Ex-situ

Brief Description : A quick, on-site determination of elemental inorganic contaminants in soils or other matrices. The results are qualitative and quantitative. Detection limits range from 5 to 90 parts per million. There are two instruments: one portable (Spectrace 9000), one transportable (Spectrace 6000). These instruments can handle samples of soil, sludge, powders, liquids, solids, or dust. Elements analyzed range from sodium to uranium on the periodic table.

Company Name/POC: TN Technologies/Spectrace Instruments/Rick Booth

Address : 2555 N. Interstate 35/Round Rock, Texas 78664

Phone Number : 512 388-9100

Fax Number : 512 388-920

Technology Maturity : Commercial use experience

Performance History : EPA's Environmental Response Team

Many Jobs

Contact: Mark Bernick

Roy F. Weston

(908) 225-3990

Wright Patterson AFB

Clean Up

Contact: Mike Radi

Engineering Sciences

(615) 481-0451

Comments :

Limitations of this technology include:

Inhomogeneous samples affect results.

Spectrace 9000 requires ambient air temperature not exceed 120 degrees Fahrenheit and 105 degrees

Fahrenheit for storage.

Spectrace 6000 must have AC power.

Weighing just 19 lbs, Spectrace 9000 is battery-operated with a field pack; this system accommodates almost any environment. The system does not require liquid nitrogen and yet provides very high resolution. The software interface and fundamental parameter analysis technique results in operator ease-of-use that is unparalleled. Spectrace 6000 can be installed in a mobile lab and provides laboratory SRF resolution and results on-site. Spectrace 6000 also has fundamental parameter software and menu driven user interfaces. The only challenge, in terms of field screening, is the required action levels for certain contaminants which may be lower than this technology can accommodate.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Chlorinated Hydrocarbon Monitor**Application :** On-site Ex-situ

Brief Description : This unique rare-earth sensor detects and measures contaminants such as carbon tetrachloride, trichloroethylene, perchloroethylene, dichloromethane, and other chlorinated solvents commonly used in nuclear weapons production. The sensor has no interference from methane, gasoline, paint thinner, and other non-chlorinated compounds.

Company Name/POC: TRANSDUCER RESEARCH, INC./William J. Buttner**Address :** 600 N. Commons Dr./Suite 117/Aurora, Illinois 60504**Phone Number :** 708 978-8802**Fax Number :** 708 978-8854**Technology Maturity :** Commercial use experience

Performance History : DOE - Hanford/Site Characterization/Cary Martin/Westinghouse 509 376-2648
 DOE - Hanford/Carbon Tetrachloride Removal (Vacuum Extraction Process)/Randy Coffman/Westinghouse/509 376-4263
 DOE - Hanford/Safety, Extraction Well Drilling/Tom Lazarski/Kaiser Engineering/509 373-4791
 Eastman - Kodak/Wastewater Treatment (Dichloropropane, Dichloromethane)/Tom Walton/Eastman Kodak/716 477-1633

Comments : This instrument detects and measures chlorinated hydrocarbon vapors only. It does not speciate (responds to all chlorinated hydrocarbons). It requires vapor dilution for concentrations above 50 ppm. Model MP-1 Gas Diluter is available from Transducer Research as separate product. Sensor life is inversely proportional to exposure concentration and exposure time. Model 2001-05 is currently being used for site characterization, safety monitoring, and clean-up process applications. Transducer Research is currently improving sensor performance through automatic dilution and pre-concentration modules. Real-time monitoring capability permits quick analysis of contamination situation. Instrument is less expensive to purchase, operate, and maintain than alternate technologies. Real-time measurement allows determination whether work can be continued. Unit can be used to monitor changes in safety conditions. Selective measurement of chlorinated solvents simplifies operating procedures and speeds up the decision process.

Source of Information : TechCon

CONTAMINANTS :

- ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Gas Chromatograph/Mass Spectrometer (Field GC/MS)**Application :** On-site Ex-situ

Brief Description : Transportable GC/MS used to detect and identify complex mixtures of environmental pollutants and toxic substances in trace amounts. Based on Hewlett-Packard's 5971A mass selective detector, Viking's field GC/MS uses miniaturized components to achieve laboratory-grade results on-site in real-time. Features of the instrument include: a heated membrane separator made from dimethyl silicone for air sampling, internal cryofocusing options for analysis of light volatiles, and high-temperature ramping for analysis of semi-volatiles with higher boiling points. Field GC/MS analysis shortcuts the current process of collecting environmental samples, sending them to a lab for analysis, and waiting weeks for results.

Company Name/POC: Viking Instruments Corporation/Thomas J. Kuehn**Address :** 3800 Concord Parkway/Suite 1500/Chantilly, Virginia 22021**Phone Number :** 703 758-9339**Fax Number :** 703 968-010**Technology Maturity :** Commercial use experience

Performance History : Viking's GC/MS has been field-proven by a number of large industrial firms and government agencies, including Tennessee Eastman, Martin Marietta, the EPA, the FBI, and the U.S. Army, for a variety of applications. The DOE, in conjunction with Sandia National Labs, uses the instrument for emergency response and on-site testing. Steve Thornberg is Viking's reference contact within the DOE (505) 846-8829.

Comments : Use of the instrument requires an operator who is skilled as a lab or field chemical technician and has completed Viking's Field GC/MS Introductory Training Course. The field GC/MS has many unique features designed into the system specifically to provide for flexibility and ease of use. Its rugged transport case, for example, permits operation in virtually any location that is accessible by jeep or plane. Once at a site, the field GC/MS can be unpacked and operational in about 15 minutes. The instrument also offers a number of sample inlet options for air, water, and soil gas and a user-friendly, Windows-based operating system. Finally, service contracts and telephone support are available with every instrument.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** On-Line Gas Chromatograph/Mass Spectrometer for Continuous Emission Monitoring**Application :** On-site Ex-situ

Brief Description : On-line continuous emission monitor (CEM) used to detect and identify complex mixtures of environmental pollutants and toxic substances, specifically in air. Based on Hewlett-Packard's 5971A mass selective detector, Viking's CEM includes on-line analysis software, multi-port sampling valves, remote control, and networking capability. The CEM delivers laboratory-grade performance on site in real time. On-line continuous emission monitoring consolidates the barrage of single-purpose instruments currently in use to ensure worker safety and comply with legislative reporting requirements. More important, the new Clean Air Act Amendments make on-line GC/MS monitoring the only practical and cost-effective means of tracking regulated toxins.

Company Name/POC: Viking Instruments Corporation/Thomas J. Kuehn**Address :** 3800 Concord Parkway/Suite 1500/Chantilly, Virginia 22021**Phone Number :** 703 758-9339**Fax Number :** 703 968-0101**Technology Maturity :** Commercial use experience

Performance History : Although the on-line CEM is ready for commercial production, its predecessor, the Viking Field GC/MS, has experienced great success. Current users of the field GC/MS include Tennessee Eastman, 3M, Martin Marietta, the EPA, FBI, U.S. Army and Sandia National Laboratory.

Comments : Use of the instrument requires an operator who is skilled as a lab technician and has completed Viking's On-Line CEM Introductory Training Course. Viking's on-line CEM is specifically designed for flexibility and ease of use. Its rugged housing, for example, can withstand outdoor use as a fence-line monitor or a long lifetime on the factory floor. The instrument itself offers a number of sample inlet options for air, water and soil gas, and a user-friendly, Windows-based operating system. Finally, service contracts and telephone support are available with every instrument.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Laboratory Analysis*

Technology Name : SMP (Sub Mitochondrial Particles)

Application : On-site

Brief Description : The technology utilizes submitochondrial particles (SMP) and is based on the mammalian enzyme complex that mediates cellular electron transport. These bioassays have broad application wherever rapid, inexpensive information about acute toxicity of aquatic or soil samples is needed. SMP-based bioassay products will complement analytical chemistry analysis and whole-organism bioassays by speeding the flow of information and lowering the overall cost of environmental monitoring. SMP tests were designed to provide a means for rapid inexpensive bioassay of harmful materials in environmental samples such as wastewater effluents, landfill leachates, or soil extracts. These tests can be used as a prescreening tool to select samples of concern for further analysis. Based on results of SMP prescreening, follow-up analysis may be carried out using analytical chemistry or whole-organism bioassays (e.g. USEPA's fathead minnow survival test or Ceriodaphnia magna reproduction tests). The SMP tests take less than thirty minutes to perform. In comparison, the whole-organism bioassays require 7 days.

Company Name/POC: Biorenewal Technologies, Inc./Alan J. Dines

Address : 2800 S. Fish Hatchery Rd./Madison, Wisconsin. 53711

Phone Number : 608 276-8980

Fax Number : 608 273-698

Technology Maturity : Commercial use experience

Performance History : Performance data are available. This technology has been used in round robin EPA toxicity tests several times during the past three years. Results are available upon request. The test is currently being used in an EPA funded storm water run-off study being conducted by the Wisconsin Department of Natural Resources in conjunction with an inclusive battery of analytical chemistry tests. This study is not complete and is continuing for the next two years. SMP technology was evaluated two years ago in a USGS study at the Green Bay municipal waste water treatment facility. Results in the form of an extensive detailed report are available. Currently the company is conducting a development contract with Waste Management to evaluate SMP technology as a toxicity test on the effluent of a Superfund landfill leachate treatment system in Wisconsin. The goal is to install a continuous toxicity testing unit that reports results to a remote monitoring location.

Comments : While SMP toxicity test gives results in less than 30 minutes and costs less than \$25 per test instead of one week for the more traditional whole organism tests at a cost of \$500 to \$1,000 per test, it does not provide results that quantify the amount of toxicity or contaminants. Toxicity tests are a general measure of contaminant's impact on the animal kingdom and the environment as a whole.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Laboratory Analysis***Technology Name :** Microwave Sample Digestion**Application :**

On-site

Off-site

Brief Description :

The CEM Microwave Sample Preparation System, MDS-2000 series, combines the speed of microwave heating with proprietary sealed vessel technology to significantly reduce the sample preparation (acid digestion) process time. For environmental samples, the process time is reduced by a factor of 8-10. In addition to time savings, the technology provides performance (measure by elemental analysis), safety and cost advantages over traditional hot plate techniques.

Company Name/POC: CEM Corporation/Gregory N. LeBlanc**Address :** 3100 Smith Farm Rd./P.O. Box 200/Matthews, N.C. 28105-200**Phone Number :** 800 726-3331**Fax Number :** 704 821-7894**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.

There are over 3000 Microwave Sample Preparation Systems in use worldwide. The systems are typically used for acid digestion of a variety of matrices for subsequent elemental analysis. It cuts across all industries. Its widest use is for environmental applications. It has proven highly successful as measured by its acceptance in the worldwide marketplace.

Comments :

Skills associated with a chemical laboratory are all that is required to operate the system. Training can be completed in <2 hours. Complete procedures are supplied with the purchase of the instrument. The system can be set up and running within 1 hour of removal from the shipping box. It can be used in a mobile lab and a standard laboratory. The system operates on 115 vac. (No special requirements). It is applicable to a wide variety of sample types encountered in remediation efforts. A fume hood is not required.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Laboratory Analysis*

Technology Name : Cold Trap Inlet System for GC

Application : Off-site

Brief Description : The cold trap inlet system is used to first cryofocus organic samples (as a frozen plug) and then rapidly deliver the sample to a capillary column for a high speed separation. The cold trap is continuously cooled with a stream of cold gas. Typical trapping temperatures range from -50 degrees Celsius to -150 degrees Celsius. After the sample is cryofocused on the metal coated trap, the trap tube is electrically heated which rapidly vaporizes the frozen sample and delivers it to the mouth of the separation column as a small vapor plug. The cold trap inlet works extremely well for compounds with volatilities as high as pentane. This technology will replace inlet systems used in conventional Gas Chromatography. This will allow for reduction in analysis times from tens of minutes to tens of seconds as compared to conventional chromatography.

Company Name/POC: Chromatofast, Inc./Robin Risser

Address : 912 N. Main Street, Suite 14/Ann Arbor, Michigan 48104

Phone Number : 313 662-3410

Fax Number : 313 662-346

Technology Maturity : Bench scale testing, only

Performance History : The cold trap inlet system has been utilized through a development contract from private industry for a speciation instrument to analyze automotive exhaust gases. The device has been successfully applied towards cryofocusing a gas sample over several minutes, this proving a means to concentrate the sample and improve detectability within the system.

Comments : The device, when combined with equipment for high-speed gas chromatography will require a single technician with familiarity in using a conventional gas chromatograph. The majority of the operation is automated. The only required procedure would be a method of sample introduction, i. e., syringe injection. The current system employs LN2-cooled N2 gas to achieve the necessary trapping temperatures. While this is satisfactory for a research instrument, alternative cooling is desirable for a commercial instrument. Additionally, smaller more portable ovens capable of quicker temperature programming need to be constructed. For the final instrument, all components must be rugged and packaged into a portable case. Computer software for acquisition and analysis along with appropriate digital displays will also be incorporated.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Laboratory Analysis***Technology Name :** Gas Valve Inlet System for GC**Application :** Off-site

Brief Description : The gas valve inlet system is used for extremely fast injections which are required for high-speed gas chromatography. A sample gas travels through an injection tube which is positioned inside a metal block. A small hole in the tube continuously leaks sample gas. The tube is traversed perpendicularly to the capillary separation column so that the leak of sample gas will pass directly over the column opening, thus accomplishing sample introduction. The gas valve inlet system works well for gas sample streams where extremely small injection band widths are desired. This technology will replace inlet systems used in conventional Gas Chromatography. This will allow for reduction in analysis times from tens of minutes to tens of seconds as compared to conventional chromatography.

Company Name/POC: Chromatofast, Inc./Robin Risser**Address :** 912 N. Main Street, Suite 14/Ann Arbor, Michigan 48104**Phone Number :** 313 662-3410**Fax Number :** 313 662-3462**Technology Maturity :**

Bench scale testing, only

Performance History : The gas valve inlet system is currently being used as a research device at the University of Michigan. It can provide analysis time as short as 2 seconds with very good reproducibility. It has been operated tens of thousands of times with no sign of wear. Project directed under Dr. Richard Sacks, Professor, (313) 764 7373.

Comments :

The device, when combined with equipment for high-speed gas chromatography will require a single technician with familiarity in using a conventional gas chromatograph. The majority of the operation is automated. The current gas valve inlet system requires a pressurized sample stream. Techniques need to be developed in order to apply the inlet system to a wider range of samples and media. The device is currently implemented on conventional gas chromatographs modified for high speed operation. Steps for ruggedization of the instrument must be developed.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides☒ Heavy Metals☒ PCB☒ Explosives/Propellants☒ Petroleum Hydrocarbons☒ Radionuclides☒ SVOC☒ Other Contaminant☒ Nonhalogenated VOC☒ Halogenated VOC☒ N/ATECHNOLOGY TYPE : *Laboratory Analysis*

Technology Name : High Speed Capillary Column for GC

Application : Off-site

Brief Description :

Capillary column strategies for high-speed gas chromatography are techniques which are used to increase the performance or resolution of a high-speed separation as overall resolution is decreased as compared to conventional gas chromatography. Techniques include serial coupled columns which can shift unresolved pairs of peaks into open areas of a chromatogram, and high-speed column switching, which employs high-speed hardware used for multidimensional techniques. The techniques perform with a good level of precision and accuracy as they all incorporate high speed components.

Company Name/POC: Chromatofast, Inc./Robin Risser

Address : 912 N. Main Street, Suite 14/Ann Arbor, Michigan 48104

Phone Number : 313 662-3410

Fax Number : 313 662-346

Technology Maturity :

Bench scale testing, only

Performance History :

The Column Strategies technology has been utilized through a development contract from private industry for a speciation instrument to analyze automotive exhaust gases and in a fast, direct non-methane hydrocarbon analyzer development contract from a State of Michigan grant for automotive exhaust analysis. The speciation project was a 1 year contract providing \$525,000 of funds and the non-methane hydrocarbon project was a year contract providing \$75,000 of funds. A mid-point backflush procedure has been developed which reduces the cycle time of the instrument by a factor of 2.

Comments :

The device, when combined with equipment for high-speed gas chromatography will require a single technician with familiarity in using a conventional gas chromatograph. The majority of the operation is automated.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Laboratory Analysis*

Technology Name : On-Line Microwave Digestion

Application : Ex-situ

Brief Description : Continuous preparation of samples for analysis by AA, Fluorescence ICP, ICP-MS. Ideal for "Hot" samples. Replaces batch systems and robotics which are labor intensive and cumbersome.

Company Name/POC: Questron Corporation/Angelo Grillo

Address : 4044 Quakerbridge, RD./Mercerville, New Jersey 08619

Phone Number : 609 587-6898

Fax Number : 609 587-0513

Technology Maturity : Bench scale testing, only

Performance History : Technology is presently at the stage where beta site units will be manufactured. A DOE site would be ideal for such an evaluation.

Comments : The system can operate at high pressure, and high temperature. It would be applicable for all but some high temperature refractory materials. Analysis has reached a high degree of automation. Sample preparation is still relatively tedious. This system would allow the sample preparation to match the speed and degree of automation of the analyzer. All of the developmental work has been completed. The remaining challenges deal with actual speed in a real environment, range of applicable samples, reliability in an adverse environment, and applicability to use in a mobile lab. This product is being developed for the Canadian Ministry of Environment by Questron with the assistance of Dr. F. Salin's group at the Chemistry Department of McGill University.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Laboratory Analysis*

Technology Name : Ion Trap Mass Spectrometer

Application : On-site Ex-situ

Brief Description : The Teledyne MEC (TMEC) Ion Trap Mass Spectrometer is one of the most sensitive mass spectrometers of its size in the world. It is designed to be transportable, rugged, and automated to minimize operator intervention. It is ideal for field evaluation of toxic contaminants. The TMEC Ion Trap Mass Spectrometer will permit field measurements of environmental contaminants in lieu of laboratory analysis.

Company Name/POC: Teledyne MEC/Mort Cohen

Address : 1274 Terra Bella Ave./P.O. Box 7244/Mountain View, California 94039-7244

Phone Number : 415 962-6989

Fax Number : 415 967-435

Technology Maturity : Field demo complete

Performance History : Field evaluations of the TMEC Ion Trap Mass Spectrometer are underway by the U.S. Army for military applications to detect chemical and biological toxins. Initial evaluation are positive. Point of contact is Dave Sickenberger, U.S. Army Chemical Research, Development, Engineering Center, (410) 671-5533.

Comments : Instrument is designed for direct sampling, or GC/LC input. The mass range is approximately 20 to 2,000 amu. It is highly sensitive (parts per billion to parts per trillion) and is excellent in isolating coeluting compounds in complex mixtures. It can be used for field evaluation, laboratory analysis, or fence post monitoring applications. The TMEC instrument is designed for ease of use. It can be powered by AC or DC (battery). It can be configured to operate with a PC-based data system, or as a stand alone device with display and data printout. The system is highly automated to minimize operator intervention, and can be easily configured for direct sampling or interface with gas or liquid chromatograph. There are no infrastructure considerations other than availability of prime power (about 1 KW). The TMEC ion trap mass spectrometer was specifically designed for field evaluation applications to measure very low levels of toxic contaminants. The original instrument was developed for the U.S. Army for military applications and to measure chemical and biological contaminants in the field. Approximately \$13M have been allocated for the R&D of this instrument. Initial field evaluations of the demonstration units are currently underway. Teledyne MEC is also developing, under an internal R&D program, an ion trap instrument for commercial applications related to real-time measurement of environmental contaminants. Initial demo units will be available by mid-1993. TMEC has filed for 8 patents on its ion trap technology, two of which have been allowed and will soon be issued. The other 6 filings are still under review by the U.S. Patent Office.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Laboratory Analysis*

Technology Name : Accelerator Mass Spectroscopy (AMS)

Application : On-site Ex-situ
Off-site

Brief Description : This instrument measures the relative abundance of carbon 14/12, Iodine 129/122, etc. to better than 1 part in 1E15.

Company Name/POC: Triumf/Phillip Gardner

Address : 4004 Wesbrook Mall/Vancouver, B.C, Canada, V6T 2A3

Phone Number : 604 222-1047

Fax Number : 604 222-1074

Technology Maturity : Commercial use experience

Performance History : AMS is a well known analytical technique worldwide - J.Vogel, L.L.B.L., CA, USA - E. Litherland, U. Toronto, Ont., Canada

Comments : AMS is only appropriate for elements that make negative ions only. Positive ions must be done in conventional E-M mass spec.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Decision Support Tools*

Technology Name : Site Planner

Application : Other Application

Brief Description : Workstation-based software for decision support in site assessment and remediation. Site Planner replaces slow, low-productivity manual data management and visualization techniques and point solution software systems.

Company Name/POC: ConSolve Inc./David Barber

Address : 70 Westview St./Lexington, MA 02173

Phone Number : 508 358-8061

Fax Number : 508 358 806

Technology Maturity : Commercial use experience

Performance History : Site Planner is currently deployed on about 20 projects including use by four DOE laboratories.

Comments : Two days on-site training required. Limited by normal computer hardware limitations. System runs on stand-alone Unix workstations.

Source of Information : TechCon

Ground Water

Characterization

Ground Water

Characterization

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Physical Sampling*

Technology Name : "Non-Drilling" Hydraulic Probe Sampling and Mobile Lab Analysis

Application : In-situ (vadose zone) Ex-situ
 In-situ (saturated zone)

Brief Description : Combined "non-drilling" sampling technology for unconsolidated soils and field laboratory analysis of VOCs using lab-grade gas chromatography equipment. Rapid sample collection (soil-gas, soil and water) with minimal investigation-derived waste generation (e.g., no cutting or purge water), and real-time field analysis with a high level of QA/QC (e.g., HAZWRAP "Level B" DQO equiv.). Cost-effective, time efficient complement to traditional drill rig sample collection in unconsolidated sediment. No waste is generated and probe equipment is very safe to operate. Real-time analytical results (primarily headspace techniques) permit rapid decision-making and "one time" thorough site assessments.

Company Name/POC: EnviroSurv, Inc./Hunt Chapman

Address : 2800 C Dorr Ave./Fairfax, Virginia 22031

Phone Number : 703 204-3580

Fax Number : 703 204-3581

Technology Maturity : Commercial use experience

Performance History : DOE Contact: Dr. Robert Siegrist, Oak Ridge National Lab.

Comments : Technology application requires experienced field chemists and hydrogeologists. The data generated equals, or exceeds, fixed lab quality. But the CLP bias must be overcome; namely the perception that such information is always superior to field analytical results. The field results can be self supporting in terms of spikes, duplicates, calibration data and supporting documentation. Probing equipment is limited to unconsolidated sediments. Also, technique is not amendable to continuous coring, or borehole logging. Large sample throughput is primarily limited to VOCs. Fewer analyses per day are possible when extractions are required. Analysis is "efficiency" limited to 10-15 target compounds. Full scan VOCs analyses are less cost-effective and time efficient. Rapid mobilization, equipment set-up and use by experienced personnel. Only a 2-person field team required for sample acquisition and on-site analysis. Flexibility for all media sample collection and analysis (soil-gas, soil and water). Regulatory agency awareness of data quality; overcoming the "fixed-lab bias." Acceptable as a complement to the traditional drill rig/fixed lab approach to environmental site characterization. The quality of data generated depends on the experience and knowledge of field personnel. Widespread technology use will increase as more people become aware of the sample quality problems associated with handling, shipment and delayed analysis.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Physical Sampling*

Technology Name : Groundwater/Sludge Borehole Pumps

Application : In-situ (vadose zone)
 In-situ (saturated zone)

Brief Description : Draws water/sludge for analysis, at variable, pre-determined rates, including abrasive solids/contaminants, & various temperatures. Ability to overcome system deficiencies, and specification to handle overcut liquids.

Company Name/POC: H2O Waste-Tec/Mr. J. Hallows

Address : Horsfield Way, Bredbury Industrial Park/Stockport, SK6 2SU UK

Phone Number : 0161 406 7111

Fax Number : 0161 406 722

Technology Maturity : Commercial use experience

Performance History : 1000's of unit installed worldwide for water, sludge abstraction.

Comments : 3,000m borehole depth; 100 degrees C temperature; sludges above 10% dissolved solids. H2O Waste-Tec water is a major part of the Dresser Group with US wide commitment to product support throughout USA.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Physical Sampling*

Technology Name : Westbay MP System

Application : In-situ (saturated zone)

Brief Description : Multi-level Groundwater Monitoring Systems - Completion systems to provide access to multiple discrete zones in a single drillhole for purposes of collecting fluid samples, measuring fluid pressure and testing hydraulic conductivity. Incorporates borehole casings, packers, valved couplings, and associated wireline probes and tools. Replaces individual monitoring wells drilled to separate depths - reduces cost and schedule for implementing characterization/monitoring system. Allows collection of fluid samples without repeated purging - reduces costs of handling purge fluids.

Company Name/POC: Westbay Instruments Inc./Rob Weiss

Address : 949 W. Third Street/Unit 115/North Vancouver, B.C., Canada, V7P3P7

Phone Number : 800 663-8770

Fax Number : 604 984-3538

Technology Maturity : Commercial use experience

Performance History : Proven technology with excellent track record a number of sites in the U.S., Canada, and overseas. Technology has been applied in over 1,000 boreholes on over 100 sites, including RCRA and CERCLA sites in the U.S. The technology was evaluated by Battelle Pacific Northwest Laboratory at the Hanford Site, and has been used repeatedly by the Y-12 and X-10 plants at ORNL, as well as for a DOE property in Albuquerque, NM. Other U.S. Government customers included EPA, NASA, the Navy and USGS. Contact names/numbers available on request.

Comments : Current technology can be applied to depths in excess of 6,000 ft. Current temperature limitation is approximately 140 degrees F. Maximum fluid sample volume is approximately 1-2 liters per trip into well. The MP System (R) is modular in design and thus provides considerably flexibility in the design of groundwater monitoring wells. The hardware is readily available and is easy to use with a small amount of training provided by Westbay. Very little infrastructure is required, apart from drillholes to install the system in, and storage or vehicle/trailer mounting of the portable wireline instrumentation. The major challenge facing this technology is simply lack of awareness of the availability, function and capabilities of the system. During implementation, coordination between the site operator, consultants, drillers and Westbay is helpful.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : Sensors/Field Analysis Equipment**Technology Name :** Energy Dispersive X-Ray Fluorescence - Thin Film**Application :** On-site

Brief Description : The EDXRF does lab quality elemental analysis (Na to Pu) using proprietary technology that can meet EPA minimum detection requirements in near realtime; low ppb analysis of trace elements in solutions, low ppm for soils/solids (sub ppm with digestions) for an exceptional range of "total unknown" sample types (soils, ores, wastes, water, etc.) and concentrations (ppm to wt percent for solids). All done in one instrument with no prior knowledge of sample.

Company Name/POC: Advanced Analytical Products & Services/Jim Wrigley**Address :** 1753 Cape Aston Court/San Jose, California 95133-1128**Phone Number :** 408 926-4057**Fax Number :** 408 926-405**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.

Small jobs mainly (10 to 50 samples). Exceptionally low detection levels and very good corroboration where available; customers report accuracy is better than CLP. References: Dr. Paul LaMothe, U.S. Geol. Survey 415 329 5258; Mrs. BiShia King, U.S. Geol. Survey 415 329 5288; Dr. Bill Walker, Walsh Associates 916 737 7240; Mr. Bill Cole, Lockheed Eng. Svc. 702 897 3226; Mr. Eric Lindgren, Sandia Nat. Lab 505 844 3820.

Comments :

Sample prep is simple for solutions and soil/solid samples. Soils must be dried and ground (to about 300 mesh), then prepared as a thin film. The skill needed for EDXRF spectroscopy is quite high. Therefore, the company is offering a service, not an instrument. Later they will develop an "expert system" to overcome this. Detects elements Na to Pu, but not H to F. Doesn't determine compounds. With digestions, can do some speciation (e.g., soluble chromates Cr+6 distinguished from total chrome) and get excellent results (.3-.5 ppm). Mobile, not portable. Two person team recommended for field operations, but can be done with one. The cost reduction implications for field operations are quite significant.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Sediment Probe

Application : In-situ (saturated zone)

Brief Description : The technology is a rugged compact probe that can locate areas where groundwater enters surface waters. The instrument is designed to be dragged behind a boat along the bottom sediment, the probe can detect: the variation in sediment temperature (plus/minus 0.2 degrees C); the temperature difference between sediment and overlying water; and the electrical conductivity of the sediment. It is the only instrument of its type for real-time monitoring. This method covers a large area quickly and cost effectively. It is meant to be a compliment to other technologies.

Company Name/POC: AECL Research/C. A. McDowall

Address : Whiteshell Laboratories/ Pinawa Manitoba, Canada R0E 1L0

Phone Number : 204 753-2311

Fax Number : 204 753-2922

Technology Maturity : Field demo complete

Performance History : (1) Performed a survey in the St. Mary's River, Ontario, for a government department, in order to identify areas with significantly increased electrical conductance (revealing contamination from discharges from a nearby metal operations). (2) Located sources of groundwater upwelling at a site of creosote contamination in Puget Sound, Washington State, for an environmental agency. (3) Located a source of alkaline groundwater in a Wisconsin lake used for acid rain studies, for a government department. (4) Performed a preliminary study of offshore gamma activity. (5) Located freshwater discharges to the sea off the coast of the U.S.A. and Northern Europe. References will be provided upon request.

Comments : Experienced hydrogeologists with skilled technical staff are required to use the probe. Familiarity with field based data logging systems and locating devices (triangulation systems) is essential. Limitations of the technology include: unseen obstacles in the water, ice, and water depth. Trained operators knowledgeable in field instrumentation would find the probe easy to use. Operator concern for safety considerations and site specific parameters, such as current and subsurface terrain, must be considered. Continuous monitoring while dragging the instrument behind a boat provides real-time readout. The instrument reduces the number of cores necessary as it identifies the area of possible contamination without coring. This in turn reduces the number of analysis that need to be performed. Locates all gamma emitting contaminants. The instrument locates all groundwater upwelling (which may contain contaminants into surface water). A minimum of 2 plus a surveyor to operate the positioning system.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Mobile Laboratory for Chemical Weapons, Explosives and Propellants

Application : On-site Ex-situ

Brief Description : Mobile laboratory with all necessary chemical and physical equipment to detect and analyze chemical weapons, explosives, propellants and other toxic materials.

Company Name/POC: Alba Industrie Umweltschutz Service GmbH/Dr. K. Faber

Address : Rehrhoferweg 160/D29625 Munster/Germany

Phone Number : 051 92 96 3212

Fax Number : 051 92 96 3311

Technology Maturity : Commercial use experience

Performance History : In use for two years, e.g., in Russia and also in Germany.

Comments : None.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Monitoring of Chemical Weapons in Soil, Water, Air, Buildings

Application : On-site Ex-situ

Brief Description : Monitors all relevant parameters, like concentrations of chemical weapons in air, soil, water, and buildings.

Company Name/POC: Alba Industrie Umweltschutz Service GmbH/Dr. K. Faber

Address : Rehrhoferweg 160/D29625 Munster/Germany

Phone Number : 051 92 96 3212

Fax Number : 051 92 96 3311

Technology Maturity : Commercial use experience

Performance History : Refer to POC for performance history.

Comments : None.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☒ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : Sensors/Field Analysis Equipment**Technology Name :** Chemical Sensing with TelecommLink**Application :** In-situ (vadose zone)

Brief Description : Ariano Technologies has developed a low-cost, centrally-managed environmental sensor and telecommunications system (Sen Tel), which will give multiple-tank owners (such as those owning thousands of service stations) real-time early warning of leaks in their gasoline and chemical storage tanks around the country. In addition, its centrally managed feature will guarantee the integrity of the record-keeping process, a critical issue when establishing environmental liability insurance rates and when it becomes necessary to provide a credible audit trail in the event of an environmental incident.

Company Name/POC: Ariano Technologies, Inc./Thomas J. Cody, Jr.**Address :** 91 Harvey St./Cambridge, MA 02140**Phone Number :** 617 661-6110**Fax Number :** 617 661-603**Technology Maturity :**

Bench scale testing, only

Performance History : Contact company for performance data.**Comments :**

SenTel, which allows the reading of any type of commercially available sensor, features a novel hydrocarbon-vapor sensor, the company's first commercial application of a line of patented fiber-optic chemical sensors and related instrumentation for detecting the presence of hazardous chemicals in air, soil or groundwater. The sensor, including a site-specific RF-transmitter link, can be battery-powered to operate independently of electrical or fiber-optic conduit beyond the immediate vicinity of the sensor. The core of the company's chemical-sensor technology was developed at Tufts University in Boston. Ariano has exclusive, worldwide environmental rights to all related patents and know-how developed to date, and has certain rights to similar technology developed at Tufts in the future. The individual unit operations of the SenTel system have been built and tested successfully, and the Company now intends to fabricate six integrated commercial prototypes for more extensive demonstration in the field. The SenTel system is expected to be sold on an EOM basis at a price well below the cost-per-sensing-point level of environmental sensors currently on the market.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Mobile Environmental Mass Spectrometer

Application : On-site

Brief Description : The Mobile Environmental Mass Spectrometer (MEM) is a fully developed electron impact ionization quadrupole Mass Spectrometer designed specifically to be rugged and flexible for on-site analysis of organic compounds. It is tolerant to extreme changes of environmental conditions allowing for a wide range of Data Quality Objectives to be completed. This all-in-one system simplifies sample preparation techniques yielding rapid qualitative and quantitative results on a real-time basis with field uptime better than 95 percent.

Company Name/POC: Bruker Instruments, Inc./J. Wronka

Address : 19 Fortune Drive/Manning Park/Billerica, MA 01821

Phone Number : 508 667-9580

Fax Number : 508 667-5993

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

The MEM is successfully being used by the U.S. Army, state agencies, fire brigades, and environmental management firms for a wide variety of applications which include emergency response, site screening and assessment, and clean up monitoring of air, water and soil samples. References: U.S. Army CRDEC, D. Durst, (410) 671 2129; Del State DNREC, J. Rogers, (302) 323 4542; Env. Res Mngmt, D. Gallis, (215) 524 3786; SiteWorks, Inc., Albert J. Robbat, Jr., (617) 627 3474.

Comments : The MEM is designed for simple operation. A one-week training course covering instrument operation, hardware components, and methodologies will enable personnel to successfully complete analytical measurements. Automatic routines simplify operation, and an internal diagnostic routine continuously monitors instrument performance and warns the operator of potential problems with calibration, temperature, power, and electronic malfunctions. Data interpretation requires some knowledge in mass spectroscopy to determine data integrity. The technology for characterizing environmental pollutants on-site is fully developed and readily available. The problem which exists is convincing people that, when implemented properly, the rapid generation of data which field analysis provides results in a dramatic savings of time and cost in comparison to conventional techniques of chemical detection.

Source of Information : TechCon

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name: Microwave Sample Digestion

Application: On-site
Off-site

Brief Description: The CEM Microwave Sample Preparation System, MDS-2000 series, combines the speed of microwave heating with proprietary sealed vessel technology to significantly reduce the sample preparation (acid digestion) process time. For environmental samples, the process time is reduced by a factor of 8-10. In addition to time savings, the technology provides performance (measure by elemental analysis), safety and cost advantages over traditional hot plate techniques.

Company Name/POC: CEM Corporation/Gregory N. LeBlanc

Address: 3100 Smith Farm Rd./P.O. Box 200/Matthews, N.C. 28105-200

Phone Number: 800 726-3331

Fax Number: 704 821-789

Technology Maturity: Commercial use experience

Performance History: Performance data are available.

There are over 3000 Microwave Sample Preparation Systems in use worldwide. The systems are typically used for acid digestion of a variety of matrices for subsequent elemental analysis. It cuts across all industries. Its widest use is for environmental applications. It has proven highly successful as measured by its acceptance in the worldwide marketplace.

Comments: Skills associated with a chemical laboratory are all that is required to operate the system. Training can be completed in <2 hours. Complete procedures are supplied with the purchase of the instrument. The system can be set up and running within 1 hour of removal from the shipping box. It can be used in a mobile lab and a standard laboratory. The system operates on 115 vac. (No special requirements). It is applicable to a wide variety of sample types encountered in remediation efforts. A fume hood is not required.

Source of Information: TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** On-line Water Monitoring**Application :** In-situ (saturated zone) Other Application

Brief Description : In-situ on-line measurement of nitrate, chloride, pressure, conductivity, diss. oxygen, redox, turbidity in ground / raw / potable water, rivers, lakes. Also applicable for monitoring of water supply areas and leakages from waste deposits. Radioactivity, ammonia, triazines/herbicides, TNT will be integrated in 1996. Probes are able to initiate an alarm in case a hazard is encountered. Performs very reliably with an excellent accuracy. Heavy metals and organics will also be integrated in 1996.

Company Name/POC: Daimler-Benz Aerospace Ag. Valx/Hermann Hack**Address :** P.O. Box 80 11 49/81663 Munich/Germany**Phone Number :** 0049 89 607 25112**Fax Number :** 0049 89 607 20176**Technology Maturity :** Commercial use experience

Performance History : Field trials: Munich municipal water supply (water quality monitoring)
 Nuremburg water supplies authority (groundwater quality) monitoring with extreme nitrate concentrations (Agricultural)
 Switzerland: waste deposit leakage monitoring
 Gilching near Munich: water quality monitoring during pump trial

Comments : Operation in corrosive environments can be adapted under certain circumstances. Probes can be submerged in a borehole/river for example and be operated almost instantly. Also usable for short term measurements; needs almost no infrastructure; easy to use; Windows software available; delivery on scheduled date.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Instrumented Cone Penetrometer

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : A series of instrumented cone penetrometers, Depth to 60m; measures ph, conductivity, redox potential, moisture, etc.; being developed for VOC's

Company Name/POC: Delft Geotechnics/Mr. Viergever

Address: #2, Stieltjesweg, P.O. Box 69/2600 AB 2628CK Delft, Netherlands

Phone Number : 011 31 152 693500

Fax Number : 011 31 152 610 82

Technology Maturity : Commercial use experience

Performance History : Delft Geotechnics performs over 700 jobs a year in which this technology is used routinely.

Comments : Limitations are depths > 80m, rocky soil. The specific technology can be adapted to meet a DOE need for rapid, semi-intrusive analysis.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : D Tech BTEX Test

Application : On-site

Brief Description : These test kits are available for determining the presence of benzene, ethylbenzene, toluene, xylene, and explosive compounds in water and soil. Analyses of concentrations as low as parts per billion are performed in the field by addition of a color-developing solution. The color is compared to a standard chart to determine the concentration present. Sensitive to 600 ppb BTEX in H₂O; sensitive to 2.5 ppm BTEX in soil.

Company Name/POC: EM Science/Bruce Crane

Address : 480 Democrat Road/Gibbstown, New Jersey 08027

Phone Number : 800 222-0342

Fax Number : 609 423-4389

Technology Maturity : Commercial use experience

Performance History : Immunoassay has become an increasingly useful method for on-site environmental sample screening. Immunossay methods have been accepted in EPA SW-846 method drafts for publication.

Comments : Test is specifically designed to detect BTEX. Up to four tests can be run in less than 25 minutes.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Reflectoquant System

Application : On-site

Brief Description : Hand-held instrument which reads a series of ion-specific test strips on a parts-per-million level. The ion-specific test strips are impregnated with various chemicals which react with the analyte in question to produce a color. The RQflex meter then reads the reflected light which is proportional to the sample concentration. The sample concentration is displayed via LCD usually in terms of ppm. For example, to measure copper: the RQflex meter is programmed using the copper bar code supplied with the Reflectoquant copper test strips. The test strip is dipped into the sample, allowed to develop over a period of time, and then inserted into the meter. The sample concentration appears on the LCD display. Each type of test strip has two reaction pads. The instrument reads both pads and the result on the display is actually the average of the two independent readings. Accuracy is generally within 10 percent of the actual, but in many cases has been found to be under 5 percent.

Company Name/POC: EM Science/Bruce Crane

Address : 480 Democrat Road/Gibbstown, New Jersey 08027

Phone Number : 800 222-0342

Fax Number : 609 423-438

Technology Maturity : Commercial, use experience

Performance History : Larry Waters, ORNL 615 571 4969 for Cr (VI), Pb, NO₃; Donna So, Chevron 310 615 5622 for NO₃, NO₂, inactivated sludge; Jim Scott, Santa Clara Valley Water District, 408 265 2607 x2113, groundwater-metals/inorganics; Bob Morgan, US Army Waterways Experiment Station at Vicksburg MS, 601 634 3575 (residual peroxide inactivated sludge).

Comments : Sample preparation may be required if analysis is being used for solid/semi-solid samples. In addition, sample preparation may be required to produce species in ionic form. Very easy to use with user immersing strip in the sample, then inserting the strip into the instrument to obtain reading.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Environmental Enzyme-Linked ImmunoSorbant Assay (ELISA)

Application : On-site

Brief Description : ELISA technology is used to screen for selected contaminants in soil and water. EnSys products detect pentachlorophenol <0.5 ppm, petroleum hydrocarbons 100 ppm, and polychlorinated biphenyl to <1 ppm. The test employs antibodies to detect contaminants and provide a colorimetric result. A test to detect Polynuclear Aromatic Hydrocarbons (PAHs) has a sensitivity appropriate to regulatory needs. All tests correlate to accepted USEPA Methods at levels of 85 percent or greater.

Company Name/POC: EnSys Environmental Products, Inc./Kevin Carter, PhD

Address : P.O. Box 14063/Res. Triangle Park, North Carolina 27709

Phone Number : 800 242-7472

Fax Number : 919 941-5519

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Comments :

ELISA technology has been used for site assessment at over 300 sites. The numbers of samples run at sites ranged from 1 to 1,200. Some of the parties which have used the kits are listed as follows: ATEC, Bechtel, Chem Waste Management, CH2M Hill, Ecology & Environment, Florida Power & Light, General Electric, Gas Research Institute, Geraghty & Miller, IT Corp., Jacobs Eng., & Roy F. Weston. A full list is available. Sample homogeneity can cause problems.

The test requires minimal skills which include basic reading comprehension and good manual handling skills. All materials are prepackaged and sample manipulations are minimized. Minimal training will allow an inexperienced operator to run tests quickly and correctly. The tests have a shelf life of 3 to 5 months at 75 degrees Fahrenheit and must be used between 40 degrees Fahrenheit and 90 degrees Fahrenheit. The tests are extremely easy to implement. The tests allow for a rapid turnaround time of sample results. This on-site information allows investigators to place other samples more effectively, saving further time and expenditures. There is no infrastructure required to run the tests, increasing its ease of implementation. The test has received, effective 7/13/92 USEPA Methods approval for field screening.

Source of Information : TechCon

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name: Toxicity & Genotoxicity Screening

Application: On-site Ex-situ

Brief Description: Company manufactures and sells a range of field testing kits for the screening of environmental samples (water, soil, sediment, sludges, etc.) for both acute toxicity, and genotoxicity and mutagenicity. Technology uses genetically engineered strains of bacteria to produce distinct color changes in the media being tested to determine biological effect endpoints.

Company Name/POC: Environmental Biodetection Products Inc./Dr. Ran Lifshitz

Address: 14 Abacus Road/Brampton, Ontario, Canada L6T 5B7

Phone Number: 905 794-2325

Fax Number: 905 794-233

Technology Maturity: Commercial use experience

Performance History: Performance Data are Available.

1. Survey of contaminated sediments and sludges around the Great Lakes basin. High correlation with much more costly comparable technologies. Contact: Dr. Barney Dutka, Canada Centre for Inland Waters, Environment Canada (905-336-4923; Fax 905-336-4989).
2. Survey of Rhine and Oder Rivers and North Sea sediments. Very favorable comparison with much more expensive and complex research technologies. Contact: Dr. Peter Hansen, Professor, Ecotoxicology, Technical University of Berlin (011-49-30-31421586; Fax 011-49-30-838113).

Comments: Full instructions provided with products. One-half day of practice for technologist is useful to become familiar with tests. Method details vary with parameter being measured. General procedure involves: (1) rehydration of freeze-dried bacteria; (2) placing the rehydrated testing bacteria into contact with a slurry of the material to be tested and allowing the mixture to incubate for one to two hours; and (3) reacting the bacterial test mixture with a chromogenic substrate and recording a color change as the biological effect endpoint. Tests have been designed to be easy to use. Quality control is done to a high degree in manufacturing, leaving little chance for variability in use resulting in a high degree of reproducibility. Tests are highly flexible for use in all types of test slurries and waters. A small (~\$300.00) 120V or 12V incubator is required for several tests. All consumable items come in the test kit. Kits are couriered to the site within two weeks of receipt of a purchase order.

Source of Information: International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Geoprobe/Mobile Lab

Application : In-situ (vadose zone) Ex-situ
 In-situ (saturated zone)

Brief Description : Mobile Lab for rapid, low-cost analysis of soil gas, soil and groundwater samples for VOC's using a temperature programmed GC with PID-FID detectors operated in series. Soil and groundwater samples are analyzed semi-quantitatively using the manual static headspace method. Performs very well for preliminary site evaluation work. On-site analysis (screening) allows real-time interactive sampling decisions and minimizes the number of samples requiring more expensive off-site analysis. Eliminates down time waiting for analytical results from off-site laboratories.

Company Name/POC: Enviroscan Corp./Doug Shubring

Address : 303 West Military Rd./Rothschild, Wisconsin 54474

Phone Number : 715 359-7226

Fax Number : 715 355-3221

Technology Maturity : Commercial use experience

Performance History : The Mobile Lab is used primarily to provide on-site VOC analysis of samples collected with the Geoprobe soil gas, soil, and groundwater sampling unit. Numerous projects have been completed throughout the midwest. Most projects range in size from one day to one week. The Geoprobe sampling system and Mobile Lab are generally successful at most sites. Sampling depth limited to about 15 ft., analysis limited to a select list of VOC's. The Mobile Lab and Geoprobe system are operated by trained and experienced Enviroscan personnel. Mobile Lab requires chemistry and GC experience.

Comments : Mobile Lab GC is set-up for relatively short (15-20 min) run time. To accommodate rapid analysis, early eluting compounds, such as vinyl chloride are usually not detected or quantitated. GC operating conditions and column type can be modified to meet project specific requirements. Certain types of geology and buried obstacles may limit use. Certification and approval requirements for Mobile Lab services may vary from state to state and from user to user. Service cost and lead time would be impacted if certification/approval requirements are substantial. Project specific QA/QC requirements will also affect cost and on-site productivity. Radioactive contamination of personnel and equipment is of great concern to the vendor. Enviroscan has no experience in handling this type of material.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : "Non-Drilling" Hydraulic Probe Sampling and Mobile Lab Analysis

Application : In-situ (vadose zone) Ex-situ
In-situ (saturated zone)

Brief Description : Combined "non-drilling" sampling technology for unconsolidated soils and field laboratory analysis of VOCs using lab-grade gas chromatography equipment. Rapid sample collection (soil-gas, soil and water) with minimal investigation-derived waste generation (e.g., no cutting or purge water), and real-time field analysis with a high level of QA/QC (e.g., HAZWRAP "Level B" DQO equiv.). Cost-effective, time efficient complement to traditional drill rig sample collection in unconsolidated sediment. No waste is generated and probe equipment is very safe to operate. Real-time analytical results (primarily headspace techniques) permit rapid decision-making and "one time" thorough site assessments.

Company Name/POC: EnviroSurv, Inc./Hunt Chapman

Address : 2800 C Dorr Ave./Fairfax, Virginia 22031

Phone Number : 703 204-3580

Fax Number : 703 204-358

Technology Maturity : Commercial use experience

Performance History : DOE Contact: Dr. Robert Siegrist, Oak Ridge National Lab.

Comments : Technology application requires experienced field chemists and hydrogeologists. The data generated equals, or exceeds, fixed lab quality. But the CLP bias must be overcome; namely the perception that such information is always superior to field analytical results. The field results can be self supporting in terms of spikes, duplicates, calibration data and supporting documentation. Probing equipment is limited to unconsolidated sediments. Also, technique is not amendable to continuous coring, or borehole logging. Large sample throughput is primarily limited to VOCs. Fewer analyses per day are possible when extractions are required. Analysis is "efficiency" limited to 10-15 target compounds. Full scan VOCs analyses are less cost-effective and time efficient. Rapid mobilization, equipment set-up and use by experienced personnel. Only a 2-person field team required for sample acquisition and on-site analysis. Flexibility for all media sample collection and analysis (soil-gas, soil and water). Regulatory agency awareness of data quality; overcoming the "fixed-lab bias." Acceptable as a complement to the traditional drill rig/fixed lab approach to environmental site characterization. The quality of data generated depends on the experience and knowledge of field personnel. Widespread technology use will increase as more people become aware of the sample quality problems associated with handling, shipment and delayed analysis.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : pH Optrode-based Measurement System

Application : On-site Ex-situ

Brief Description : The measurement system consists of a pH optrode (fiber optic sensor), a support opto-electronics interface (PC compatible), a personal computer and software. It measures the pH in contact with a small sensing region by monitoring the ratio of absorbed light at two wavelengths. The system presently operates over the range of pH 3.5 to 8.0. It provides a .1 pH resolution over this range. Glass electrodes are commonly used for pH measurements. The optrode-based measurement system provides much improved stability in low ionic strength solutions, such as typical groundwater.

Company Name/POC: GEO-CENTERS, Inc./Bruce Nelson

Address : 7 Wells Avenue/Newton Centre, Massachusetts 02159

Phone Number : 617 964-7070

Fax Number : 617 527-7592

Technology Maturity : Commercial use experience

Performance History : pH measurement systems have been utilized to monitor the pH of nutrient solutions of NASA plant growth experiments at NASA Kennedy Space Flight Center. They have undergone evaluations during plant growth cycles (2-3 months on in-situ measurements). Contact: Dr. John Sager, NASA KSC 407 853-5142. They have been extensively evaluated in the laboratory. They are about to undergo extensive beta site-testing at a water-treatment facility in the UK.

Comments : Color (dyes, etc.) of aqueous solutions can impact use. Systems can operate successfully with significant biofouling and fouling. Limited use at high temperatures (most operations at < 65 degrees celsius). The only requirement is electrical power at the location of measurement. The optrode is connected to the optoelectronics interface housed in the PC; the PC is turned on and the software is executed. The system is then ready for measurement/data logging/etc. The pH measurement system is the first optrode-based system that GEO-CENTERS has made available for commercial sale. Sensors for the measurement of NH₃ will be available next, H₂O (moisture) sensors will follow shortly. Sensors to monitor hydrazines, BTX, ethylene, CO and CO₂ have been demonstrated. The technology is also applicable for the detection of heavy metals (total), halogenated compounds, and other hazardous organics. The unique element of GEO-CENTERS systems is the use of porous polymer-based sensing elements in which the sensing reagent is chemically bound to the polymer matrix. This provides superior stability in the optrode. Additionally, this technique provides enhanced effective surface areas in small length (<3mm) sensing elements.

Source of Information : TechCon

GROUNDWATER

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : CPT Continuous Soil Gas Sampling

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Rapid Optical Screening Tool (ROST-TM)**Application :**
In-situ (vadose zone)
In-situ (saturated zone)**Brief Description :** The Rapid Optical Screening Tool (ROST) is a transportable, state-of-the-art Laser Induced Fluorescence (LIF) system for soil and groundwater hydrocarbon analysis. ROST is used with a cone penetrometer test (CPT) vehicle. The ROST system employs laser-induced fluorescence spectroscopy for in-situ analysis of petroleum hydrocarbons. ROST can differentiate petroleum fuel types by acquiring a wavelength time matrix (WTM) during a short pause (one minute) in the CPT push. WTM's are especially useful for determining whether multiple sources of contamination are present. Through correlation of ROST intensity with a small number of laboratory-analyzed soil samples from a site, it is possible to build calibration curves that give ROST correlation, in mg/kg, with conventional EPA methodologies.**Company Name/POC:** Loral Defense Systems - Eagan/David A. Bohne**Address :** PO Box 64525/ St Paul MN 55164-0525**Phone Number :** 612 456-2339**Fax Number :** 612 456-3098**Technology Maturity :** Commercial use experience**Performance History :** The ROST system has been successfully demonstrated and/or applied to environmental investigations at over 30 sites that include oil refineries, air force bases (domestic and foreign), abandoned coal gasification plants, gas stations and three EPA Superfund sites. Loral has integrated the ROST system with all major cone penetrometer test systems available worldwide, and has worked with environmental regulatory agencies at the federal, state and local levels to obtain support and regulatory acceptance of the LIF/CPT technology for field screening purposes.**Comments :** ROST is easily installed in a cone penetrometer test vehicle in either a temporary or permanent configuration. The ROST system uses UV excitation to generate the fluorescence spectra. Even the best fiber optic cable has high loss in the UV. This limits the push depth to approximately 50 meters. The limits of detection established for ROST for total petroleum hydrocarbons is 10-20 mg/kg (ppm).**Source of Information :** TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Mobil Radiological Analysis Laboratory (MRAL)

Application : On-site Ex-situ

Brief Description : The Mobile Radiological Analysis Laboratory was conceived to provide both qualitative and quantitative radioanalytical services for field operations. The system was designed to utilize commercially available technology, integrated with both standard and modified analytical procedures, to meet the specific needs of the customers. Los Alamos National Laboratory currently has two units in operation that have been supporting field operations for two years. Two additional mobile laboratories were to be in place for the field sampling season of fiscal year 1994. The advantages include proximal real-time analysis and reporting of samples at a fraction of the cost of fixed-base labs and high sample through-put. Disadvantages include higher detection limits and some non-specific analysis.

Company Name/POC: Los Alamos National Laboratory/George Brooks

Address : P.O. Box 1663/TSD-9/MS-K494/Los Alamos, New Mexico 87545

Phone Number : 505 665-2583

Fax Number : 505 665-598

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

The Mobile Radiological Analysis Laboratories (two currently in operation) have been supporting the Environmental Restoration Program since March of 1992. They have supported approximately 15 separate Operable Projects for site characterization within LANL. Support is expanding to include equipment release programs. Total samples analyzed within the mobile laboratories for the above-mentioned programs exceed 3000, with each of the samples requiring up to as many as 10 separate analyses.

Comments : The Mobile Radiological Analysis Laboratory should not be utilized/deployed when the analytical requirements of the project cannot be met from the data generated from the lab.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Contaminated Land Measurements**Application :**

Non-intrusive

Brief Description :

In-situ high resolution gamma spectrometry is used to perform large area radiological clearance surveys and plant inventory measurements. Characterization and quantification of gamma emitting nuclides are typically possible to well below UK de minimis standards (400 Bq/kg). Measurements of total dose rates from spectral determinations at less than 0.05 microSv/h are routine. By use of high resolution gamma spectrometry in large area surveys, adequate limits of detection can be confidently obtained with short count times enabling many points to be surveyed in a working day.

Company Name/POC: Nuclear Electric plc/Dr. R. Clayton**Address :** Littlebrook Complex/Littlebrook Manorway/Dartford Kent DA1 5PY, UK**Phone Number :** 44 1322 28 2800**Fax Number :** 44 1322 28 2819**Technology Maturity :** Commercial use experience

Performance History : Many internal measurements on Nuclear Electric plant and site, experience in foreign plant measurements (PWRs in Spain and Belgium). Site surveys have been carried out, inter alia, at British Rail railheads and around the Trawsfynydd lake. Internal confidential reports may be made available on request.

Comments :

On site supply to liquid nitrogen and electricity supply point for battery charging is required. Measurements are restricted to gamma emitting isotopes. However, the results are routinely extrapolated to non gamma-emitters by use of fingerprinting and radiochemistry techniques. Easy to use with minimal local support requirements.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Nuclear Magnetic Resonance (NMR)

Application : Ex-situ

Brief Description : Determines the structure and type of molecules in solution based on nuclear spin of component atoms using spectrographic techniques applied at radio frequencies. Method can be very sensitive (ppm detection), mainly used on organics, suffers signal to noise problems for low concentration measurements, not all atoms have nuclear spins. Solid state NMR is possible. NMR can potentially replace wet analysis. NMR systems are being developed that could be deployed in the field to continuously monitor a small volume in a large multiphase background volume.

Company Name/POC: Oxford Instruments UK Ltd./W. Proctor

Address : Osney Mead/Oxford OX2 ODX U.K.

Phone Number : 18 6526 9500

Fax Number : 18 6526 950

Technology Maturity : Commercial use experience

Bench scale testing, only

Performance History : NMR is well established in the laboratory (1,000 units). It is also widely used in medicine (Magnetic Resonance Imaging). The technology is under development for a range of industrial measurement situations. Oxford Instruments is developing magnet and radio frequency systems for underground operation (oil) and stand alone support of cryogenic magnets.

Comments : Technology is supported by the supplier in software to transform NMR data into concentrations of identified species. Data can be recorded as in a well logging situation. Technicians need electromechanical skills and training in general measurement techniques.

NMR scientific measurements are well established - underground measurements are not. Technology needs to be developed. Nearly all elements have isotopes that can provide a NMR signal and many organic complexes are now characterized. Signal to noise limits detection sensitivity which can make detection of species of low abundance take many hours. NMR is being developed for underground use by the oil industry to characterize fluids on the basis of proton chemistry. For field deployment, self-contained probes will be operated remotely using electronic data gathering. In concept, probe and base station operation is straightforward. Interpretation methods are being researched.

The main challenge is to deploy probes that have enough field strength to enable targeted spectrometry experiments. This requires the support of high field magnets (possible cryogenic) which it is thought could be done using new materials or compact (military) coolers. It is believed that spectrometry could be carried out in bore holes down to 100 metres using coolers or new magnetic materials, but this contention needs to be proved. Ground penetration to a depth of 2m may be possible using distributed arrays of magnets and radio frequency coils.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Differential DIE Away For Induced Fission Using NeuSight

Application : Non-intrusive

Brief Description : Intense pulsed neutron source for use in induced fission characterization of waste through differential DIE away technique and neutron radiography (matrix correction). Excellent pulsing characteristic with negligible DAR current and intensity at least x10 nearest alternative transportable source (D-T Tube) significantly improved detection levels due to improved signal to noise.

Company Name/POC: Oxford Instruments/Nigel Boulding

Address : Accelerator Technology Group/Osney Mead/ Oxford OX2 ODX, UK

Phone Number : 44 1865 269500

Fax Number : 44 1865 269502

Technology Maturity : Commercial use experience

Performance History : Accelerator is already a proven product in medical and nuclear applications in fixed sites.

Comments : Lower limits of detection of fissile material yet to be determined. Can be configured as a mobile source/system for use at various sites. Minimal infrastructure requirements. Delivery of system within one year. Can collaborate with Rolls-Royce and could jointly provide x-ray/neutron interrogation systems for waste drum characterization.

Source of Information : International TechCon

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name: Germanium Sonde Operation

Application: On-site Ex-situ

Brief Description: The germanium "cryoprobe" or "cryosonde" uses a high purity Ge spectrometer cooled by a solid cryogen to make high resolution logs of gamma activity. The method is unsurpassed sensitivity and selectivity. The technology alternative is coring and lab assay.

Company Name/POC: Princeton Geophysical Services, Inc./J. Baicker

Address: P.O. Box 900/Rocky Hill, New Jersey 08553

Phone Number: 609 921-7061

Fax Number: 609 921-713

Technology Maturity: Commercial use experience

Performance History: Logged more than 100,000 feet in holes totaling more than 1.2 million feet. Clients include most uranium mining companies.

Comments: Operators are provided. Limited to gamma rays >60KeV. Logging trucks are available. No general challenges except quantitative calibration in DOE environments.

Source of Information: TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** AB-5 Radiation Detector**Application :** On-site Ex-situ

Brief Description : An industry accepted standard for the measurement of radon gas in air, water and soil; working level; surface contamination of alpha and beta particles; gamma detection - using various probes such as zinc sulphide, scintillation cells, disks. Sensitivities range between 1 to 23 cpm/pCi/L depending on accessory use.

Company Name/POC: Pylon Electronics Inc./Fran Higginson**Address :** 147 Colonnade Rd/Ottawa, Ontario K2E 7L9**Phone Number :** 613 226-7920**Fax Number :** 613 226-8195**Technology Maturity :** Commercial use experience

Performance History : Number and size of jobs have been varied over the years. AB-5 used by DOE contractors (50), EPA offices and HP physicists (10) for various application. Ref. Doug Daniels/Fermco 513 738-6088

Comments : 8 digit display: information may be dumped on printer or retrieved via PC or obtained manually. Condensing humidity is a limitation. -10 degrees C to 50 degrees C operating temperature. AB-5 is delivered ready for use in the field; manual provides operating instructions on day to day operation. QA includes verifying background of cell and electronic noise; plateau curve and all efficiency may be verified annually using a standard. Initial use of equipment may be challenging, but manual describes fully the use and changing of accessories for various applications.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : EMFLUX

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Passive, non-invasive soil-gas sampling method for locating and identifying subsurface contamination (volatile and semi-volatile organic compounds) in groundwater and/or subsurface soil. EMFLUX evaluation on EPA Test Bed reported 91% correlation with actual contamination at depth, reportedly the best to date on the Test Bed. EMFLUX data allows accurate site investigations to be conducted with fewer wells and core borings, thus saving substantial dollars by reducing the cost of drilling.

Company Name/POC: Quadrel Services, Inc./Bruce R. Tucker

Address : 1896 Urbana Pike/Suite 20/Clarksburg, MD 20871

Phone Number : 301 874-5510

Fax Number : 301 874-5556

Technology Maturity : Commercial use experience

Performance History : EMFLUX has been employed successfully on 32 sites in 17 states. Jobs have ranged from 10 to 250 sample points, covering a fraction of an acre to a hundred acres/study. No significant problems encountered on any site. Reference: Mr. Carl Nardin, U.S. Army Corps of Engineers, Omaha District, phone number (402) 221-7774.

Comments : One hour training, comprised of hands-on field practice. Personnel must possess good mechanical skills and ability to work outdoors, but no formal education or training is required to correctly deploy and retrieve EMFLUX devices. Different absorbents used for different applications, thus cannot sample PAHs and light aromatics at same time, for instance. Must have 6" holes cut through asphalt or concrete so EMFLUX devices can rest on bare soil. Analysis limited to offsite GC/MC. Extremely easy to use by 2-person team in field with minimum of training. Field team supported by offsite equipment preparation and analytical laboratory (GC/MS) facilities in place and in daily commercial use. Level of field QA/QC is a function of the care with which EMFLUX devices are emplaced and (later) retrieved.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Prompt Gamma Neutron Activation Analysis (PGNAA)**Application :** In-situ (vadose zone) Ex-situ**Brief Description :** PGNAA performs a non-invasive characterization of concentration profiles of hazardous or radioactive elements; can be used in-situ in the natural environment, within isolated packages or objects, or, as appropriate, in process monitoring control. Sensitivity down to "clean" levels is generally achievable, and the technique applies throughout the periodic table. It leaves no residual radioactivity.**Company Name/POC:** Scientific Ecology Group, Inc./C.P. Keegan**Address :** 1501 Ardmore Boulevard/Pittsburgh, Pennsylvania 15221**Phone Number :** 412 247-6255**Fax Number :****Technology Maturity :** Field demo complete**Performance History :** Bench scale testing and calibration for buried uranium.
Other elements in process.
Field application with uranium-contaminated soil (in-situ).**Comments :** Limited to penetration of a few feet in packed soil for in situ environmental application (approximately 1-4 feet, depending upon contaminant sought).**Source of Information :** TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : SIGNATURE Gamma Radionuclide Detection and Analysis System

Application : On-site Ex-situ

Brief Description : Provides spectral analysis of a radioactive sample using sodium iodide scintillation detectors with greater efficiency than high purity germanium, and without complex and expensive cooling systems. Uses sophisticated digital signal processing techniques to provide measurement resolution comparable with high purity germanium at reduced cost of ownership. Original concept applied to reactor on-line fission product monitoring, further developed for environmental monitoring. Has undergone trials using blind and mixed radionuclide sources. Identification and quantification of component radionuclides has been achieved down to levels of a few becquerels. Use of sodium iodide well detector and automated sample changing will give further benefits. Suitable for initial evaluation of contamination or confirmation of satisfactory decontamination.

Company Name/POC: Siemens Environmental Systems Ltd./Dr. W.E. Croydon

Address : Sopers Lane, Poole/Dorset, BH 17 7ER/England

Phone Number : 44 1202 782648

Fax Number : 44 1202 78215

Technology Maturity : Field demo complete

Performance History : Performance Data are Available.

Trial systems monitoring reactor coolant have been installed on three UK power stations, both AGR and MAGNOX, and on other PWR nuclear plant. A 2 out of 4 voted hardware trip mode is available to shut down the reactor in the event of a significant increase of specific fission products. Typical measurements are of ~50 kBq/kg Kr-88 in a mixed power spectrum of ~50 MBq/kg N-16 and other isotopes, and agree with grab sample measurements made with a high purity germanium system to within 10 percent. A trial system for environmental monitoring has been configured to detect atmospheric contamination, suitable for the UK national RIMNET2 emergency response system. Laboratory evaluation has detected radionuclides at levels of a few Becquerels. Further improvements are under consideration.

Comments : Limited by detector characteristics, which must be designed for the particular application e.g., operating temperature, mechanical shock, weight of background radiation shielding. Flexible system which can be tailored to meet the needs of a specific application. Stand alone or connected to network for remote operation. Challenges are in optimization of system for ease of calibration and extension to variable geometries. Discussions are underway with the Geosciences Advisory unit at Southampton University, UK with a view to combining a sodium iodide well detector and automated sample changing stage with the SIGNATURE analysis system. This would provide improved automated equipment for analysis of radionuclide contamination for either field or laboratory use, and with low cost of ownership. Alternative detector systems could be designed to address other monitoring requirements. Trials have been carried out involving the following isotopes: Eu-155, Mn-54, Ba-133, Na-22, Zn-65, Am-241, Co-60, Cs-134, Cs-137, Eu-152, Ru-106, Co-58, Co-57, Sr-85, I-131, K-40, Gd-153, Sc-46, Tb-160, Ru-103, Cd-109, Ce-139, Sn-113, Y-88, Ra-226, Pb-214, Bi-214, Kr-88, N-16, O-19, Ar-41, Ir-192, Hg-203. However, the system is not limited to available test isotopes but should detect any gamma emitting radionuclide through the use of library emission data.

Source of Information : International TechCon

CONTAMINANTS :

- ☒ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Rapid Screening Field Measurements of Organic Contaminants**Application :** On-site Ex-situ**Brief Description :** Provide rapid screening (5-10 min/sample) and more quantitative analysis (20-30 min/sample) for EPA listed VOCs and semi-VOCs including explosives. Conducted studies with Argonne National Laboratory, EPA (EMSL-Las Vegas) RSKERL - Ada; ERL - Narragansette Region 1) Tenneco, Navy and Army.**Company Name/POC:** SiteWorks, Inc./Dr. L. John Hoover**Address :** Suite 363/11160-F South Lakes Drive/Reston, Virginia 22091**Phone Number :** 703 385-1549**Fax Number :** 703 385-3658**Technology Maturity :** Commercial use experience**Performance History :** Performance Data are Available.

Tufts University/Site Works
 Argonne National Laboratory; Candace Rose; Dr. Jacqueline Burton 1-708-252-8795
 Currently providing service in support of VOC analysis

Army/2 months Fort Devens
 Navy/3 weeks San Diego Harbor
 Tenneco/1 month pipeline
 4 EPA projects

Comments : Sample throughput dependent on sample matrix TDGC/MS. Analysis of full range of EPA listed organics reduces sample throughput; nonetheless, 2 times faster than fixed laboratory. Can have instruments ready for operation in 4 hrs including calibration. Personnel and mobile unit available to provide service immediately. Can analyze soil gas, direct and extracted soil, air and aqueous media.

3 publications have appeared in the peer-reviewed journals Analytical Chemistry and Journal of Chromatography. Conducted successful field validation studies with EPA, DOE, Army, Navy and private sector documenting data quality and cost/benefit.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : BioTector - On-line Analyser for Total Organic Carbon

Application : On-site Ex-situ

Brief Description : TOC analysers especially designed to perform reliably in industrial on-lie applications. No filtration required. Long term stable operation experienced. No interference from chloride.

Company Name/POC: Skinstriment A/S Pollution Control/Tor Anders Petteroe

Address : Trykkeriveien 8/N-1653 Sellebark/Norway

Phone Number : 47 69 36 32 90

Fax Number : 47 69 36 32 9

Technology Maturity : Commercial use experience

Performance History : First prototype developed in 1990, and tested in pulp and paper water in Temiscamin, Canada among other places. The instrument had too long response time, and too many component errors. New oxidation method was developed together with a team of German and French scientists, and the current version of the Bio Tector was launched in 1993/94. Approximately 50 units are installed in various applications, mainly industrial effluent. Main application is control of water going into the biological treatment plants in industries to control the addition of nutrients. Best reference will be Mr. Hans Dufva, Instrumental Engineer, and responsible for the purchase, installation and operation of the Bio Tector at the chemical plant AKZO NOBEL, Stenungssund, Sweden. He has analytical experience and a high request for quality in his own and other's work and equipment.

Comments : Sample must be available, or made available max. 3 meters below the analyser. Oxygen flask with reduction valve must be present. A room free from direct sunlight or direct rain must be available. Max. ambient temp 35 degrees centigrade. Temp. must be above freezing point. The Bio Tector has not been installed in clean water installations, and below 3-4 mg-C/L the accuracy is not documented. Can be used as a stand alone piece of equipment. Included in the analyser is a system for data collection and presentation that stores all data for one year, and can present these on screen, paper or diskette. The Bio Tector TOC analyser is made of high quality components and materials. All cabinets are made of stainless steel. Unlike most TOC analysers, the built-in CO2 detector is a non drifting device. To avoid variations in the gas flow through the system a computer controlled mass flow controller is implemented instead of the manual rotameter used in most TOC analysers. All operations are made by step by step menus presented on a touch screen.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Mapping of Soil/Groundwater Pollution**Application :** On-site Ex-situ**Brief Description :** Mobile laboratory.**Company Name/POC:** Steins Laboratorium A/S/Viggo Larsen**Address :** Olof Palmes Alle 13a/8200 AÅrhus N/Denmark**Phone Number :** 45 86 10 80 70**Fax Number :** 45 86 10 88 89**Technology Maturity :** Commercial use experience**Performance History :** During the last 5 years Steins Laboratory has analyzed 4,000 samples for organic and inorganic elements and compounds. The mobile laboratory has been fully operational for 150 working hours during the last 2 years.**Comments :** Easy to move and transport. Flexible 24-hour operation.**Source of Information :** International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Ion Trap Mass Spectrometer**Application :** On-site Ex-situ**Brief Description :** The Teledyne MEC (TMEC) Ion Trap Mass Spectrometer is one of the most sensitive mass spectrometers of its size in the world. It is designed to be transportable, rugged, and automated to minimize operator intervention. It is ideal for field evaluation of toxic contaminants. The TMEC Ion Trap Mass Spectrometer will permit field measurements of environmental contaminants in lieu of laboratory analysis.**Company Name/POC:** Teledyne MEC/Mort Cohen**Address :** 1274 Terra Bella Ave./P.O. Box 7244/Mountain View, California 94039-7244**Phone Number :** 415 962-6989**Fax Number :** 415 967-435**Technology Maturity :** Field demo complete**Performance History :** Field evaluations of the TMEC Ion Trap Mass Spectrometer are underway by the U.S. Army for military applications to detect chemical and biological toxins. Initial evaluation are positive. Point of contact is Dave Sickenberger, U.S. Army Chemical Research, Development, Engineering Center, (410) 671-5533.**Comments :** Instrument is designed for direct sampling, or GC/LC input. The mass range is approximately 20 to 2,000 amu. It is highly sensitive (parts per billion to parts per trillion) and is excellent in isolating coeluting compounds in complex mixtures. It can be used for field evaluation, laboratory analysis, or fence post monitoring applications. The TMEC instrument is designed for ease of use. It can be powered by AC or DC (battery). It can be configured to operate with a PC-based data system, or as a stand alone device with display and data printout. The system is highly automated to minimize operator intervention, and can be easily configured for direct sampling or interface with gas or liquid chromatograph. There are no infrastructure considerations other than availability of prime power (about 1 KW). The TMEC ion trap mass spectrometer was specifically designed for field evaluation applications to measure very low levels of toxic contaminants. The original instrument was developed for the U.S. Army for military applications and to measure chemical and biological contaminants in the field. Approximately \$13M have been allocated for the R&D of this instrument. Initial field evaluations of the demonstration units are currently underway. Teledyne MEC is also developing, under an internal R&D program, an ion trap instrument for commercial applications related to real-time measurement of environmental contaminants. Initial demo units will be available by mid-1993. TMEC has filed for 8 patents on its ion trap technology, two of which have been allowed and will soon be issued. The other 6 filings are still under review by the U.S. Patent Office.**Source of Information :** TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : X-Ray Fluorescence

Application :

On-site Ex-situ

Brief Description :

A quick, on-site determination of elemental inorganic contaminants in soils or other matrices. The results are qualitative and quantitative. Detection limits range from 5 to 90 parts per million. There are two instruments: one portable (Spectrace 9000), one transportable (Spectrace 6000). These instruments can handle samples of soil, sludge, powders, liquids, solids, or dust. Elements analyzed range from sodium to uranium on the periodic table.

Company Name/POC: TN Technologies/Spectrace Instruments/Rick Booth

Address : 2555 N. Interstate 35/Round Rock, Texas 78664

Phone Number : 512 388-9100

Fax Number : 512 388-9200

Technology Maturity : Commercial use experience

Performance History : EPA's Environmental Response Team
Many Jobs

Contact: Mark Bernick
Roy F. Weston
(908) 225-3990

Wright Patterson AFB
Clean Up
Contact: Mike Radi
Engineering Sciences
(615) 481-0451

Comments :

Limitations of this technology include:

Inhomogeneous samples affect results.

Spectrace 9000 requires ambient air temperature not exceed 120 degrees Fahrenheit and 105 degree Fahrenheit for storage.

Spectrace 6000 must have AC power.

Weighing just 19 lbs, Spectrace 9000 is battery-operated with a field pack; this system accommodates almost any environment. The system does not require liquid nitrogen and yet provides very high resolution. The software interface and fundamental parameter analysis technique results in operator ease-of-use that is unparalleled. Spectrace 6000 can be installed in a mobile lab and provides laboratory SRF resolution and results on-site. Spectrace 6000 also has fundamental parameter software and menu driven user interfaces. The only challenge, in terms of field screening, is the required action levels for certain contaminants which may be lower than this technology can accommodate.

Source of Information : TechCon

CONTAMINANTS: ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name: Chlorinated Hydrocarbon Monitor

Application: On-site Ex-situ

Brief Description: This unique rare-earth sensor detects and measures contaminants such as carbon tetrachloride, trichloroethylene, perchloroethylene, dichloromethane, and other chlorinated solvents commonly used in nuclear weapons production. The sensor has no interference from methane, gasoline, paint thinner, and other non-chlorinated compounds.

Company Name/POC: TRANSDUCER RESEARCH, INC./William J. Buttner

Address: 600 N. Commons Dr./Suite 117/Aurora, Illinois 60504

Phone Number: 708 978-8802

Fax Number: 708 978-885

Technology Maturity: Commercial use experience

Performance History: DOE - Hanford/Site Characterization/Cary Martin/Westinghouse 509 376-2648
 DOE - Hanford/Carbon Tetrachloride Removal (Vacuum Extraction Process)/Randy Coffman/Westinghouse/509 376-4263
 DOE - Hanford/Safety, Extraction Well Drilling/Tom Lazarski/Kaiser Engineering/509 373-4791
 Eastman - Kodak/Wastewater Treatment (Dichloropropane, Dichloromethane)/Tom Walton/Eastman
 Kodak/716 477-1633

Comments: This instrument detects and measures chlorinated hydrocarbon vapors only. It does not speciate (responds to all chlorinated hydrocarbons). It requires vapor dilution for concentrations above 50 ppm. Model MP-1 Gas Diluter is available from Transducer Research as separate product. Sensor life is inversely proportional to exposure concentration and exposure time. Model 2001-05 is currently being used for site characterization, safety monitoring, and clean-up process applications. Transducer Research is currently improving sensor performance through automatic dilution and pre-concentration modules. Real-time monitoring capability permits quick analysis of contamination situation. Instrument is less expensive to purchase, operate, and maintain than alternate technologies. Real-time measurement allows determination whether work can be continued. Unit can be used to monitor changes in safety conditions. Selective measurement of chlorinated solvents simplifies operating procedures and speeds up the decision process.

Source of Information: TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Gas Chromatograph/Mass Spectrometer (Field GC/MS)**Application :** On-site Ex-situ

Brief Description : Transportable GC/MS used to detect and identify complex mixtures of environmental pollutants and toxic substances in trace amounts. Based on Hewlett-Packard's 5971A mass selective detector, Viking's field GC/MS uses miniaturized components to achieve laboratory-grade results on-site in real-time. Features of the instrument include: a heated membrane separator made from dimethyl silicone for air sampling, internal cryofocusing options for analysis of light volatiles, and high-temperature ramping for analysis of semi-volatiles with higher boiling points. Field GC/MS analysis shortcuts the current process of collecting environmental samples, sending them to a lab for analysis, and waiting weeks for results.

Company Name/POC: Viking Instruments Corporation/Thomas J. Kuehn**Address :** 3800 Concord Parkway/Suite 1500/Chantilly, Virginia 22021**Phone Number :** 703 758-9339**Fax Number :** 703 968-0101**Technology Maturity :** Commercial use experience

Performance History : Viking's GC/MS has been field-proven by a number of large industrial firms and government agencies, including Tennessee Eastman, Martin Marietta, the EPA, the FBI, and the U.S. Army, for a variety of applications. The DOE, in conjunction with Sandia National Labs, uses the instrument for emergency response and on-site testing. Steve Thornberg is Viking's reference contact within the DOE (505) 846-8829.

Comments : Use of the instrument requires an operator who is skilled as a lab or field chemical technician and has completed Viking's Field GC/MS Introductory Training Course. The field GC/MS has many unique features designed into the system specifically to provide for flexibility and ease of use. Its rugged transport case, for example, permits operation in virtually any location that is accessible by jeep or plane. Once at a site, the field GC/MS can be unpacked and operational in about 15 minutes. The instrument also offers a number of sample inlet options for air, water, and soil gas and a user-friendly, Windows-based operating system. Finally, service contracts and telephone support are available with every instrument.

Source of Information : TechCon

CONTAMINANTS :

Pesticides/Herbicides

Heavy Metals

Explosives/Propellants

Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

☒ Halogenated VOC

N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : On-Line Gas Chromatograph/Mass Spectrometer for Continuous Emission Monitoring

Application :

On-site

Ex-situ

Brief Description :

On-line continuous emission monitor (CEM) used to detect and identify complex mixtures of environmental pollutants and toxic substances, specifically in air. Based on Hewlett-Packard's 5971A mass selective detector, Viking's CEM includes on-line analysis software, multi-port sampling valves, remote control, and networking capability. The CEM delivers laboratory-grade performance on site in real time. On-line continuous emission monitoring consolidates the barrage of single-purpose instruments currently in use to ensure worker safety and comply with legislative reporting requirements. More important, the new Clean Air Act Amendments make on-line GC/MS monitoring the only practical and cost-effective means of tracking regulated toxins.

Company Name/POC: Viking Instruments Corporation/Thomas J. Kuehn

Address :

3800 Concord Parkway/Suite 1500/Chantilly, Virginia 22021

Phone Number : 703 758-9339

Fax Number : 703 968-010

Technology Maturity : Commercial use experience

Performance History : Although the on-line CEM is ready for commercial production, its predecessor, the Viking Field GC/MS, has experienced great success. Current users of the field GC/MS include Tennessee Eastman, 3M, Martin Marietta, the EPA, FBI, U.S. Army and Sandia National Laboratory.

Comments : Use of the instrument requires an operator who is skilled as a lab technician and has completed Viking's On-Line CEM Introductory Training Course. Viking's on-line CEM is specifically designed for flexibility and ease of use. Its rugged housing, for example, can withstand outdoor use as a fence-line monitor or a long lifetime on the factory floor. The instrument itself offers a number of sample inlet options for air, water and soil gas, and a user-friendly, Windows-based operating system. Finally, service contracts and telephone support are available with every instrument.

Source of Information :TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Laboratory Analysis***Technology Name :** Microwave Sample Digestion**Application :**

On-site

Off-site

Brief Description : The CEM Microwave Sample Preparation System, MDS-2000 series, combines the speed of microwave heating with proprietary sealed vessel technology to significantly reduce the sample preparation (acid digestion) process time. For environmental samples, the process time is reduced by a factor of 8-10. In addition to time savings, the technology provides performance (measure by elemental analysis), safety and cost advantages over traditional hot plate techniques.

Company Name/POC: CEM Corporation/Gregory N. LeBlanc**Address :** 3100 Smith Farm Rd./P.O. Box 200/Matthews, N.C. 28105-200**Phone Number :** 800 726-3331**Fax Number :** 704 821-7894**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.

There are over 3000 Microwave Sample Preparation Systems in use worldwide. The systems are typically used for acid digestion of a variety of matrices for subsequent elemental analysis. It cuts across all industries. Its widest use is for environmental applications. It has proven highly successful as measured by its acceptance in the worldwide marketplace.

Comments :

Skills associated with a chemical laboratory are all that is required to operate the system. Training can be completed in <2 hours. Complete procedures are supplied with the purchase of the instrument. The system can be set up and running within 1 hour of removal from the shipping box. It can be used in a mobile lab and a standard laboratory. The system operates on 115 vac. (No special requirements). It is applicable to a wide variety of sample types encountered in remediation efforts. A fume hood is not required.

Source of Information : TechCon

CONTAMINANTS:

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE: *Laboratory Analysis*

Technology Name: Cold Trap Inlet System for GC

Application: Off-site

Brief Description: The cold trap inlet system is used to first cryofocus organic samples (as a frozen plug) and then rapidly deliver the sample to a capillary column for a high speed separation. The cold trap is continuously cooled with a stream of cold gas. Typical trapping temperatures range from -50 degrees Celsius to -150 degrees Celsius. After the sample is cryofocused on the metal coated trap, the trap tube is electrically heated which rapidly vaporizes the frozen sample and delivers it to the mouth of the separation column as a small vapor plug. The cold trap inlet works extremely well for compounds with volatilities as high as pentane. This technology will replace inlet systems used in conventional Gas Chromatography. This will allow for reduction in analysis times from tens of minutes to tens of seconds as compared to conventional chromatography.

Company Name/POC: Chromatofast, Inc./Robin Risser

Address: 912 N. Main Street, Suite 14/Ann Arbor, Michigan 48104

Phone Number: 313 662-3410

Fax Number: 313 662-346

Technology Maturity:

Bench scale testing, only

Performance History: The cold trap inlet system has been utilized through a development contract from private industry for a speciation instrument to analyze automotive exhaust gases. The device has been successfully applied towards cryofocusing a gas sample over several minutes, this proving a means to concentrate the sample and improve detectability within the system.

Comments: The device, when combined with equipment for high-speed gas chromatography will require a single technician with familiarity in using a conventional gas chromatograph. The majority of the operation is automated. The only required procedure would be a method of sample introduction, i. e., syringe injection. The current system employs LN2-cooled N2 gas to achieve the necessary trapping temperatures. While this is satisfactory for a research instrument, alternative cooling is desirable for a commercial instrument. Additionally, smaller more portable ovens capable of quicker temperature programming need to be constructed. For the final instrument, all components must be rugged and packaged into a portable case. Computer software for acquisition and analysis along with appropriate digital displays will also be incorporated.

Source of Information: TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Laboratory Analysis***Technology Name :** Gas Valve Inlet System for GC**Application :** Off-site

Brief Description : The gas valve inlet system is used for extremely fast injections which are required for high-speed gas chromatography. A sample gas travels through an injection tube which is positioned inside a metal block. A small hole in the tube continuously leaks sample gas. The tube is traversed perpendicularly to the capillary separation column so that the leak of sample gas will pass directly over the column opening, thus accomplishing sample introduction. The gas valve inlet system works well for gas sample streams where extremely small injection band widths are desired. This technology will replace inlet systems used in conventional Gas Chromatography. This will allow for reduction in analysis times from tens of minutes to tens of seconds as compared to conventional chromatography.

Company Name/POC: Chromatofast, Inc./Robin Risser**Address :** 912 N. Main Street, Suite 14/Ann Arbor, Michigan 48104**Phone Number :** 313 662-3410**Fax Number :** 313 662-3462**Technology Maturity :**

Bench scale testing, only

Performance History : The gas valve inlet system is currently being used as a research device at the University of Michigan. It can provide analysis time as short as 2 seconds with very good reproducibility. It has been operated tens of thousands of times with no sign of wear. Project directed under Dr. Richard Sacks, Professor, (313) 764 7373.

Comments : The device, when combined with equipment for high-speed gas chromatography will require a single technician with familiarity in using a conventional gas chromatograph. The majority of the operation is automated. The current gas valve inlet system requires a pressurized sample stream. Techniques need to be developed in order to apply the inlet system to a wider range of samples and media. The device is currently implemented on conventional gas chromatographs modified for high speed operation. Steps for ruggedization of the instrument must be developed.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Laboratory Analysis**Technology Name :** High Speed Capillary Column for GC**Application :** Off-site

Brief Description : Capillary column strategies for high-speed gas chromatography are techniques which are used to increase the performance or resolution of a high-speed separation as overall resolution is decreased as compared to conventional gas chromatography. Techniques include serial coupled columns which can shift unresolved pairs of peaks into open areas of a chromatogram, and high-speed column switching, which employs high-speed hardware used for multidimensional techniques. The techniques perform with a good level of precision and accuracy as they all incorporate high speed components.

Company Name/POC: Chromatofast, Inc./Robin Risser**Address :** 912 N. Main Street, Suite 14/Ann Arbor, Michigan 48104**Phone Number :** 313 662-3410**Fax Number :** 313 662-346**Technology Maturity :**

Bench scale testing, only

Performance History : The Column Strategies technology has been utilized through a development contract from private industry for a speciation instrument to analyze automotive exhaust gases and in a fast, direct non-methane hydrocarbon analyzer development contract from a State of Michigan grant for automotive exhaust analysis. The speciation project was a 1 year contract providing \$525,000 of funds and the non-methane hydrocarbon project was a year contract providing \$75,000 of funds. A mid-point backflush procedure has been developed which reduces the cycle time of the instrument by a factor of 2.

Comments : The device, when combined with equipment for high-speed gas chromatography will require a single technician with familiarity in using a conventional gas chromatograph. The majority of the operation is automated.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Laboratory Analysis***Technology Name :** On-Line Microwave Digestion**Application :**

Ex-situ

Brief Description : Continuous preparation of samples for analysis by AA, Fluorescence ICP, ICP-MS. Ideal for "Hot" samples. Replaces batch systems and robotics which are labor intensive and cumbersome.

Company Name/POC: Questron Corporation/Angelo Grillo**Address :** 4044 Quakerbridge, RD./Mercerville, New Jersey 08619**Phone Number :** 609 587-6898**Fax Number :** 609 587-0513**Technology Maturity :**

Bench scale testing, only

Performance History : Technology is presently at the stage where beta site units will be manufactured. A DOE site would be ideal for such an evaluation.

Comments :

The system can operate at high pressure, and high temperature. It would be applicable for all but some high temperature refractory materials. Analysis has reached a high degree of automation. Sample preparation is still relatively tedious. This system would allow the sample preparation to match the speed and degree of automation of the analyzer. All of the developmental work has been completed. The remaining challenges deal with actual speed in a real environment, range of applicable samples, reliability in an adverse environment, and applicability to use in a mobile lab. This product is being developed for the Canadian Ministry of Environment by Questron with the assistance of Dr. F. Salin's group at the Chemistry Department of McGill University.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Laboratory Analysis

Technology Name : Ion Trap Mass Spectrometer

Application : On-site Ex-situ

Brief Description : The Teledyne MEC (TMEC) Ion Trap Mass Spectrometer is one of the most sensitive mass spectrometers of its size in the world. It is designed to be transportable, rugged, and automated to minimize operator intervention. It is ideal for field evaluation of toxic contaminants. The TMEC Ion Trap Mass Spectrometer will permit field measurements of environmental contaminants in lieu of laboratory analysis.

Company Name/POC: Teledyne MEC/Mort Cohen

Address : 1274 Terra Bella Ave./P.O. Box 7244/Mountain View, California 94039-7244

Phone Number : 415 962-6989

Fax Number : 415 967-435

Technology Maturity : Field demo complete

Performance History : Field evaluations of the TMEC Ion Trap Mass Spectrometer are underway by the U.S. Army for military applications to detect chemical and biological toxins. Initial evaluation are positive. Point of contact is Dave Sickenberger, U.S. Army Chemical Research, Development, Engineering Center, (410) 671-5533.

Comments : Instrument is designed for direct sampling, or GC/LC input. The mass range is approximately 20 to 2,000 amu. It is highly sensitive (parts per billion to parts per trillion) and is excellent in isolating coeluting compounds in complex mixtures. It can be used for field evaluation, laboratory analysis, or fence post monitoring applications. The TMEC instrument is designed for ease of use. It can be powered by AC or DC (battery). It can be configured to operate with a PC-based data system, or as a stand alone device with display and data printout. The system is highly automated to minimize operator intervention, and can be easily configured for direct sampling or interface with gas or liquid chromatograph. There are no infrastructure considerations other than availability of prime power (about 1 KW). The TMEC ion trap mass spectrometer was specifically designed for field evaluation applications to measure very low levels of toxic contaminants. The original instrument was developed for the U.S. Army for military applications and to measure chemical and biological contaminants in the field. Approximately \$13M have been allocated for the R&D of this instrument. Initial field evaluations of the demonstration units are currently underway. Teledyne MEC is also developing, under an internal R&D program, an ion trap instrument for commercial applications related to real-time measurement of environmental contaminants. Initial demo units will be available by mid-1993. TMEC has filed for 8 patents on its ion trap technology, two of which have been allowed and will soon be issued. The other 6 filings are still under review by the U.S. Patent Office.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Laboratory Analysis*

Technology Name : Accelerator Mass Spectroscopy (AMS)

Application :

On-site	Ex-situ
Off-site	

Brief Description : This instrument measures the relative abundance of carbon 14/12, Iodine 129/122, etc. to better than 1 part in 1E15.

Company Name/POC: Triumph/Phillip Gardner

Address : 4004 Westbrook Mall/Vancouver, B.C, Canada, V6T 2A3

Phone Number : 604 222-1047

Fax Number : 604 222-1074

Technology Maturity : Commercial use experience

Performance History : AMS is a well known analytical technique worldwide - J.Vogel, L.L.B.L., CA, USA - E. Litherland, U. Toronto, Ont., Canada

Comments : AMS is only appropriate for elements that make negative ions only. Positive ions must be done in conventional E-M mass spec.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Decision Support Tools***Technology Name :** Site Planner**Application :**

Other Application

Brief Description : Workstation-based software for decision support in site assessment and remediation. Site Planner replaces slow, low-productivity manual data management and visualization techniques and point solution software systems.

Company Name/POC: ConSolve Inc./David Barber**Address :** 70 Westview St./Lexington, MA 02173**Phone Number :** 508 358-8061**Fax Number :** 508 358 806**Technology Maturity :** Commercial use experience

Performance History : Site Planner is currently deployed on about 20 projects including use by four DOE laboratories.

Comments : Two days on-site training required. Limited by normal computer hardware limitations. System runs on stand-alone Unix workstations.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Decision Support Tools***Technology Name :** Hydrogeological Decision Analysis (COAST)**Application :**

Other Application

Brief Description :

A risk-cost-benefit computer model has been developed for application of decision analysis to engineering design for projects in which the hydrogeological environment plays an important role. The model assists managers in assessing cost-effectiveness of groundwater remediation plans and site-investigation programs. It is suitable for any contaminant and is especially well suited to dissolved contaminants such as metals or radioactive species. The model has been used for tritium contamination at Savannah River site, S.C.

Company Name/POC: Gartner Lee Limited/David Osmond**Address :** 6400 Roberts St./Burnaby, B.C. V5G 4C9**Phone Number :** 604 299-4144**Fax Number :** 604 299-1455**Technology Maturity :**

Field demo complete

Performance History : Highland Valley: Tony Sperling, Gartner Lee
 Savannah River: Allan Freeze, 604 538-8210 (Subconsultant to Geraghty-Miller)
 Research Applications

Comments :

Needs adequate hydrogeological information
 Requires acceptance of risk-cost-benefit approach to decision making
 Requires assignment of monetary value to environmental/social impacts

Further development of computer codes needed before routine application. Codes are currently in research state.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Decision Support Tools*

Technology Name : Computer Aided Pumping and Sampling

Application : On-site Ex-situ

Brief Description : A sophisticated software for on-line monitoring and control of well purging or pumping: physical and chemical parameters from many types of commercially available pumps, meters and probes are recorded, pumping rate and drawdown are controlled, and exact documentation (text and graphs) is available as well as digital data for subsequent evaluation purposes. Specific pumping tests in low permeability formations can be conducted automatically having a Grundfos Redi-Flo Pump controlled by the computer. Operation costs are reduced by automatization, groundwater remediation costs are reduced by higher efficiency due to better and reproducible data. Specific project demands can be met by adaptation. 4 years of practical field use, certifications by ISO 9000.

Company Name/POC: Geo-Infometric/Leonardo van Straaten

Address : RichthofenstraBe 29/31137 Hildesheim, Germany

Phone Number : 49 5121 76 82 31

Fax Number : 49 5121 51 57 0

Technology Maturity : Commercial use experience

Performance History : CAPS has first been developed for the company's own sampling device, installed in a van (some 1200 groundwater samples up to now). Later devices have been sold to (semi) governmental institutions and private enterprises. The system was then enhanced for use with pumping tests. Company's presently involved in a \$200 million project (remediation of a chemical waste site), testing the permeability of an encapsulation system on pilot scale.

Clients include:

3 water authorities (StUA Minden, StUa Hagen, LUA Dusseldorf)

1 mining authority (LOBA Dortmund)

Former geological survey of East Germany (GFE Halle)

German corporation for construction and management of nuclear waste storage sites (DBE)

Geophysical service company (BLM)

Comments : The limitations are related to the equipment connected to the computer and the accuracy of the AD-converter. Each instrument that has a 0-10 V or 0-20 mA outlet can basically be connected. There must be a possibility of generating a calibration curve. Meters, probes etc. can be integrated in a van or container or in different small outdoor devices as convenient. Usually piezometric head, pumping rate, EC, T, pH and DO are monitored. Project related adaptations concerning client-availability hardware have already been made.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Decision Support Tools*

Technology Name : Lynx Geoscience Modeling Software

Application : Other Application

Brief Description : Lynx is a complete software system that characterizes subsurface geology. Lynx simplifies 3-D characterization of the subsurface through the use of advanced integrated raster and vector modeling of algorithms. The coil volume modeling technology allows interactive interpretation of complex geological conditions, integrated with advanced geostatistical prediction algorithms.

Company Name/POC: Lynx Geosystems Inc./Mike Mitton

Address : #400, 322 Water St./Vancouver, B.C., Canada V6B 1B6

Phone Number : 604 682-5484

Fax Number : 604 669-3659

Technology Maturity : Commercial use experience

Performance History : Performance data are available. Over 230 clients world wide. Yucca Mountain, McClellan AFB. Reference: Jim Burnett, Mitre Corp., 703 883-6523.

Comments : Open-ended design and data standards facilitate smooth links with in-house software and third party products such as CAD, GIS and spreadsheet systems. A preface to software and hardware standards ensures platform portability and compatibility using peripheral devices, protecting the investment in hard work and training.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
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☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Decision Support Tools*

Technology Name : Visual Airflow 3-D Gas FlowModelling

Application : On-site Ex-situ
Off-site

Brief Description : Prediction of migration of gas (vapor) through unsaturated zone.
Calculation of pressures; velocities and pathlines.
Calculation of remedial scenarios (e.g. vapor extraction).
Graphical visualization of input data and results.

[Contact numbers for Waterloo Hydrogeologic (905) 880-2886 Office; (905) 880-2887 Fax]

Company Name/POC: WISMUT GmbH/A. T. Jakubick [Waterloo Hydrogeologic/Thomas Franz]

Address : 09117 Chemnitz/Jagdschanken-strabe 29/WATERLOO HYDROGEOLOGIC/19 McCauley Dr.
/Bolton, Ontario, Canada L7E 5B8

Phone Number : 49 371 8120 112

Fax Number : 49 371 8120 10

Technology Maturity : Commercial use experience

Performance History : Underground Research Laboratory (URL), Manitoba, Ontario Hydro, Canada
IKI Chemicals, Wisconsin
Approximately 50 users of software in U.S.

Comments : Software operates only IBM or compatible PCs (486 or better) with at least 8 MB RAM, large hard drive (500 MB or greater). Requires hydrogeological characterization of unsaturated zone; does not explicitly describe fractured rock conditions; assumes that water in unsaturated zone is immobile. Easy to use: menu-driven graphical software. Requires modelling specialist; model calibration is often difficult due to lack of appropriate data (moisture content as a spatial distribution, intrinsic permeability distribution, knowledge of fractures, etc.). Modeling of vapor migration allows the prediction of impacts; technique allows the evaluation of remedial scenarios; the model is extremely user-friendly and interactive; implementation of mass transport model is in preparation.

Source of Information : International TechCon

CONTAMINANTS :

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☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Geophysics/Hydrogeologic Measurements***Technology Name :** High Resolution Shear & Compressional Reflection Seismic**Application :** Non-intrusive

Brief Description : Utilizes compressional (P-) and shear (S-) reflection seismology to map/delineate subsurface lithostratigraphy and to delineate or discriminate clay aquicludes from saturated sand aquifers. Uses the principle that P-wave propagation through porous materials is controlled by the properties of the fluid in the pore spaces while S-wave propagation is not. Provides depth resolution of approximately 1 foot or less to depths of 250 feet and lateral resolution in the range of 2 to 5 feet.

Company Name/POC: Bay Geophysical Associates, Inc./John Clark**Address :** 868 Robinwood Ct./Traverse City, Michigan 49686**Phone Number :** 616 941-7660**Fax Number :** 616 941-7412**Technology Maturity :** Field demo complete**Performance History :** Performance Data are Available.

Field demonstration of technology was completed at Cooke Crossroads, SC in Oct. 91. Excellent resolution was obtained (vertical 1 ft; horizontal approx. 3 ft). The primary problem encountered was that correlation of the P- and S-wave seismic sections is not possible without detailed P- and S-velocity information from a nearby borehole. Data quality and resolution far exceeded expectations. Contact: Dr. Mitchell D. Erickson, Argonne National Laboratory (708) 252-7772. Contract is currently under negotiation to utilize shear wave reflection seismology alone to delineate mine workings in an abandoned mine in Illinois. Approximately 300-ft of line is to be acquired.

Comments :

Technology benefit: (1) Noninvasive; therefore safer if subsurface contaminants are suspected. For large areas, provides much more subsurface information than drilling alone. Subsurface information for large area can provide continuous profile information, which borehole data cannot. (2) Potential collaboration with ARA using ECPT to obtain subsurface P- and S-Wave velocity information. Additionally, potential use of ARA truck as seismic source.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Remote Sensing***Technology Name :** Prompt Fission Neutron Logging**Application :** In-situ (vadose zone)
In-situ (saturated zone)**Brief Description :** Detects presence of and quantity of thermal neutron fissionable radionuclides in situ.**Company Name/POC:** Uranium Resources Inc. (URI)/Dick Clement**Address :** 12750 Merit Drive, Suite 1020, LB 12/ Dallas, Texas 75251**Phone Number :** 214 387-7777**Fax Number :** 214 387-777**Technology Maturity :** Commercial use experience**Performance History :** The PFN tool has been successfully utilized several times by Total Minerals Corp. as well as URI to measure, quantitatively, uranium deposits in situ in Texas and Wyoming. There have been no problems and all parties concerned have expressed satisfaction with tool's performance. Can contact Albert McNeil, Total Minerals at (512) 747-5401 for reference.**Comments :** The PFN logging tool can detect the presence of any isotope with thermal neutron fission cross section. The PFN logging tool requires a borehole penetrating the material below the water table to be evaluated. Calibration of the PFN tool is achieved with nine (9) calibration pits. Operation of the tool is straightforward as it comes with a vehicle outfitted with the required reel, sensing devices, and recording equipment and on-board computer and plotter. The basic challenge is to place a borehole in the proximity of the fissionable material to be detected and measured below the water table. Dry sediments and pure aqueous solutions may be accurately assayed but calibration models fairly identical to those conditions must be designed. The PFN logging tool can be used in place of coring at a greatly reduced cost in dollars, time, and effort. Under most conditions with known formation densities, borehole fluid, and diameter, assays should be accurate within 5 to 10%.**Source of Information :** TechCon

Surface Water

Characterization

Surface Water

Characterization

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Physical Sampling***Technology Name :** Groundwater/Sludge Borehole Pumps**Application :** In-situ (vadose zone)
In-situ (saturated zone)**Brief Description :** Draws water/sludge for analysis, at variable, pre-determined rates, including abrasive solids/contaminants, & various temperatures. Ability to overcome system deficiencies, and specificaiton to handle overout liquids.**Company Name/POC:** H2O Waste-Tec/Mr. I. Hallows**Address :** Horsfield Way, Bredbury Industrial Park/Stockport, SK6 2SU UK**Phone Number :** 0161 406 7111**Fax Number :** 0161 406 7222**Technology Maturity :** Commercial use experience**Performance History :** 1000's of unit installed worldwide for water, sludge abstraction.**Comments :** 3,000m borehole depth; 100 degrees C temperature; sludges above 10% dissolved solids. H2O Waste-Tec water is a major part of the Dresser Group with US wide commitment to product support throughout USA.**Source of Information :** International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Energy Dispersive X-Ray Fluoresance - Thin Film

Application : On-site

Brief Description : The EDXRF does lab quality elemental analysis (Na to Pu) using proprietary technology that can meet EPA minimum detection requirements in near realtime; low ppb analysis of trace elements in solutions, low ppm for soils/solids (sub ppm with digestions) for an exceptional range of "total unknown" sample types (soils, ores, wastes, water, etc.) and concentrations (ppm to wt percent for solids). All done in one instrument with no prior knowledge of sample.

Company Name/POC: Advanced Analytical Products & Services/Jim Wrigley

Address : 1753 Cape Aston Court/San Jose, California 95133-1128

Phone Number : 408 926-4057

Fax Number : 408 926-405

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Small jobs mainly (10 to 50 samples). Exceptionally low detection levels and very good corroboration where available; customers report accuracy is better than CLP. References: Dr. Paul LaMothe, U.S. Geol. Survey 415 329 5258; Mrs. BiShia King, U.S. Geol. Survey 415 329 5288; Dr. Bill Walker, Walsh Associates 916 737 7240; Mr. Bill Cole, Lockheed Eng. Svc. 702 897 3226; Mr. Eric Lindgren, Sandia Nat. Lab 505 844 3820.

Comments : Sample prep is simple for solutions and soil/solid samples. Soils must be dried and ground (to about 300 mesh), then prepared as a thin film. The skill needed for EDXRF spectroscopy is quite high. Therefore, the company is offering a service, not an instrument. Later they will develop an "expert system" to overcome this. Detects elements Na to Pu, but not H to F. Doesn't determine compounds. With digestions, can do some speciation (e.g., soluble chromates Cr+6 distinguished from total chrome) and get excellent results (.3-.5 ppm). Mobile, not portable. Two person team recommended for field operations, but can be done with one. The cost reduction implications for field operations are quite significant.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Sediment Probe

Application : In-situ (saturated zone)

Brief Description : The technology is a rugged compact probe that can locate areas where groundwater enters surface waters. The instrument is designed to be dragged behind a boat along the bottom sediment, the probe can detect: the variation in sediment temperature (plus/minus 0.2 degrees C); the temperature difference between sediment and overlying water; and the electrical conductivity of the sediment. It is the only instrument of its type for real-time monitoring. This method covers a large area quickly and cost effectively. It is meant to be a compliment to other technologies.

Company Name/POC: AECL Research/C. A. McDowall

Address : Whiteshell Laboratories/ Pinawa Manitoba, Canada R0E 1L0

Phone Number : 204 753-2311

Fax Number : 204 753-2922

Technology Maturity : Field demo complete

Performance History : (1) Performed a survey in the St. Mary's River, Ontario, for a government department, in order to identify areas with significantly increased electrical conductance (revealing contamination from discharges from a nearby metal operations). (2) Located sources of groundwater upwelling at a site of creosote contamination in Puget Sound, Washington State, for an environmental agency. (3) Located a source of alkaline groundwater in a Wisconsin lake used for acid rain studies, for a government department. (4) Performed a preliminary study of offshore gamma activity. (5) Located freshwater discharges to the sea off the coast of the U.S.A. and Northern Europe. References will be provided upon request.

Comments : Experienced hydrogeologists with skilled technical staff are required to use the probe. Familiarity with field based data logging systems and locating devices (triangulation systems) is essential. Limitations of the technology include: unseen obstacles in the water, ice, and water depth. Trained operators knowledgeable in field instrumentation would find the probe easy to use. Operator concern for safety considerations and site specific parameters, such as current and subsurface terrain, must be considered. Continuous monitoring while dragging the instrument behind a boat provides real-time readout. The instrument reduces the number of cores necessary as it identifies the area of possible contamination without coring. This in turn reduces the number of analysis that need to be performed. Locates all gamma emitting contaminants. The instrument locates all groundwater upwelling (which may contain contaminants into surface water). A minimum of 2 plus a surveyor to operate the positioning system.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Mobile Laboratory for Chemical Weapons, Explosives and Propellants

Application : On-site Ex-situ

Brief Description : Mobile laboratory with all necessary chemical and physical equipment to detect and analyze chemical weapons, explosives, propellants and other toxic materials.

Company Name/POC: Alba Industrie Umweltschutz Service GmbH/Dr. K. Faber

Address : Rehrhoferweg 160/D29625 Munster/Germany

Phone Number : 051 92 96 3212

Fax Number : 051 92 96 3311

Technology Maturity : Commercial use experience

Performance History : In use for two years, e.g., in Russia and also in Germany.

Comments : None:

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Monitoring of Chemical Weapons in Soil, Water, Air, Buildings

Application : On-site Ex-situ

Brief Description : Monitors all relevant parameters, like concentrations of chemical weapons in air, soil, water, and buildings.

Company Name/POC: Alba Industrie Umweltschutz Service GmbH/Dr. K. Faber

Address : Rehrhoferweg 160/D29625 Munster/Germany

Phone Number : 051 92 96 3212

Fax Number : 051 92 96 3311

Technology Maturity : Commercial use experience

Performance History : Refer to POC for performance history.

Comments : None.

Source of Information : International TechCon

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name: Chemical Sensing with TelecommLink

Application: In-situ (vadose zone)

Brief Description: Ariano Technologies has developed a low-cost, centrally-managed environmental sensor and telecommunications system (Sen Tel), which will give multiple-tank owners (such as those owning thousands of service stations) real-time early warning of leaks in their gasoline and chemical storage tanks around the country. In addition, its centrally managed feature will guarantee the integrity of the record-keeping process, a critical issue when establishing environmental liability insurance rates and when it becomes necessary to provide a credible audit trail in the event of an environmental incident.

Company Name/POC: Ariano Technologies, Inc./Thomas J. Cody, Jr.

Address: 91 Harvey St./Cambridge, MA 02140

Phone Number: 617 661-6110

Fax Number: 617 661-603

Technology Maturity:

Bench scale testing, only

Performance History: Contact company for performance data.

Comments: SenTel, which allows the reading of any type of commercially available sensor, features a novel hydrocarbon-vapor sensor, the company's first commercial application of a line of patented fiber-optic chemical sensors and related instrumentation for detecting the presence of hazardous chemicals in air, soil or groundwater. The sensor, including a site-specific RF-transmitter link, can be battery-powered to operate independently of electrical or fiber-optic conduit beyond the immediate vicinity of the sensor. The core of the company's chemical-sensor technology was developed at Tufts University in Boston. Ariano has exclusive, worldwide environmental rights to all related patents and know-how developed to date, and has certain rights to similar technology developed at Tufts in the future. The individual unit operations of the SenTel system have been built and tested successfully, and the Company now intends to fabricate six integrated commercial prototypes for more extensive demonstration in the field. The SenTel system is expected to be sold on an EOM basis at a price well below the cost-per-sensing-point level of environmental sensors currently on the market.

Source of Information: TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** SMP (Sub Mitochondrial Particles)**Application :** On-site

Brief Description : The technology utilizes submitochondrial particles (SMP) and is based on the mammalian enzyme complex that mediates cellular electron transport. These bioassays have broad application wherever rapid, inexpensive information about acute toxicity of aquatic or soil samples is needed. SMP-based bioassay products will complement analytical chemistry analysis and whole-organism bioassays by speeding the flow of information and lowering the overall cost of environmental monitoring. SMP tests were designed to provide a means for rapid inexpensive bioassay of harmful materials in environmental samples such as wastewater effluents, landfill leachates, or soil extracts. Tests can be used as a prescreening tool to select samples of concern for further analysis. Based on results of SMP prescreening, follow-up analysis may be carried out using analytical chemistry or whole-organism bioassays. SMP tests take less than thirty minutes to perform. In comparison, the whole-organism bioassays require 7 days.

Company Name/POC: Biorenewal Technologies, Inc./Alan J. Dines**Address :** 2800 S. Fish Hatchery Rd./Madison, Wisconsin 53711**Phone Number :** 608 276-8980**Fax Number :** 608 273-6989**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.

This technology has been used in round robin EPA toxicity tests several times during the past three years. Results are available upon request. The test is currently being used in an EPA funded storm-water run-off study being conducted by the Wisconsin Department of Natural Resources in conjunction with an inclusive battery of analytical chemistry tests. This study is not complete and is continuing for the next two years. SMP technology was evaluated two years ago in a USGS study at the Green Bay municipal waste water treatment facility. Results in the form of an extensive detailed report are available. Currently the company is conducting a development contract with Waste Management to evaluate SMP technology as a toxicity test on the effluent of a Superfund landfill leachate treatment system in Wisconsin. The goal is to install a continuous toxicity testing unit that reports results to a remote monitoring location.

Comments : While SMP toxicity test gives results in less than 30 minutes and costs less than \$25 per test instead of one week for the more traditional whole organism tests at a cost of \$500 to \$1,000 per test, it does not provide results that quantify the amount of toxicity or contaminants. Toxicity tests are a general measure of contaminant's impact on the animal kingdom and the environment as a whole.

Source of Information : TechCon

CONTAMINANTS :☒ Pesticides/Herbicides☒ Heavy Metals☒ PCB☒ Explosives/Propellants☒ Petroleum Hydrocarbons☒ Radionuclides☒ SVOC☒ Other Contaminant☒ Nonhalogenated VOC☒ Halogenated VOC☒ N/A**TECHNOLOGY TYPE :** *Sensors/Field Analysis Equipment***Technology Name :** Mobile Environmental Mass Spectrometer**Application :** On-site**Brief Description :**

The Mobile Environmental Mass Spectrometer (MEM) is a fully developed electron impact ionization quadrupole Mass Spectrometer designed specifically to be rugged and flexible for on-site analysis of organic compounds. It is tolerant to extreme changes of environmental conditions allowing for a wide range of Data Quality Objectives to be completed. This all-in-one system simplifies sample preparation techniques yielding rapid qualitative and quantitative results on a real-time basis with field uptime better than 95 percent.

Company Name/POC: Bruker Instruments, Inc./J. Wronka**Address :** 19 Fortune Drive/Manning Park/Billerica, MA 01821**Phone Number :** 508 667-9580**Fax Number :** 508 667-599**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.

The MEM is successfully being used by the U.S. Army, state agencies, fire brigades, and environmental management firms for a wide variety of applications which include emergency response, site screening and assessment, and clean up monitoring of air, water and soil samples. References: U.S. Army CRDEC, D. Durst, (410) 671 2129; Del State DNREC, J. Rogers, (302) 323 4542; Env. Res Mngmt, D. Gallis, (215) 524 3786; SiteWorks, Inc., Albert J. Robbat, Jr., (617) 627 3474.

Comments :

The MEM is designed for simple operation. A one-week training course covering instrument operation, hardware components, and methodologies will enable personnel to successfully complete analytical measurements. Automatic routines simplify operation, and an internal diagnostic routine continuously monitors instrument performance and warns the operator of potential problems with calibration, temperature, power, and electronic malfunctions. Data interpretation requires some knowledge in mass spectroscopy to determine data integrity. The technology for characterizing environmental pollutants on-site is fully developed and readily available. The problem which exists is convincing people that, when implemented properly, the rapid generation of data which field analysis provides results in a dramatic savings of time and cost in comparison to conventional techniques of chemical detection.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Microwave Sample Digestion**Application :**

On-site

Off-site

Brief Description :

The CEM Microwave Sample Preparation System, MDS-2000 series, combines the speed of microwave heating with proprietary sealed vessel technology to significantly reduce the sample preparation (acid digestion) process time. For environmental samples, the process time is reduced by a factor of 8-10. In addition to time savings, the technology provides performance (measure by elemental analysis), safety and cost advantages over traditional hot plate techniques.

Company Name/POC: CEM Corporation/Gregory N. LeBlanc**Address :** 3100 Smith Farm Rd./P.O. Box 200/Matthews, N.C. 28105-200**Phone Number :** 800 726-3331**Fax Number :** 704 821-7894**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.**Comments :**

There are over 3000 Microwave Sample Preparation Systems in use worldwide. The systems are typically used for acid digestion of a variety of matrices for subsequent elemental analysis. It cuts across all industries. Its widest use is for environmental applications. It has proven highly successful as measured by its acceptance in the worldwide marketplace.

Skills associated with a chemical laboratory are all that is required to operate the system. Training can be completed in <2 hours. Complete procedures are supplied with the purchase of the instrument. The system can be set up and running within 1 hour of removal from the shipping box. It can be used in a mobile lab and a standard laboratory. The system operates on 115 vac. (No special requirements). It is applicable to a wide variety of sample types encountered in remediation efforts. A fume hood is not required.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : On-line Water Monitoring

Application : In-situ (saturated zone) Other Application

Brief Description : In-situ on-line measurement of nitrate, chloride, pressure, conductivity, diss. oxygen, redox, turbidity in ground / raw / potable water, rivers, lakes. Also applicable for monitoring of water supply areas and leakages from waste deposits. Radioactivity, ammonia, triazines/herbicides, TNT will be integrated in 1996. Probes are able to initiate an alarm in case a hazard is encountered. Performs very reliably with an excellent accuracy. Heavy metals and organics will also be integrated in 1996.

Company Name/POC: Daimler-Benz Aerospace Ag. Valx/Hermann Hack

Address : P.O. Box 80 11 49/81663 Munich/Germany

Phone Number : 0049 89 607 25112

Fax Number : 0049 89 607 2017

Technology Maturity : Commercial use experience

Performance History : Field trials: Munich municipal water supply (water quality monitoring)
 Nuremburg water supplies authority (groundwater quality) monitoring with
 extreme nitrate concentrations (Agricultural)
 Switzerland: waste deposit leakage monitoring
 Gilching near Munich: water quality monitoring during pump trial

Comments : Operation in corrosive environments can be adapted under certain circumstances. Probes can be submerged in a borehole/river for example and be operated almost instantly. Also usable for short term measurements; needs almost no infrastructure; easy to use; Windows software available; delivery on scheduled date.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** D Tech BTEX Test**Application :** On-site

Brief Description : These test kits are available for determining the presence of benzene, ethylbenzene, toluene, xylene, and explosive compounds in water and soil. Analyses of concentrations as low as parts per billion are performed in the field by addition of a color-developing solution. The color is compared to a standard chart to determine the concentration present. Sensitive to 600 ppb BTEX in H₂O; sensitive to 2.5 ppm BTEX in soil.

Company Name/POC: EM Science/Bruce Crane**Address :** 480 Democrat Road/Gibbstown, New Jersey 08027**Phone Number :** 800 222-0342**Fax Number :** 609 423-4389**Technology Maturity :** Commercial use experience

Performance History : Immunoassay has become an increasingly useful method for on-site environmental sample screening. Immunossay methods have been accepted in EPA SW-846 method drafts for publication.

Comments : Test is specifically designed to detect BTEX. Up to four tests can be run in less than 25 minutes.

Source of Information : TechCon

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name: Reflectoquant System

Application: On-site

Brief Description: Hand-held instrument which reads a series of ion-specific test strips on a parts-per-million level. The ion-specific test strips are impregnated with various chemicals which react with the analyte in question to produce a color. The RQflex meter then reads the reflected light which is proportional to the sample concentration. The sample concentration is displayed via LCD usually in terms of ppm. For example, to measure copper: the RQflex meter is programmed using the copper bar code supplied with the Reflectoquant copper test strips. The test strip is dipped into the sample, allowed to develop over a period of time, and then inserted into the meter. The sample concentration appears on the LCD display. Each type of test strip has two reaction pads. The instrument reads both pads and the result on the display is actually the average of the two independent readings. Accuracy is generally within 10 percent of the actual, but in many cases has been found to be under 5 percent.

Company Name/POC: EM Science/Bruce Crane

Address: 480 Democrat Road/Gibbstown, New Jersey 08027

Phone Number: 800 222-0342

Fax Number: 609 423-438

Technology Maturity: Commercial use experience

Performance History: Larry Waters, ORNL 615 571 4969 for Cr (VI), Pb, NO₃; Donna So, Chevron 310 615 5622 for NO₃, NO₂, inactivated sludge; Jim Scott, Santa Clara Valley Water District, 408 265 2607 x2113, groundwater-metals/inorganics; Bob Morgan, US Army Waterways Experiment Station at Vicksburg MS, 601 634 3575 (residual peroxide inactivated sludge).

Comments: Sample preparation may be required if analysis is being used for solid/semi-solid samples. In addition, sample preparation may be required to produce species in ionic form. Very easy to use with user immersing strip in the sample, then inserting the strip into the instrument to obtain reading.

Source of Information: TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Environmental Enzyme-Linked ImmunoSorbant Assay (ELISA)

Application : On-site

Brief Description : ELISA technology is used to screen for selected contaminants in soil and water. EnSys products detect pentachlorophenol <0.5 ppm, petroleum hydrocarbons 100 ppm, and polychlorinated biphenyl to <1 ppm. The test employs antibodies to detect contaminants and provide a colorimetric result. A test to detect Polynuclear Aromatic Hydrocarbons (PAHs) has a sensitivity appropriate to regulatory needs. All tests correlate to accepted USEPA Methods at levels of 85 percent or greater.

Company Name/POC: EnSys Environmental Products, Inc./Kevin Carter, PhD

Address : P.O. Box 14063/Res. Triangle Park, North Carolina 27709

Phone Number : 800 242-7472

Fax Number : 919 941-5519

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

ELISA technology has been used for site assessment at over 300 sites. The numbers of samples run at sites ranged from 1 to 1,200. Some of the parties which have used the kits are listed as follows: ATEC, Bechtel, Chem Waste Management, CH2M Hill, Ecology & Environment, Florida Power & Light, General Electric, Gas Research Institute, Geraghty & Miller, IT Corp., Jacobs Eng., & Roy F. Weston. A full list is available. Sample homogeneity can cause problems.

Comments : The test requires minimal skills which include basic reading comprehension and good manual handling skills. All materials are prepackaged and sample manipulations are minimized. Minimal training will allow an inexperienced operator to run tests quickly and correctly. The tests have a shelf life of 3 to 5 months at 75 degrees Fahrenheit and must be used between 40 degrees Fahrenheit and 90 degrees Fahrenheit. The tests are extremely easy to implement. The tests allow for a rapid turnaround time of sample results. This on-site information allows investigators to place other samples more effectively, saving further time and expenditures. There is no infrastructure required to run the tests, increasing its ease of implementation. The test has received, effective 7/13/92 USEPA Methods approval for field screening.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Toxicity & Genotoxicity Screening

Application : On-site Ex-situ

Brief Description : Company manufactures and sells a range of field testing kits for the screening of environmental samples (water, soil, sediment, sludges, etc.) for both acute toxicity, and genotoxicity and mutagenicity. Technology uses genetically engineered strains of bacteria to produce distinct color changes in the media being tested to determine biological effect endpoints.

Company Name/POC: Environmental Biodetection Products Inc./Dr. Ran Lifshitz

Address : 14 Abacus Road/Brampton, Ontario, Canada L6T 5B7

Phone Number : 905 794-2325

Fax Number : 905 794-233

Technology Maturity : Commercial use experience

Performance History : Performance Data are Available.

1. Survey of contaminated sediments and sludges around the Great Lakes basin. High correlation with much more costly comparable technologies. Contact: Dr. Barney Dulka, Canada Centre for Inland Waters, Environment Canada (905-336-4923; Fax 905-336-4989).
2. Survey of Rhine and Oder Rivers and North Sea sediments. Very favorable comparison with much more expensive and complex research technologies. Contact: Dr. Peter Hansen, Professor, Ecotoxicology, Technical University of Berlin (011-49-30-31421586; Fax 011-49-30-838113).

Comments : Full instructions provided with products. One-half day of practice for technologist is useful to become familiar with tests. Method details vary with parameter being measured. General procedure involves: (1) rehydration of freeze-dried bacteria; (2) placing the rehydrated testing bacteria into contact with a slurry of the material to be tested and allowing the mixture to incubate for one to two hours; and (3) reacting the bacterial test mixture with a chromogenic substrate and recording a color change as the biological effect endpoint. Tests have been designed to be easy to use. Quality control is done to a high degree in manufacturing, leaving little chance for variability in use resulting in a high degree of reproducibility. Tests are highly flexible for use in all types of test slurries and waters. A small (~\$300.00) 120V or 12V incubator is required for several tests. All consumable items come in the test kit. Kits are couriered to the site within two weeks of receipt of a purchase order.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : pH Optrode-based Measurement System

Application : On-site Ex-situ

Brief Description : The measurement system consists of a pH optrode (fiber optic sensor), a support opto-electronics interface (PC compatible), a personal computer and software. It measures the pH in contact with a small sensing region by monitoring the ratio of absorbed light at two wavelengths. The system presently operates over the range of pH 3.5 to 8.0. It provides a .1 pH resolution over this range. Glass electrodes are commonly used for pH measurements. The optrode-based measurement system provides much improved stability in low ionic strength solutions, such as typical groundwater.

Company Name/POC: GEO-CENTERS, Inc./Bruce Nelson

Address : 7 Wells Avenue/Newton Centre, Massachusetts 02159

Phone Number : 617 964-7070

Fax Number : 617 527-7592

Technology Maturity : Commercial use experience

Performance History : pH measurement systems have been utilized to monitor the pH of nutrient solutions of NASA plant growth experiments at NASA Kennedy Space Flight Center. They have undergone evaluations during plant growth cycles (2-3 months on in-situ measurements). Contact: Dr. John Sager, NASA KSC 407 853-5142. They have been extensively evaluated in the laboratory. They are about to undergo extensive beta site-testing at a water-treatment facility in the UK.

Comments : Color (dyes, etc.) of aqueous solutions can impact use. Systems can operate successfully with significant biofouling and fouling. Limited use at high temperatures (most operations at < 65 degrees celsius). The only requirement is electrical power at the location of measurement. The optrode is connected to the optoelectronics interface housed in the PC; the PC is turned on and the software is executed. The system is then ready for measurement/data logging/etc. The pH measurement system is the first optrode-based system that GEO-CENTERS has made available for commercial sale. Sensors for the measurement of NH₃ will be available next, H₂O (moisture) sensors will follow shortly. Sensors to monitor hydrazines, BTX, ethylene, CO and CO₂ have been demonstrated. The technology is also applicable for the detection of heavy metals (total), halogenated compounds, and other hazardous organics. The unique element of GEO-CENTERS systems is the use of porous polymer-based sensing elements in which the sensing reagent is chemically bound to the polymer matrix. This provides superior stability in the optrode. Additionally, this technique provides enhanced effective surface areas in small length (<3mm) sensing elements.

Source of Information : TechCon

CONTAMINANTS :

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☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Mobil Radiological Analysis Laboratory (MRAL)**Application :**

On-site

Ex-situ

Brief Description :

The Mobile Radiological Analysis Laboratory was conceived to provide both qualitative and quantitative radioanalytical services for field operations. The system was designed to utilize commercially available technology, integrated with both standard and modified analytical procedures, to meet the specific needs of the customers. Los Alamos National Laboratory currently has two units in operation that have been supporting field operations for two years. Two additional mobile laboratories were to be in place for the field sampling season of fiscal year 1994. The advantages include proximal real-time analysis and reporting of samples at a fraction of the cost of fixed-base labs and high sample through-put. Disadvantages include higher detection limits and some non-specific analysis.

Company Name/POC: Los Alamos National Laboratory/George Brooks**Address :** P.O. Box 1663/TSD-9/MS-K494/Los Alamos, New Mexico 87545**Phone Number :** 505 665-2583**Fax Number :** 505 665-598**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.

The Mobile Radiological Analysis Laboratories (two currently in operation) have been supporting the Environmental Restoration Program since March of 1992. They have supported approximately 15 separate Operable Projects for site characterization within LANL. Support is expanding to include equipment release programs. Total samples analyzed within the mobile laboratories for the above-mentioned programs exceed 3000, with each of the samples requiring up to as many as 10 separate analyses.

Comments :

The Mobile Radiological Analysis Laboratory should not be utilized/deployed when the analytical requirements of the project cannot be met from the data generated from the lab.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Contaminated Land Measurements

Application : Non-intrusive

Brief Description : In-situ high resolution gamma spectrometry is used to perform large area radiological clearance surveys and plant inventory measurements. Characterization and quantification of gamma emitting nuclides are typically possible to well below UK de minimis standards (400 Bq/kg). Measurements of total dose rates from spectral determinations at less than 0.05 microSv/h are routine. By use of high resolution gamma spectrometry in large area surveys, adequate limits of detection can be confidently obtained with short count times enabling many points to be surveyed in a working day.

Company Name/POC: Nuclear Electric plc/Dr. R. Clayton

Address : Littlebrook Complex/Littlebrook Manorway/Dartford Kent DA1 5PY, UK

Phone Number : 44 1322 28 2800

Fax Number : 44 1322 28 2819

Technology Maturity : Commercial use experience

Performance History : Many internal measurements on Nuclear Electric plant and site, experience in foreign plant measurements (PWRs in Spain and Belgium). Site surveys have been carried out, inter alia, at British Rail railheads and around the Trawsfynydd lake. Internal confidential reports may be made available on request.

Comments : On site supply to liquid nitrogen and electricity supply point for battery charging is required. Measurements are restricted to gamma emitting isotopes. However, the results are routinely extrapolated to non gamma-emitters by use of fingerprinting and radiochemistry techniques. Easy to use with minimal local support requirements.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Differential DIE Away For Induced Fission Using NeuSight

Application : Non-intrusive

Brief Description : Intense pulsed neutron source for use in induced fission characterization of waste through differential DIE away technique and neutron radiography (matrix correction). Excellent pulsing characteristic with negligible DAR current and intensity at least x10 nearest alternative transportable source (D-T Tube) significantly improved detection levels due to improved signal to noise.

Company Name/POC: Oxford Instruments/Nigel Boulding

Address : Accelerator Technology Group/Osney Mead/ Oxford OX2 ODX, UK

Phone Number : 44 1865 269500

Fax Number : 44 1865 26950

Technology Maturity : Commercial use experience

Performance History : Accelerator is already a proven product in medical and nuclear applications in fixed sites.

Comments : Lower limits of detection of fissile material yet to be determined. Can be configured as a mobile source/system for use at various sites. Minimal infrastructure requirements. Delivery of system within one year. Can collaborate with Rolls-Royce and could jointly provide x-ray/neutron interrogation systems for waste drum characterization.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Prompt Gamma Neutron Activation Analysis (PGNAA)

Application : In-situ (vadose zone) Ex-situ

Brief Description : PGNAA performs a non-invasive characterization of concentration profiles of hazardous or radioactive elements; can be used in-situ in the natural environment, within isolated packages or objects, or, as appropriate, in process monitoring control. Sensitivity down to "clean" levels is generally achievable, and the technique applies throughout the periodic table. It leaves no residual radioactivity.

Company Name/POC: Scientific Ecology Group, Inc./C.P. Keegan

Address : 1501 Ardmore Boulevard/Pittsburgh, Pennsylvania 15221

Phone Number : 412 247-6255

Fax Number :

Technology Maturity : Field demo complete

Performance History : Bench scale testing and calibration for buried uranium.
Other elements in process.
Field application with uranium-contaminated soil (in-situ).

Comments : Limited to penetration of a few feet in packed soil for in situ environmental application (approximately 1-4 feet, depending upon contaminant sought).

Source of Information : TechCon

CONTAMINANTS :

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☐ Petroleum Hydrocarbons	☒ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : SIGNATURE Gamma Radionuclide Detection and Analysis System

Application : On-site Ex-situ

Brief Description : Provides spectral analysis of a radioactive sample using sodium iodide scintillation detectors with greater efficiency than high purity germanium, and without complex and expensive cooling systems. Uses sophisticated digital signal processing techniques to provide measurement resolution comparable with high purity germanium at reduced cost of ownership. Original concept applied to reactor on-line fission product monitoring, further developed for environmental monitoring. Has undergone trials using blind and mixed radionuclide sources. Identification and quantification of component radionuclides has been achieved down to levels of a few becquerels. Use of sodium iodide well detector and automated sample changing will give further benefits. Suitable for initial evaluation of contamination or confirmation of satisfactory decontamination.

Company Name/POC: Siemens Environmental Systems Ltd./Dr. W.E. Croydon

Address : Sopers Lane, Poole/Dorset, BH 17 7ER/England

Phone Number : 44 1202 782648

Fax Number : 44 1202 782157

Technology Maturity : Field demo complete

Performance History : Performance Data are Available.

Trial systems monitoring reactor coolant have been installed on three UK power stations, both AGR and MAGNOX, and on other PWR nuclear plant. A 2 out of 4 voted hardware trip mode is available to shut down the reactor in the event of a significant increase of specific fission products. Typical measurements are of ~50 kBq/kg Kr-88 in a mixed power spectrum of ~50 MBq/kg N-16 and other isotopes, and agree with grab sample measurements made with a high purity germanium system to within 10 percent. A trial system for environmental monitoring has been configured to detect atmospheric contamination, suitable for the UK national RIMNET2 emergency response system. Laboratory evaluation has detected radionuclides at levels of a few Becquerels. Further improvements are under consideration.

Comments : Limited by detector characteristics, which must be designed for the particular application e.g., operating temperature, mechanical shock, weight of background radiation shielding. Flexible system which can be tailored to meet the needs of a specific application. Stand alone or connected to network for remote operation. Challenges are in optimization of system for ease of calibration and extension to variable geometries. Discussions are underway with the Geosciences Advisory unit at Southampton University, UK with a view to combining a sodium iodide well detector and automated sample changing stage with the SIGNATURE analysis system. This would provide improved automated equipment for analysis of radionuclide contamination for either field or laboratory use, and with low cost of ownership. Alternative detector systems could be designed to address other monitoring requirements. Trials have been carried out involving the following isotopes: Eu-155, Mn-54, Ba-133, Na-22, Zn-65, Am-241, Co-60, Cs-134, Cs-137, Eu-152, Ru-106, Co-58, Co-57, Sr-85, I-131, K-40, Gd-153, Sc-46, Tb-160, Ru-103, Cd-109, Ce-139, Sn-113, Y-88, Ra-226, Pb-214, Bi-214, Kr-88, N-16, O-19, Ar-41, Ir-192, Hg-203. However, the system is not limited to available test isotopes but should detect any gamma emitting radionuclide through the use of library emission data.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Rapid Screening Field Measurements of Organic Contaminants

Application : On-site Ex-situ

Brief Description : Provide rapid screening (5-10 min/sample) and more quantitative analysis (20-30 min/sample) for EPA listed VOCs and semi-VOCs including explosives. Conducted studies with Argonne National Laboratory, EPA (EMSL-Las Vegas) RSKERL - Ada; ERL - Narragansette Region 1) Tenneco, Navy and Army.

Company Name/POC: SiteWorks, Inc./Dr. L. John Hoover

Address : Suite 363/11160-F South Lakes Drive/Reston, Virginia 22091

Phone Number : 703 385-1549

Fax Number : 703 385-365

Technology Maturity : Commercial use experience

Performance History : Performance Data are Available.

Tufts University/Site Works
 Argonne National Laboratory; Candace Rose; Dr. Jacqueline Burton 1-708-252-8795
 Currently providing service in support of VOC analysis

Army/2 months Fort Devens
 Navy/3 weeks San Diego Harbor
 Tenneco/1 month pipeline
 4 EPA projects

Comments: Sample throughput dependent on sample matrix TDGC/MS. Analysis of full range of EPA listed organics reduces sample throughput; nonetheless, 2 times faster than fixed laboratory. Can have instruments ready for operation in 4 hrs including calibration. Personnel and mobile unit available to provide service immediately. Can analyze soil gas, direct and extracted soil, air and aqueous media.

3 publications have appeared in the peer-reviewed journals Analytical Chemistry and Journal of Chromatography. Conducted successful field validation studies with EPA, DOE, Army, Navy and private sector documenting data quality and cost/benefit.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : BioTector - On-line Analyser for Total Organic Carbon

Application : On-site Ex-situ

Brief Description : TOC analysers especially designed to perform reliably in industrial on-lie applications. No filtration required. Long term stable operation experienced. No interference from chloride.

Company Name/POC: Skinstrument A/S Pollution Control/Tor Anders Petteroe

Address : Trykkeriveien 8/N-1653 Sellebark/Norway

Phone Number : 47 69 36 32 90

Fax Number : 47 69 36 32 95

Technology Maturity : Commercial use experience

Performance History : First prototype developed in 1990, and tested in pulp and paper water in Temiscamin, Canada among other places. The instrument had too long response time, and too many component errors. New oxidation method was developed together with a team of German and French scientists, and the current version of the Bio Tector was launched in 1993/94. Approximately 50 units are installed in various applications, mainly industrial effluent. Main application is control of water going into the biological treatment plants in industries to control the addition of nutrients. Best reference will be Mr. Hans Dufva, Instrumental Engineer, and responsible for the purchase, installation and operation of the Bio Tector at the chemical plant AKZO NOBEL, Stenungssund, Sweden. He has analytical experience and a high request for quality in his own and other's work and equipment.

Comments : Sample must be available, or made available max. 3 meters below the analyser. Oxygen flask with reduction valve must be present. A room free from direct sunlight or direct rain must be available. Max. ambient temp 35 degrees centigrade. Temp. must be above freezing point. The Bio Tector has not been installed in clean water installations, and below 3-4 mg-C/L the accuracy is not documented. Can be used as a stand alone piece of equipment. Included in the analyser is a system for data collection and presentation that stores all data for one year, and can present these on screen, paper or diskette. The Bio Tector TOC analyser is made of high quality components and materials. All cabinets are made of stainless steel. Unlike most TOC analysers, the built-in CO2 detector is a non drifting device. To avoid variations in the gas flow through the system a computer controlled mass flow controller is implemented instead of the manual rotameter used in most TOC analysers. All operations are made by step by step menus presented on a touch screen.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Mapping of Soil/Groundwater Pollution**Application :** On-site Ex-situ**Brief Description :** Mobile laboratory.**Company Name/POC:** Steins Labororium A/S/Viggo Larsen**Address :** Olof Palmes Alle 13a/8200 Aarhus N/Denmark**Phone Number :** 45 86 10 80 70**Fax Number :** 45 86 10 88 8**Technology Maturity :** Commercial use experience**Performance History :** During the last 5 years Steins Laboratory has analyzed 4,000 samples for organic and inorganic elements and compounds. The mobile laboratory has been fully operational for 150 working hours during the last 2 years.**Comments :** Easy to move and transport. Flexible 24-hour operation.**Source of Information :** International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Ion Trap Mass Spectrometer

Application : On-site Ex-situ

Brief Description : The Teledyne MEC (TMEC) Ion Trap Mass Spectrometer is one of the most sensitive mass spectrometers of its size in the world. It is designed to be transportable, rugged, and automated to minimize operator intervention. It is ideal for field evaluation of toxic contaminants. The TMEC Ion Trap Mass Spectrometer will permit field measurements of environmental contaminants in lieu of laboratory analysis.

Company Name/POC: Teledyne MEC/Mort Cohen

Address : 1274 Terra Bella Ave./P.O. Box 7244/Mountain View, California 94039-7244

Phone Number : 415 962-6989

Fax Number : 415 967-4353

Technology Maturity : Field demo complete

Performance History : Field evaluations of the TMEC Ion Trap Mass Spectrometer are underway by the U.S. Army for military applications to detect chemical and biological toxins. Initial evaluation are positive. Point of contact is Dave Sickenberger, U.S. Army Chemical Research, Development, Engineering Center, (410) 671-5533.

Comments : Instrument is designed for direct sampling, or GC/LC input. The mass range is approximately 20 to 2,000 amu. It is highly sensitive (parts per billion to parts per trillion) and is excellent in isolating coeluting compounds in complex mixtures. It can be used for field evaluation, laboratory analysis, or fence post monitoring applications. The TMEC instrument is designed for ease of use. It can be powered by AC or DC (battery). It can be configured to operate with a PC-based data system, or as a stand alone device with display and data printout. The system is highly automated to minimize operator intervention, and can be easily configured for direct sampling or interface with gas or liquid chromatograph. There are no infrastructure considerations other than availability of prime power (about 1 KW). The TMEC ion trap mass spectrometer was specifically designed for field evaluation applications to measure very low levels of toxic contaminants. The original instrument was developed for the U.S. Army for military applications and to measure chemical and biological contaminants in the field. Approximately \$13M have been allocated for the R&D of this instrument. Initial field evaluations of the demonstration units are currently underway. Teledyne MEC is also developing, under an internal R&D program, an ion trap instrument for commercial applications related to real-time measurement of environmental contaminants. Initial demo units will be available by mid-1993. TMEC has filed for 8 patents on its ion trap technology, two of which have been allowed and will soon be issued. The other 6 filings are still under review by the U.S. Patent Office.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** X-Ray Fluorescence**Application :**

On-site

Ex-situ

Brief Description :

A quick, on-site determination of elemental inorganic contaminants in soils or other matrices. The results are qualitative and quantitative. Detection limits range from 5 to 90 parts per million. There are two instruments: one portable (Spectrace 9000), one transportable (Spectrace 6000). These instruments can handle samples of soil, sludge, powders, liquids, solids, or dust. Elements analyzed range from sodium to uranium on the periodic table.

Company Name/POC: TN Technologies/Spectrace Instruments/Rick Booth**Address :** 2555 N. Interstate 35/Round Rock, Texas 78664**Phone Number :** 512-388-9100**Fax Number :** 512 388-920**Technology Maturity :** Commercial use experience**Performance History :** EPA's Environmental Response Team

Many Jobs

Contact: Mark Bernick

Roy F. Weston

(908) 225-3990

Wright Patterson AFB

Clean Up

Contact: Mike Radi

Engineering Sciences

(615) 481-0451

Comments :

Limitations of this technology include:

Inhomogeneous samples affect results.

Spectrace 9000 requires ambient air temperature not exceed 120 degrees Fahrenheit and 105 degrees

Fahrenheit for storage.

Spectrace 6000 must have AC power.

Weighing just 19 lbs, Spectrace 9000 is battery-operated with a field pack; this system accommodates almost any environment. The system does not require liquid nitrogen and yet provides very high resolution. The software interface and fundamental parameter analysis technique results in operator ease-of-use that is unparalleled. Spectrace 6000 can be installed in a mobile lab and provides laboratory SRF resolution and results on-site. Spectrace 6000 also has fundamental parameter software and menu driven user interfaces. The only challenge, in terms of field screening, is the required action levels for certain contaminants which may be lower than this technology can accommodate.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Chlorinated Hydrocarbon Monitor

Application : On-site Ex-situ

Brief Description : This unique rare-earth sensor detects and measures contaminants such as carbon tetrachloride, trichloroethylene, perchloroethylene, dichloromethane, and other chlorinated solvents commonly used in nuclear weapons production. The sensor has no interference from methane, gasoline, paint thinner, and other non-chlorinated compounds.

Company Name/POC: TRANSDUCER RESEARCH, INC./William J. Buttner

Address : 600 N. Commons Dr./Suite 117/Aurora, Illinois 60504

Phone Number : 708 978-8802

Fax Number : 708 978-8854

Technology Maturity : Commercial use experience

Performance History : DOE - Hanford/Site Characterization/Cary Martin/Westinghouse 509 376-2648
DOE - Hanford/Carbon Tetrachloride Removal (Vacuum Extraction Process)/Randy Coffman/Westinghouse/509 376-4263
DOE - Hanford/Safety, Extraction Well Drilling/Tom Lazarski/Kaiser Engineering/509 373-4791
Eastman - Kodak/Wastewater Treatment (Dichloropropane, Dichloromethane)/Tom Walton/Eastman Kodak/716 477-1633

Comments : This instrument detects and measures chlorinated hydrocarbon vapors only. It does not speciate (responds to all chlorinated hydrocarbons). It requires vapor dilution for concentrations above 50 ppm. Model MP-1 Gas Diluter is available from Transducer Research as separate product. Sensor life is inversely proportional to exposure concentration and exposure time. Model 2001-05 is currently being used for site characterization, safety monitoring, and clean-up process applications. Transducer Research is currently improving sensor performance through automatic dilution and pre-concentration modules. Real-time monitoring capability permits quick analysis of contamination situation. Instrument is less expensive to purchase, operate, and maintain than alternate technologies. Real-time measurement allows determination whether work can be continued. Unit can be used to monitor changes in safety conditions. Selective measurement of chlorinated solvents simplifies operating procedures and speeds up the decision process.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Gas Chromatograph/Mass Spectrometer (Field GC/MS)

Application : On-site ☒ Ex-situ ☒

Brief Description : Transportable GC/MS used to detect and identify complex mixtures of environmental pollutants and toxic substances in trace amounts. Based on Hewlett-Packard's 5971A mass selective detector, Viking's field GC/MS uses miniaturized components to achieve laboratory-grade results on-site in real-time. Features of the instrument include: a heated membrane separator made from dimethyl silicone for air sampling, internal cryofocusing options for analysis of light volatiles, and high-temperature ramping for analysis of semi-volatiles with higher boiling points. Field GC/MS analysis shortcuts the current process of collecting environmental samples, sending them to a lab for analysis, and waiting weeks for results.

Company Name/POC: Viking Instruments Corporation/Thomas J. Kuehn

Address : 3800 Concord Parkway/Suite 1500/Chantilly, Virginia 22021

Phone Number : 703 758-9339

Fax Number : 703 968-010

Technology Maturity : Commercial use experience

Performance History : Viking's GC/MS has been field-proven by a number of large industrial firms and government agencies, including Tennessee Eastman, Martin Marietta, the EPA, the FBI, and the U.S. Army, for a variety of applications. The DOE, in conjunction with Sandia National Labs, uses the instrument for emergency response and on-site testing. Steve Thornberg is Viking's reference contact within the DOE (505) 846-8829.

Comments : Use of the instrument requires an operator who is skilled as a lab or field chemical technician and has completed Viking's Field GC/MS Introductory Training Course. The field GC/MS has many unique features designed into the system specifically to provide for flexibility and ease of use. Its rugged transport case, for example, permits operation in virtually any location that is accessible by jeep or plane. Once at a site, the field GC/MS can be unpacked and operational in about 15 minutes. The instrument also offers a number of sample inlet options for air, water, and soil gas and a user-friendly, Windows-based operating system. Finally, service contracts and telephone support are available with every instrument.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Laboratory Analysis*

Technology Name : Microwave Sample Digestion

Application : On-site
Off-site

Brief Description : The CEM Microwave Sample Preparation System, MDS-2000 series, combines the speed of microwave heating with proprietary sealed vessel technology to significantly reduce the sample preparation (acid digestion) process time. For environmental samples, the process time is reduced by a factor of 8-10. In addition to time savings, the technology provides performance (measure by elemental analysis), safety and cost advantages over traditional hot plate techniques.

Company Name/POC: CEM Corporation/Gregory N. LeBlanc

Address : 3100 Smith Farm Rd./P.O. Box 200/Matthews, N.C. 28105-200

Phone Number : 800 726-3331

Fax Number : 704 821-7894

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

There are over 3000 Microwave Sample Preparation Systems in use worldwide. The systems are typically used for acid digestion of a variety of matrices for subsequent elemental analysis. It cuts across all industries. Its widest use is for environmental applications. It has proven highly successful as measured by its acceptance in the worldwide marketplace.

Comments : Skills associated with a chemical laboratory are all that is required to operate the system. Training can be completed in <2 hours. Complete procedures are supplied with the purchase of the instrument. The system can be set up and running within 1 hour of removal from the shipping box. It can be used in a mobile lab and a standard laboratory. The system operates on 115 vac. (No special requirements). It is applicable to a wide variety of sample types encountered in remediation efforts. A fume hood is not required.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Laboratory Analysis***Technology Name :** Cold Trap Inlet System for GC**Application :** Off-site

Brief Description : The cold trap inlet system is used to first cryofocus organic samples (as a frozen plug) and then rapidly deliver the sample to a capillary column for a high speed separation. The cold trap is continuously cooled with a stream of cold gas. Typical trapping temperatures range from -50 degrees Celsius to -150 degrees Celsius. After the sample is cryofocused on the metal coated trap, the trap tube is electrically heated which rapidly vaporizes the frozen sample and delivers it to the mouth of the separation column as a small vapor plug. The cold trap inlet works extremely well for compounds with volatilities as high as pentane. This technology will replace inlet systems used in conventional Gas Chromatography. This will allow for reduction in analysis times from tens of minutes to tens of seconds as compared to conventional chromatography.

Company Name/POC: Chromatofast, Inc./Robin Risser**Address :** 912 N. Main Street, Suite 14/Ann Arbor, Michigan 48104**Phone Number :** 313 662-3410**Fax Number :** 313 662-346**Technology Maturity :** Bench scale testing, only

Performance History : The cold trap inlet system has been utilized through a development contract from private industry for a speciation instrument to analyze automotive exhaust gases. The device has been successfully applied towards cryofocusing a gas sample over several minutes, this proving a means to concentrate the sample and improve detectability within the system.

Comments : The device, when combined with equipment for high-speed gas chromatography will require a single technician with familiarity in using a conventional gas chromatograph. The majority of the operation is automated. The only required procedure would be a method of sample introduction, i. e., syringe injection. The current system employs LN2-cooled N2 gas to achieve the necessary trapping temperatures. While this is satisfactory for a research instrument, alternative cooling is desirable for a commercial instrument. Additionally, smaller more portable ovens capable of quicker temperature programming need to be constructed. For the final instrument, all components must be rugged and packaged into a portable case. Computer software for acquisition and analysis along with appropriate digital displays will also be incorporated.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☐ Heavy Metals	☒ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☒ SVOC	☐ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Laboratory Analysis*

Technology Name : Gas Valve Inlet System for GC

Application : Off-site

Brief Description : The gas valve inlet system is used for extremely fast injections which are required for high-speed gas chromatography. A sample gas travels through an injection tube which is positioned inside a metal block. A small hole in the tube continuously leaks sample gas. The tube is traversed perpendicularly to the capillary separation column so that the leak of sample gas will pass directly over the column opening, thus accomplishing sample introduction. The gas valve inlet system works well for gas sample streams where extremely small injection band widths are desired. This technology will replace inlet systems used in conventional Gas Chromatography. This will allow for reduction in analysis times from tens of minutes to tens of seconds as compared to conventional chromatography.

Company Name/POC: Chromatofast, Inc./Robin Risser

Address : 912 N. Main Street, Suite 14/Ann Arbor, Michigan 48104

Phone Number : 313 662-3410

Fax Number : 313 662-3462

Technology Maturity : Bench scale testing, only

Performance History : The gas valve inlet system is currently being used as a research device at the University of Michigan. It can provide analysis time as short as 2 seconds with very good reproducibility. It has been operated tens of thousands of times with no sign of wear. Project directed under Dr. Richard Sacks, Professor, (313) 764 7373.

Comments : The device, when combined with equipment for high-speed gas chromatography will require a single technician with familiarity in using a conventional gas chromatograph. The majority of the operation is automated. The current gas valve inlet system requires a pressurized sample stream. Techniques need to be developed in order to apply the inlet system to a wider range of samples and media. The device is currently implemented on conventional gas chromatographs modified for high speed operation. Steps for ruggedization of the instrument must be developed.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : Laboratory Analysis**Technology Name :** High Speed Capillary Column for GC**Application :** Off-site

Brief Description : Capillary column strategies for high-speed gas chromatography are techniques which are used to increase the performance or resolution of a high-speed separation as overall resolution is decreased as compared to conventional gas chromatography. Techniques include serial coupled columns which can shift unresolved pairs of peaks into open areas of a chromatogram, and high-speed column switching, which employs high-speed hardware used for multidimensional techniques. The techniques perform with a good level of precision and accuracy as they all incorporate high speed components.

Company Name/POC: Chromatofast, Inc./Robin Risser
Address : 912 N. Main Street, Suite 14/Ann Arbor, Michigan 48104

Phone Number : 313 662-3410**Fax Number :** 313 662-346**Technology Maturity :** Bench scale testing, only

Performance History : The Column Strategies technology has been utilized through a development contract from private industry for a speciation instrument to analyze automotive exhaust gases and in a fast, direct non-methane hydrocarbon analyzer development contract from a State of Michigan grant for automotive exhaust analysis. The speciation project was a 1 year contract providing \$525,000 of funds and the non-methane hydrocarbon project was a year contract providing \$75,000 of funds. A mid-point backflush procedure has been developed which reduces the cycle time of the instrument by a factor of 2.

Comments : The device, when combined with equipment for high-speed gas chromatography will require a single technician with familiarity in using a conventional gas chromatograph. The majority of the operation is automated.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Laboratory Analysis*

Technology Name : On-Line Microwave Digestion

Application : Ex-situ

Brief Description : Continuous preparation of samples for analysis by AA, Fluorescence ICP, ICP-MS. Ideal for "Hot" samples. Replaces batch systems and robotics which are labor intensive and cumbersome.

Company Name/POC : Questron Corporation/Angelo Grillo

Address : 4044 Quakerbridge, RD./Mercerville, New Jersey 08619

Phone Number : 609 587-6898

Fax Number : 609 587-0513

Technology Maturity : Bench scale testing, only

Performance History : Technology is presently at the stage where beta site units will be manufactured. A DOE site would be ideal for such an evaluation.

Comments : The system can operate at high pressure, and high temperature. It would be applicable for all but some high temperature refractory materials. Analysis has reached a high degree of automation. Sample preparation is still relatively tedious. This system would allow the sample preparation to match the speed and degree of automation of the analyzer. All of the developmental work has been completed. The remaining challenges deal with actual speed in a real environment, range of applicable samples, reliability in an adverse environment, and applicability to use in a mobile lab. This product is being developed for the Canadian Ministry of Environment by Questron with the assistance of Dr. F. Salin's group at the Chemistry Department of McGill University.

Source of Information : TechCon

CONTAMINANTS :☒ Pesticides/Herbicides☒ Heavy Metals☒ PCB☒ Explosives/Propellants☒ Petroleum Hydrocarbons☒ Radionuclides☒ SVOC☒ Other Contaminant☒ Nonhalogenated VOC☒ Halogenated VOC☒ N/A**TECHNOLOGY TYPE : Laboratory Analysis****Technology Name :** Ion Trap Mass Spectrometer**Application :**

On-site

Ex-situ

Brief Description :

The Teledyne MEC (TMEC) Ion Trap Mass Spectrometer is one of the most sensitive mass spectrometers of its size in the world. It is designed to be transportable, rugged, and automated to minimize operator intervention. It is ideal for field evaluation of toxic contaminants. The TMEC Ion Trap Mass Spectrometer will permit field measurements of environmental contaminants in lieu of laboratory analysis.

Company Name/POC: Teledyne MEC/Mort Cohen**Address :** 1274 Terra Bella Ave./P.O. Box 7244/Mountain View, California 94039-7244**Phone Number :** 415 962-6989**Fax Number :** 415 967-435**Technology Maturity :**

Field demo complete

Performance History :

Field evaluations of the TMEC Ion Trap Mass Spectrometer are underway by the U.S. Army for military applications to detect chemical and biological toxins. Initial evaluation are positive. Point of contact is Dave Sickenberger, U.S. Army Chemical Research, Development, Engineering Center, (410) 671-5533.

Comments :

Instrument is designed for direct sampling, or GC/LC input. The mass range is approximately 20 to 2,000 amu. It is highly sensitive (parts per billion to parts per trillion) and is excellent in isolating coeluting compounds in complex mixtures. It can be used for field evaluation, laboratory analysis, or fence post monitoring applications. The TMEC instrument is designed for ease of use. It can be powered by AC or DC (battery). It can be configured to operate with a PC-based data system, or as a stand alone device with display and data printout. The system is highly automated to minimize operator intervention, and can be easily configured for direct sampling or interface with gas or liquid chromatograph. There are no infrastructure considerations other than availability of prime power (about 1 KW). The TMEC ion trap mass spectrometer was specifically designed for field evaluation applications to measure very low levels of toxic contaminants. The original instrument was developed for the U.S. Army for military applications and to measure chemical and biological contaminants in the field. Approximately \$13M have been allocated for the R&D of this instrument. Initial field evaluations of the demonstration units are currently underway. Teledyne MEC is also developing, under an internal R&D program, an ion trap instrument for commercial applications related to real-time measurement of environmental contaminants. Initial demo units will be available by mid-1993. TMEC has filed for 8 patents on its ion trap technology, two of which have been allowed and will soon be issued. The other 6 filings are still under review by the U.S. Patent Office.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Laboratory Analysis*

Technology Name : Accelerator Mass Spectroscopy (AMS)

Application :

	On-site	Ex-situ
	Off-site	

Brief Description : This instrument measures the relative abundance of carbon 14/12, Iodine 129/122, etc. to better than 1 part in 1E15.

Company Name/POC: Triumph/Phillip Gardner

Address : 4004 Wesbrook Mall/Vancouver, B.C, Canada, V6T 2A3

Phone Number : 604 222-1047

Fax Number : 604 222-1074

Technology Maturity : Commercial use experience

Performance History : AMS is a well known analytical technique worldwide - J.Vogel, L.L.B.L., CA, USA - E. Litherland, U. Toronto, Ont., Canada

Comments : AMS is only appropriate for elements that make negative ions only. Positive ions must be done in conventional E-M mass spec.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Decision Support Tools***Technology Name :** Site Planner**Application :**

Other Application

Brief Description : Workstation-based software for decision support in site assessment and remediation. Site Planner replaces slow, low-productivity manual data management and visualization techniques and point solution software systems.

Company Name/POC: ConSolve Inc./David Barber**Address :** 70 Westview St./Lexington, MA 02173**Phone Number :** 508 358-8061**Fax Number :** 508 358 806**Technology Maturity :** Commercial use experience

Performance History : Site Planner is currently deployed on about 20 projects including use by four DOE laboratories.

Comments : Two days on-site training required. Limited by normal computer hardware limitations. System runs on stand-alone Unix workstations.

Source of Information : TechCon

Process Wastes/Sludge

Characterization

Process Wastes/Sludge

Characterization

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Physical Sampling*

Technology Name : Groundwater/Sludge Borehole Pumps

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Draws water/sludge for analysis, at variable, pre-determined rates, including abrasive solids/contaminents, & various temperatures. Ability to overcome system deficiencies, and specificaiton to handle overout liquids.

Company Name/POC: H2O Waste-Tec/Mr. I. Hallows

Address : Horsfield Way, Bredbury Industrial Park/Stockport, SK6 2SU UK

Phone Number : 0161 406 7111

Fax Number : 0161 406 7222

Technology Maturity : Commercial use experience

Performance History : 1000's of unit installed worldwide for water, sludge abstraction.

Comments : 3,000m borehole depth; 100 degrees C temperature; sludges above 10% dissolved solids. H2O Waste-Tec water is a major part of the Dresser Group with US wide commitment to product support throughout USA.

Source of Information : International TechCon

PROCESS WASTES/SLUDGE

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name: Energy Dispersive X-Ray Fluorescence - Thin Film

Application: On-site

Brief Description: The EDXRF does lab quality elemental analysis (Na to Pu) using proprietary technology that can meet EPA minimum detection requirements in near realtime; low ppb analysis of trace elements in solutions, low ppm for soils/solids (sub ppm with digestions) for an exceptional range of "total unknown" sample types (soils, ores, wastes, water, etc.) and concentrations (ppm to wt percent for solids). All done in one instrument with no prior knowledge of sample.

Company Name/POC: Advanced Analytical Products & Services/Jim Wrigley

Address: 1753 Cape Aston Court/San Jose, California 95133-1128

Phone Number: 408 926-4057

Fax Number: 408 926-405

Technology Maturity: Commercial use experience

Performance History: Performance data are available.

Small jobs mainly (10 to 50 samples). Exceptionally low detection levels and very good corroboration where available; customers report accuracy is better than CLP. References: Dr. Paul LaMothe, U.S. Geol. Survey 415 329 5258; Mrs. BiShia King, U.S. Geol. Survey 415 329 5288; Dr. Bill Walker, Walsh Associates 916 737 7240; Mr. Bill Cole, Lockheed Eng. Svc. 702 897 3226; Mr. Eric Lindgren, Sandia Nat. Lab 505 844 3820.

Comments: Sample prep is simple for solutions and soil/solid samples. Soils must be dried and ground (to about 300 mesh), then prepared as a thin film. The skill needed for EDXRF spectroscopy is quite high. Therefore, the company is offering a service, not an instrument. Later they will develop an "expert system" to overcome this. Detects elements Na to Pu, but not H to F. Doesn't determine compounds. With digestions, can do some speciation (e.g., soluble chromates Cr+6 distinguished from total chrome) and get excellent results (.3-.5 ppm). Mobile, not portable. Two person team recommended for field operations, but can be done with one. The cost reduction implications for field operations are quite significant.

Source of Information: TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides☐ Heavy Metals☐ PCB☐ Explosives/Propellants☐ Petroleum Hydrocarbons☐ Radionuclides☐ SVOC☐ Other Contaminant☐ Nonhalogenated VOC☐ Halogenated VOC☐ N/A**TECHNOLOGY TYPE :** *Sensors/Field Analysis Equipment***Technology Name :** Mobile Laboratory for Chemical Weapons, Explosives and Propellants**Application :** On-site Ex-situ**Brief Description :** Mobile laboratory with all necessary chemical and physical equipment to detect and analyze chemical weapons, explosives, propellants and other toxic materials.**Company Name/POC:** Alba Industrie Umweltschutz Service GmbH/Dr. K. Faber**Address :** Rehrhoferweg 160/D29625 Munster/Germany**Phone Number :** 051 92 96 3212**Fax Number :** 051 92 96 3311**Technology Maturity :** Commercial use experience**Performance History :** In use for two years, e.g., in Russia and also in Germany.**Comments :** None.**Source of Information :** International TechCon

PROCESS WASTES/SLUDGE

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Monitoring of Chemical Weapons in Soil, Water, Air, Buildings

Application : ☐ On-site ☐ Ex-situ

Brief Description : Monitors all relevant parameters, like concentrations of chemical weapons in air, soil, water, and buildings.

Company Name/POC: Alba Industrie Umweltschutz Service GmbH/Dr. K. Faber

Address : Rehrhoferweg 160/D29625 Munster/Germany

Phone Number : 051 92 96 3212

Fax Number : 051 92 96 3311

Technology Maturity : Commercial use experience

Performance History : Refer to POC for performance history.

Comments : None.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Fourier Transform Infrared Photoacoustic Spectrometry of Solids

Application :

On-site Ex-situ
Off-site

Brief Description : The FTIR unit identifies volatile organic compounds in vapor and liquid. It also has the potential for use in sampling vapor and liquid contained in soil. Modulating infrared light passes through the sample chamber where it is selectively absorbed by the vapor sample. Components in the vapor selectively absorb the light and an acoustic signal is produced that is proportional to the concentration in the sample. The detection limits for organic compounds are 0.1 ppm to 10 ppm.

Company Name/POC: Ames Laboratory/US DOE/John Mclellan**Address :** Iowa State University/Ames, IA 50011-3020**Phone Number :** 515 294-7948**Fax Number :** 515 294-4748**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.

FTIR-PAS can analyze for any molecular or polyatomic component, such as organic solvents and polyatomic ions. Our most recent work has been on the measurement of nitrate, ferrocyanide and similar ions in tank sludges. FTIR-PAS has been used extensively for the analysis of various manufactured materials, but its application to environmental tasks is new. The technology group is presently involved in applying FTIR-PAS to waste-tank sludges (Reference: Dr. T. Rebagay, Westinghouse Hanford Co., 509 373-3174). For a recent broad discussion see "A Practical Guide to FT-IR Photoacoustic Spectroscopy" by J. McClelland, et al., in Practical Sampling Techniques for Infrared Analysis, P.B. Coleman, editor.

Comments :

FTIR-PAS is not applicable to volatile liquids and solids (unless only the volatiles need be analyzed). It is not readily applicable to large, intact objects. It cannot analyze components made of monatomic species (e.g., sodium chloride). It is not a trace analysis technique. FTIR-PAS draws its analysis from a very thin region at the surface of the sample. If this surface is not representative of the unit being analyzed, it is difficult to extrapolate from the analysis to the whole unit. FTIR-PAS determines infrared spectra (and related composition and physical properties) of non-volatile liquids and solids irrespective of their condition (e.g., sludge, powder, slab) and with minimal sample handling. Routine analysis only requires that a small sample be placed in the instrument, and the analysis takes less than 5 minutes. The minimal handling translates into faster and cheaper analyses. Minimum sample size is 1 to 10 milligrams, which limits worker exposure.

Source of Information : International TechCon

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name: Mobile Environmental Mass Spectrometer

Application: On-site

Brief Description: The Mobile Environmental Mass Spectrometer (MEM) is a fully developed electron impact ionization quadrupole Mass Spectrometer designed specifically to be rugged and flexible for on-site analysis of organic compounds. It is tolerant to extreme changes of environmental conditions allowing for a wide range of Data Quality Objectives to be completed. This all-in-one system simplifies sample preparation techniques yielding rapid qualitative and quantitative results on a real-time basis with field uptime better than 95 percent.

Company Name/POC: Bruker Instruments, Inc./J. Wronka

Address: 19 Fortune Drive/Manning Park/Billerica, MA 01821

Phone Number: 508 667-9580

Fax Number: 508 667-599

Technology Maturity: Commercial use experience

Performance History: Performance data are available.

The MEM is successfully being used by the U.S. Army, state agencies, fire brigades, and environmental management firms for a wide variety of applications which include emergency response, site screening and assessment, and clean up monitoring of air, water and soil samples. References: U.S. Army CRDEC, D. Durst, (410) 671 2129; Del. State DNREC, J. Rogers, (302) 323-4542; Env. Res Mngmt, D. Gallis, (215) 524 3786; SiteWorks, Inc., Albert J. Robbat, Jr., (617) 627 3474.

Comments: The MEM is designed for simple operation. A one-week training course covering instrument operation, hardware components, and methodologies will enable personnel to successfully complete analytical measurements. Automatic routines simplify operation, and an internal diagnostic routine continuously monitors instrument performance and warns the operator of potential problems with calibration, temperature, power, and electronic malfunctions. Data interpretation requires some knowledge in mass spectroscopy to determine data integrity. The technology for characterizing environmental pollutants on-site is fully developed and readily available. The problem which exists is convincing people that, when implemented properly, the rapid generation of data which field analysis provides results in a dramatic savings of time and cost in comparison to conventional techniques of chemical detection.

Source of Information: TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Microwave Sample Digestion

Application : On-site
Off-site

Brief Description : The CEM Microwave Sample Preparation System, MDS-2000 series, combines the speed of microwave heating with proprietary sealed vessel technology to significantly reduce the sample preparation (acid digestion) process time. For environmental samples, the process time is reduced by a factor of 8-10. In addition to time savings, the technology provides performance (measure by elemental analysis), safety and cost advantages over traditional hot plate techniques.

Company Name/POC: CEM Corporation/Gregory N. LeBlanc

Address : 3100 Smith Farm Rd./P.O. Box 200/Matthews, N.C. 28105-200

Phone Number : 800 726-3331

Fax Number : 704 821-7894

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Comments :

There are over 3000 Microwave Sample Preparation Systems in use worldwide. The systems are typically used for acid digestion of a variety of matrices for subsequent elemental analysis. It cuts across all industries. Its widest use is for environmental applications. It has proven highly successful as measured by its acceptance in the worldwide marketplace.

Skills associated with a chemical laboratory are all that is required to operate the system. Training can be completed in <2 hours. Complete procedures are supplied with the purchase of the instrument. The system can be set up and running within 1 hour of removal from the shipping box. It can be used in a mobile lab and a standard laboratory. The system operates on 115 vac. (No special requirements). It is applicable to a wide variety of sample types encountered in remediation efforts. A fume hood is not required.

Source of Information : TechCon

PROCESS WASTES/SLUDGE

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Reflectoquant System

Application : On-site

Brief Description : Hand-held instrument which reads a series of ion-specific test strips on a parts-per-million level. The ion-specific test strips are impregnated with various chemicals which react with the analyte in question to produce a color. The RQflex meter then reads the reflected light which is proportional to the sample concentration. The sample concentration is displayed via LCD usually in terms of ppm. For example, to measure copper, the RQflex meter is programmed using the copper bar code supplied with the Reflectoquant copper test strips. The test strip is dipped into the sample, allowed to develop over a period of time, and then inserted into the meter. The sample concentration appears on the LCD display. Each type of test strip has two reaction pads. The instrument reads both pads and the result on the display is actually the average of the two independent readings. Accuracy is generally within 10 percent of the actual, but in many cases has been found to be under 5 percent.

Company Name/POC: EM Science/Bruce Crane

Address : 480 Democrat Road/Gibbstown, New Jersey 08027

Phone Number : 800 222-0342

Fax Number : 609 423-438

Technology Maturity : Commercial use experience

Performance History : Larry Waters, ORNL 615 571 4969 for Cr (VI), Pb, NO₃; Donna So, Chevron 310 615 5622 for NO₃, NO₂, inactivated sludge; Jim Scott, Santa Clara Valley Water District, 408 265 2607 x2113, groundwater-metals/inorganics; Bob Morgan, US Army Waterways Experiment Station at Vicksburg MS, 601 634 3575 (residual peroxide inactivated sludge).

Comments : Sample preparation may be required if analysis is being used for solid/semi-solid samples. In addition, sample preparation may be required to produce species in ionic form. Very easy to use with user immersing strip in the sample, then inserting the strip into the instrument to obtain reading.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Environmental Enzyme-Linked ImmunoSorbant Assay (ELISA)

Application : On-site

Brief Description : ELISA technology is used to screen for selected contaminants in soil and water. EnSys products detect pentachlorophenol <0.5 ppm, petroleum hydrocarbons 100 ppm, and polychlorinated biphenyl to <1 ppm. The test employs antibodies to detect contaminants and provide a colorimetric result. A test to detect Polynuclear Aromatic Hydrocarbons (PAHs) has a sensitivity appropriate to regulatory needs. All tests correlate to accepted USEPA Methods at levels of 85 percent or greater.

Company Name/POC: EnSys Environmental Products, Inc./Kevin Carter, PhD

Address : P.O. Box 14063/Res. Triangle Park, North Carolina 27709

Phone Number : 800 242-7472

Fax Number : 919 941-5519

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Comments :

ELISA technology has been used for site assessment at over 300 sites. The numbers of samples run at sites ranged from 1 to 1,200. Some of the parties which have used the kits are listed as follows: ATEC, Bechtel, Chem Waste Management, CH2M Hill, Ecology & Environment, Florida Power & Light, General Electric, Gas Research Institute, Geraghty & Miller, IT Corp., Jacobs Eng., & Roy F. Weston. A full list is available. Sample homogeneity can cause problems.

The test requires minimal skills which include basic reading comprehension and good manual handling skills. All materials are prepackaged and sample manipulations are minimized. Minimal training will allow an inexperienced operator to run tests quickly and correctly. The tests have a shelf life of 3 to 5 months at 75 degrees Fahrenheit and must be used between 40 degrees Fahrenheit and 90 degrees Fahrenheit. The tests are extremely easy to implement. The tests allow for a rapid turnaround time of sample results. This on-site information allows investigators to place other samples more effectively, saving further time and expenditures. There is no infrastructure required to run the tests, increasing its ease of implementation. The test has received, effective 7/13/92 USEPA Methods approval for field screening.

Source of Information : TechCon

PROCESS WASTES/SLUDGE

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Toxicity & Genotoxicity Screening

Application : On-site Ex-situ

Brief Description : Company manufactures and sells a range of field testing kits for the screening of environmental samples (water, soil, sediment, sludges, etc.) for both acute toxicity, and genotoxicity and mutagenicity. Technology uses genetically engineered strains of bacteria to produce distinct color changes in the media being tested to determine biological effect endpoints.

Company Name/POC: Environmental Biodetection Products Inc./Dr. Ran Lifshitz

Address : 14 Abacus Road/Brampton, Ontario, Canada L6T 5B7

Phone Number : 905 794-2325

Fax Number : 905 794-233

Technology Maturity : Commercial use experience

Performance History : Performance Data are Available.

1. Survey of contaminated sediments and sludges around the Great Lakes basin. High correlation with much more costly comparable technologies. Contact: Dr. Barney Dutka, Canada Centre for Inland Waters, Environment Canada (905-336-4923; Fax 905-336-4989).
2. Survey of Rhine and Oder Rivers and North Sea sediments. Very favorable comparison with much more expensive and complex research technologies. Contact: Dr. Peter Hansen, Professor, Ecotoxicology, Technical University of Berlin (011-49-30-31421586; Fax 011-49-30-838113).

Comments : Full instructions provided with products. One-half day of practice for technologist is useful to become familiar with tests. Method details vary with parameter being measured. General procedure involves: (1) rehydration of freeze-dried bacteria; (2) placing the rehydrated testing bacteria into contact with a slurry of the material to be tested and allowing the mixture to incubate for one to two hours; and (3) reacting the bacterial test mixture with a chromogenic substrate and recording a color change as the biological effect endpoint. Tests have been designed to be easy to use. Quality control is done to a high degree in manufacturing, leaving little chance for variability in use resulting in a high degree of reproducibility. Tests are highly flexible for use in all types of test slurries and waters. A small (~\$300.00) 120V or 12V incubator is required for several tests. All consumable items come in the test kit. Kits are couriered to the site within two weeks of receipt of a purchase order.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Gamma Ray/Neutron/X-Ray Detection Systems

Application :

On-site Ex-situ

Off-site

Brief Description : The company provides x-ray, gamma ray and neutron detection in the gamma energy spectrum of 1KeV to 3MeV, with detection of radiation from 1 microR/hr. Equipment has capabilities of both spectral and total count detection; detector sizes range from 4.5 cu inches to 8800 cu inches. Detection is facilitated by a plastic scintillator medium and/or sodium iodine. Fixed, portable, vehicle mounted and airborne systems are available.

Company Name/POC: Exploranium G.S. Limited/Stan Boyington**Address :** 264 Watline Ave./ Mississauga, Ontario, Canada L4Z 1P4**Phone Number :** 905 712-3100**Fax Number :** 905 712-3105**Technology Maturity :** Commercial use experience

Performance History : More than 200 GR-110 gamma ray scintillometers are currently in service. Approximately 40 GR-820 airborne multichannel gamma ray spectrometers with a variety of detector packs (ranging in size from 1024 cu. in. to 3840 cu. in.) are operating in both helicopter and fixed wing aircraft. List of operators is available on request.

Comments : Temperature ranges for Model GR-110: operating -24 C to + 50 C; Storage -30 C to + 70 C.
 Temperature ranges for model GR-820: detectors -20 C to + 40 C; Console: -10 C to +40 C.

Source of Information : International TechCon

PROCESS WASTES/SLUDGE

CONTAMINANTS : ☐ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : MetPAD and MetPLATE Heavy Metal Toxicity Test Kits

Application : On-site Ex-situ

Brief Description : MetPAD and MetPLATE are rapid qualitative and quantitative microbial assays that are specific to heavy metal toxicity. The technological basis of the kits is the inhibition of a bacterial enzyme by toxic heavy metals in environmental samples. The sensitivity of these kits to heavy metals is generally higher than MICROTOX and is of the same order or better than Daphnia and fish bioassays. The MetPAD and MetPLATE greatly reduce the costs associated with determining toxicity characteristics. Using either the MetPAD and MetPLATE concurrent with other general toxicity assays would help determine the nature of chemicals causing toxicity.

Company Name/POC: Group 206 Technologies, Inc./J. Craig Watts

Address : 6705 NW 24th Place/Gainesville, Florida 32606

Phone Number : 800 869-8729

Fax Number : 904 376-9131

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

The MetPAD and MetPLATE have proved successful by research groups in the public and private sector. Oscar Pancorbo (State of MA, DEP, 508 682 5237) has used and is planning to use these kits for toxicity screening and identification at several sites throughout Massachusetts. These kits have been evaluated by at least two independent research groups. Rochelle Rabidue (3M, 612 778 7065) and Rosalind Wei (In Vitro, 714 851 8356) have performed separate evaluations of these kits with results supporting the Company's claims.

Comments :

The MetPAD and MetPLATE are small, lightweight test kits; however, a portable incubator is required to complete either test. The MetPAD and MetPLATE test kits are designed to detect and measure toxic heavy metals in the ppm range. These kits will not detect heavy metals that carry a negative charge, e.g., cyanide and arsenic and will not differentiate among the various heavy metals found within a sample. The kits must be stored under refrigeration and must not be exposed to direct sunlight. The MetPAD and MetPLATE are simple to use and portable; flexible in the sense that it can be used on several types of samples (e.g., soils, sludge, water and wastewater). Each kit comes with easy-to-follow instructions.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : MetSOIL Direct Heavy Metal Toxicity Assay for Soils

Application : On-site Ex-situ

Brief Description : MetSOIL is a direct toxicity assay for soils, sediments, and sludges which is specific for heavy metal toxicity. In the test protocol, bacteria are exposed to the solids, then provided with an enzyme substrate. Absorbance of the reaction mixture is used as a measure of enzyme activity, thus toxicity. MetSOIL greatly reduces the high cost associated with determining toxicity characteristics. The MetSOIL minimizes the dilution of extractable heavy metals. MetSOIL incorporates a quantitative and repeatable means of controlling the interaction between the solid matrix and the enzyme substrate reaction. This is in contrast to the complex approach employed in the MICROTOX solid phase assay.

Company Name/POC: Group 206 Technologies, Inc./J. Craig Watts

Address : 6705 NW 24th Place/Gainesville, Florida 32606

Phone Number : 800 869-8729

Fax Number : 904 376-9135

Technology Maturity :

Bench scale testing, only

Performance History : The MetSOIL technology has not been used outside the laboratory setting; however, the MetSOIL test kit is based on the same technology found in the proven MetPAD and MetPLATE. Until now, the inventors and their associates have been the only people to use the MetSOIL technology (Dr. Gaby Bitton, University of Florida 904 392 4409).

Comments : The MetSOIL is a small, lightweight test kit. A portable incubator is required to complete the test. The MetSOIL test kit is designed to detect and measure toxic heavy metals in the ppm range. These test kits will not detect heavy metals which carry a negative charge (e.g., cyanide and arsenic). This test kit will not differentiate among the various heavy metals found within a sample. This test kit must be stored under refrigeration and must not be exposed to direct sunlight. The MetSOIL test kit, upon completion, will provide advantages over expensive and time-consuming laboratory procedures. The MetSOIL makes it possible to screen soil, sediments, or sludge samples for heavy metal toxicity. The MetSOIL is ideal for either laboratory or field use. Final MetSOIL packaging issues are being resolved for commercialization.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : On Line Gamma Monitoring Systems

Application : On-site Ex-situ

Brief Description : On line gamma monitoring systems for discrimination of radioactively contaminated and uncontaminated materials.

Company Name/POC: KEMA Nederland B.V./J. van der Steen

Address : P.O. Box 9035 NL-6800 ET/ARNHEM The Netherlands

Phone Number : 31 26 356 6104

Fax Number : 31 26 351 5835

Technology Maturity :

Field demo complete

Performance History : Contact company for performance history data.

Comments : High gamma background might present some problems with the detection limit. The system has been developed for the cleanup of disposal areas for low level radioactive waste at KEMA. It proved to be a quick and reliable system, which accelerated the cleanup operation considerably.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Mobil Radiological Analysis Laboratory (MRAL)**Application :** On-site Ex-situ

Brief Description : The Mobile Radiological Analysis Laboratory was conceived to provide both qualitative and quantitative radioanalytical services for field operations. The system was designed to utilize commercially available technology, integrated with both standard and modified analytical procedures, to meet the specific needs of the customers. Los Alamos National Laboratory currently has two units in operation that have been supporting field operations for two years. Two additional mobile laboratories were to be in place for the field sampling season of fiscal year 1994. The advantages include proximal real-time analysis and reporting of samples at a fraction of the cost of fixed-base labs and high sample through-put. Disadvantages include higher detection limits and some non-specific analysis.

Company Name/POC: Los Alamos National Laboratory/George Brooks**Address :** P.O. Box 1663/TSD-9/MS-K494/Los Alamos, New Mexico 87545**Phone Number :** 505 665-2583**Fax Number :** 505 665-5982**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.

The Mobile Radiological Analysis Laboratories (two currently in operation) have been supporting the Environmental Restoration Program since March of 1992. They have supported approximately 15 separate Operable Projects for site characterization within LANL. Support is expanding to include equipment release programs. Total samples analyzed within the mobile laboratories for the above-mentioned programs exceed 3000, with each of the samples requiring up to as many as 10 separate analyses.

Comments : The Mobile Radiological Analysis Laboratory should not be utilized/deployed when the analytical requirements of the project cannot be met from the data generated from the lab.

Source of Information : TechCon

PROCESS WASTES/SLUDGE

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Contaminated Land Measurements

Application : Non-intrusive

Brief Description : In-situ high resolution gamma spectrometry is used to perform large area radiological clearance surveys and plant inventory measurements. Characterization and quantification of gamma emitting nuclides are typically possible to well below UK de minimis standards (400 Bq/kg). Measurements of total dose rates from spectral determinations at less than 0.05 microSv/h are routine. By use of high resolution gamma spectrometry in large area surveys, adequate limits of detection can be confidently obtained with short count times enabling many points to be surveyed in a working day.

Company Name/POC: Nuclear Electric plc/Dr. R. Clayton

Address : Littlebrook Complex/Littlebrook Manorway/Dartford Kent DA1 5PY, UK

Phone Number : 44 1322 28 2800

Fax Number : 44 1322 28 281

Technology Maturity : Commercial use experience

Performance History : Many internal measurements on Nuclear Electric plant and site, experience in foreign plant measurements (PWRs in Spain and Belgium). Site surveys have been carried out, inter alia, at British Rail railheads and around the Trawsfynydd lake. Internal confidential reports may be made available on request.

Comments : On site supply to liquid nitrogen and electricity supply point for battery charging is required. Measurements are restricted to gamma emitting isotopes. However, the results are routinely extrapolated to non gamma-emitters by use of fingerprinting and radiochemistry techniques. Easy to use with minimal local support requirements.

Source of Information : International TechCon

CONTAMINANTS :

- ☒ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Nuclear Magnetic Resonance (NMR)

Application : Ex-situ

Brief Description : Determines the structure and type of molecules in solution based on nuclear spin of component atoms using spectrographic techniques applied at radio frequencies. Method can be very sensitive (ppm detection), mainly used on organics, suffers signal to noise problems for low concentration measurements, not all atoms have nuclear spins. Solid state NMR is possible. NMR can potentially replace wet analysis. NMR systems are being developed that could be deployed in the field to continuously monitor a small volume in a large multiphase background volume.

Company Name/POC: Oxford Instruments UK Ltd./W. Proctor

Address : Osney Mead/Oxford OX2 ODX U.K.

Phone Number : 18 6526 9500

Fax Number : 18 6526 9501

Technology Maturity : Commercial use experience

Bench scale testing, only

Performance History : NMR is well established in the laboratory (1,000 units). It is also widely used in medicine (Magnetic Resonance Imaging). The technology is under development for a range of industrial measurement situations. Oxford Instruments is developing magnet and radio frequency systems for underground operation (oil) and stand alone support of cryogenic magnets.

Comments : Technology is supported by the supplier in software to transform NMR data into concentrations of identified species. Data can be recorded as in a well logging situation. Technicians need electromechanical skills and training in general measurement techniques.

NMR scientific measurements are well established - underground measurements are not. Technology needs to be developed. Nearly all elements have isotopes that can provide a NMR signal and many organic complexes are now characterized. Signal to noise limits detection sensitivity which can make detection of species of low abundance take many hours. NMR is being developed for underground use by the oil industry to characterize fluids on the basis of proton chemistry. For field deployment, self-contained probes will be operated remotely using electronic data gathering. In concept, probe and base station operation is straightforward. Interpretation methods are being researched.

The main challenge is to deploy probes that have enough field strength to enable targeted spectrometry experiments. This requires the support of high field magnets (possible cryogenic) which it is thought could be done using new materials or compact (military) coolers. It is believed that spectrometry could be carried out in bore holes down to 100 metres using coolers or new magnetic materials, but this contention needs to be proved. Ground penetration to a depth of 2m may be possible using distributed arrays of magnets and radio frequency coils.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Sensors/Field Analysis Equipment

Technology Name : Differential DIE Away For Induced Fission Using NeuSight

Application : Non-intrusive

Brief Description : Intense pulsed neutron source for use in induced fission characterization of waste through differential DIE away technique and neutron radiography (matrix correction). Excellent pulsing characteristic with negligible DAR current and intensity at least x10 nearest alternative transportable source (D-T Tube) significantly improved detection levels due to improved signal to noise.

Company Name/POC: Oxford Instruments/Nigel Boulding

Address : Accelerator Technology Group/Osney Mead/ Oxford OX2 ODX, UK

Phone Number : 44 1865 269500

Fax Number : 44 1865 26950

Technology Maturity : Commercial use experience

Performance History : Accelerator is already a proven product in medical and nuclear applications in fixed sites.

Comments : Lower limits of detection of fissile material yet to be determined. Can be configured as a mobile source/system for use at various sites. Minimal infrastructure requirements. Delivery of system within one year. Can collaborate with Rolls-Royce and could jointly provide x-ray/neutron interrogation systems for waste drum characterization.

Source of Information : International TechCon

CONTAMINANTS:

Pesticides/Herbicides

Heavy Metals

PCB

Explosives/Propellants

■ Petroleum Hydrocarbons

■ Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

■ **Halogenated VOC**

☒ N/A

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name : Ion Mobility Spectrometry

Application :	On-site	Ex-situ

Brief Description : Real-time measurement of trace chemicals in laboratory or field (ppm to ppb and smaller).

Company Name/POC: PCP, Inc./Martin J. Cohen

Address : 2155 Indian Road/West Palm Beach, Florida 33409-3287

Phone Number : 407 683-0507

Fax Number : 407 683-0507

Technology Maturity : Commercial use experience

Performance History : Contact company for performance history.

Comments :

The instrument is designed to be operated by a skilled technician. Interpretation of data depends on the sophistication of the application. Gross contamination (>ppm) will overload the instrument; however, proper sample preparation can overcome this problem. The instrumentation can be battery operated but its operating time will depend on the life of the battery. Batteries can be rechargeable and a charger is provided with the instrument. Remote sensor (18 lbs) with gas supply (9 lbs). Need computer for readout. Computer can also be portable. Detection of trace quantities easily accomplished in the field. Identification of unknowns requires more massive equipment not readily portable. Can be used in connection with a gas chromatograph or liquid chromatograph. Available coupled to a quadrupole mass spectrometer for identification. Chemical library available.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : Sensors/Field Analysis Equipment**Technology Name :** Germanium Sonde Operation**Application :** ☐ On-site ☐ Ex-situ

Brief Description : The germanium "cryoprobe" or "cryosonde" uses a high purity Ge spectrometer cooled by a solid cryogen to make high resolution logs of gamma activity. The method is unsurpassed sensitivity and selectivity. The technology alternative is coring and lab assay.

Company Name/POC: Princeton Geophysical Services, Inc./J. Baicker**Address :** P.O. Box 900/Rocky Hill, New Jersey 08553**Phone Number :** 609 921-7061**Fax Number :** 609 921-713**Technology Maturity :** Commercial use experience

Performance History : Logged more than 100,000 feet in holes totaling more than 1.2 million feet. Clients include most uranium mining companies.

Comments : Operators are provided. Limited to gamma rays >60KeV. Logging trucks are available. No general challenges except quantitative calibration in DOE environments.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Prompt Gamma Neutron Activation Analysis (PGNAA)**Application :** In-situ (vadose zone) Ex-situ**Brief Description :** PGNAA performs a non-invasive characterization of concentration profiles of hazardous or radioactive elements; can be used in-situ in the natural environment, within isolated packages or objects, or, as appropriate, in process monitoring control. Sensitivity down to "clean" levels is generally achievable, and the technique applies throughout the periodic table. It leaves no residual radioactivity.**Company Name/POC :** Scientific Ecology Group, Inc./C.P. Keegan**Address :** 1501 Ardmore Boulevard/Pittsburgh, Pennsylvania 15221**Phone Number :** 412 247-6255**Fax Number :****Technology Maturity :** Field demo complete**Performance History :** Bench scale testing and calibration for buried uranium.
Other elements in process.
Field application with uranium-contaminated soil (in-situ).**Comments :** Limited to penetration of a few feet in packed soil for in situ environmental application (approximately 1-4 feet, depending upon contaminant sought).**Source of Information :** TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : SIGNATURE Gamma Radionuclide Detection and Analysis System

Application : On-site Ex-situ

Brief Description : Provides spectral analysis of a radioactive sample using sodium iodide scintillation detectors with greater efficiency than high purity germanium, and without complex and expensive cooling systems. Uses sophisticated digital signal processing techniques to provide measurement resolution comparable with high purity germanium at reduced cost of ownership. Original concept applied to reactor on-line fission product monitoring, further developed for environmental monitoring. Has undergone trials using blind and mixed radionuclide sources. Identification and quantification of component radionuclides has been achieved down to levels of a few becquerels. Use of sodium iodide well detector and automated sample changing will give further benefits. Suitable for initial evaluation of contamination or confirmation of satisfactory decontamination.

Company Name/POC: Siemens Environmental Systems Ltd./Dr. W.E. Croydon

Address : Sopers Lane, Poole/Dorset, BH 17 7ER/England

Phone Number : 44 1202 782648

Fax Number : 44 1202 78215

Technology Maturity : Field demo complete

Performance History : Performance Data are Available.

Trial systems monitoring reactor coolant have been installed on three UK power stations, both AGR and MAGNOX, and on other PWR nuclear plant. A 2 out of 4 voted hardware trip mode is available to shut down the reactor in the event of a significant increase of specific fission products. Typical measurements are of ~50 kBq/kg Kr-88 in a mixed power spectrum of ~50 MBq/kg N-16 and other isotopes, and agree with grab sample measurements made with a high purity germanium system to within 10 percent. A trial system for environmental monitoring has been configured to detect atmospheric contamination, suitable for the UK national RIMNET2 emergency response system. Laboratory evaluation has detected radionuclides at levels of a few Becquerels. Further improvements are under consideration.

Comments : Limited by detector characteristics, which must be designed for the particular application e.g., operating temperature, mechanical shock, weight of background radiation shielding. Flexible system which can be tailored to meet the needs of a specific application. Stand-alone or connected to network for remote operation. Challenges are in optimization of system for ease of calibration and extension to variable geometries. Discussions are underway with the Geosciences Advisory unit at Southampton University, UK with a view to combining a sodium iodide well detector and automated sample changing stage with the SIGNATURE analysis system. This would provide improved automated equipment for analysis of radionuclide contamination for either field or laboratory use, and with low cost of ownership. Alternative detector systems could be designed to address other monitoring requirements. Trials have been carried out involving the following isotopes: Eu-155, Mn-54, Ba-133, Na-22, Zn-65, Am-241, Co-60, Cs-134, Cs-137, Eu-152, Ru-106, Co-58, Co-57, Sr-85, I-131, K-40, Gd-153, Sc-46, Tb-160, Ru-103, Cd-109, Ce-139, Sn-113, Y-88, Ra-226, Pb-214, Bi-214, Kr-88, N-16, O-19, Ar-41, Ir-192, Hg-203. However, the system is not limited to available test isotopes but should detect any gamma emitting radionuclide through the use of library emission data.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Rapid Screening Field Measurements of Organic Contaminants

Application : On-site Ex-situ

Brief Description : Provide rapid screening (5-10 min/sample) and more quantitative analysis (20-30 min/sample) for EPA listed VOCs and semi-VOCs including explosives. Conducted studies with Argonne National Laboratory, EPA (EMSL-Las Vegas) RSKERL - Ada; ERL - Narragansette Region 1) Tenneco, Navy and Army.

Company Name/POC: SiteWorks, Inc./Dr. L. John Hoover

Address : Suite 363/11160-F South Lakes Drive/Reston, Virginia 22091

Phone Number : 703 385-1549 **Fax Number :** 703 385-3658

Technology Maturity : Commercial use experience

Performance History : Performance Data are Available.

Tufts University/Site Works
Argonne National Laboratory; Candace Rose; Dr. Jacqueline Burton 1-708-252-8795
Currently providing service in support of VOC analysis

Army/2 months Fort Devens
Navy/3 weeks San Diego Harbor
Tenneco/1 month pipeline
4 EPA projects

Comments : Sample throughput dependent on sample matrix TDGC/MS. Analysis of full range of EPA listed organics reduces sample throughput; nonetheless, 2 times faster than fixed laboratory. Can have instruments ready for operation in 4 hrs including calibration. Personnel and mobile unit available to provide service immediately. Can analyze soil gas, direct and extracted soil, air and aqueous media.

3 publications have appeared in the peer-reviewed journals Analytical Chemistry and Journal of Chromatography. Conducted successful field validation studies with EPA, DOE, Army, Navy and private sector documenting data quality and cost/benefit.

Source of Information : TechCon

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☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : BioTector - On-line Analyser for Total Organic Carbon

Application : On-site Ex-situ

Brief Description : TOC analysers especially designed to perform reliably in industrial on-line applications. No filtration required. Long term stable operation experienced. No interference from chloride.

Company Name/POC: Skinstrument A/S Pollution Control/Tor Anders Petteroe

Address : Trykkeriveien 8/N-1653 Sellebark/Norway

Phone Number : 47 69 36 32 90

Fax Number : 47 69 36 32 9

Technology Maturity : Commercial use experience

Performance History : First prototype developed in 1990, and tested in pulp and paper water in Temiscamin, Canada among other places. The instrument had too long response time, and too many component errors. New oxidation method was developed together with a team of German and French scientists, and the current version of the Bio Tector was launched in 1993/94. Approximately 50 units are installed in various applications, mainly industrial effluent. Main application is control of water going into the biological treatment plants in industries to control the addition of nutrients. Best reference will be Mr. Hans Dufva, Instrumental Engineer, and responsible for the purchase, installation and operation of the Bio Tector at the chemical plant AKZO NOBEL, Stenungssund, Sweden. He has analytical experience and a high request for quality in his own and other's work and equipment.

Comments : Sample must be available, or made available max. 3 meters below the analyser. Oxygen flask with reduction valve must be present. A room free from direct sunlight or direct rain must be available. Max. ambient temp 35 degrees centigrade. Temp. must be above freezing point. The Bio Tector has not been installed in clean water installations, and below 3-4 mg-C/L the accuracy is not documented. Can be used as a stand alone piece of equipment. Included in the analyser is a system for data collection and presentation that stores all data for one year, and can present these on screen, paper or diskette. The Bio Tector TOC analyser is made of high quality components and materials. All cabinets are made of stainless steel. Unlike most TOC analysers, the built-in CO2 detector is a non drifting device. To avoid variations in the gas flow through the system a computer controlled mass flow controller is implemented instead of the manual rotameter used in most TOC analysers. All operations are made by step by step menus presented on a touch screen.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides☒ Heavy Metals☐ PCB☐ Explosives/Propellants☒ Petroleum Hydrocarbons☐ Radionuclides☒ SVOC☐ Other Contaminant☒ Nonhalogenated VOC☒ Halogenated VOC☐ N/A**TECHNOLOGY TYPE :** *Sensors/Field Analysis Equipment***Technology Name :** Mapping of Soil/Groundwater Pollution**Application :** On-site Ex-situ**Brief Description :** Mobile laboratory.**Company Name/POC:** Steins Laboratorium A/S/Viggo Larsen**Address :** Olof Palmes Alle 13a/8200 Aarhus N/Denmark**Phone Number :** 45 86 10 80 70**Fax Number :** 45 86 10 88 89**Technology Maturity :** Commercial use experience**Performance History :** During the last 5 years Steins Laboratory has analyzed 4,000 samples for organic and inorganic elements and compounds. The mobile laboratory has been fully operational for 150 working hours during the last 2 years.**Comments :** Easy to move and transport. Flexible 24-hour operation.**Source of Information :** International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☐ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Ion Trap Mass Spectrometer

Application : On-site Ex-situ

Brief Description : The Teledyne MEC (TMEC) Ion Trap Mass Spectrometer is one of the most sensitive mass spectrometers of its size in the world. It is designed to be transportable, rugged, and automated to minimize operator intervention. It is ideal for field evaluation of toxic contaminants. The TMEC Ion Trap Mass Spectrometer will permit field measurements of environmental contaminants in lieu of laboratory analysis.

Company Name/POC: Teledyne MEC/Mort Cohen

Address : 1274 Terra Bella Ave./P.O. Box 7244/Mountain View, California 94039-7244

Phone Number : 415 962-6989

Fax Number : 415 967-435

Technology Maturity : Field demo complete

Performance History : Field evaluations of the TMEC Ion Trap Mass Spectrometer are underway by the U.S. Army for military applications to detect chemical and biological toxins. Initial evaluation are positive. Point of contact is Dave Sickenberger, U.S. Army Chemical Research, Development, Engineering Center, (410) 671-5533.

Comments : Instrument is designed for direct sampling, or GC/LC input. The mass range is approximately 20 to 2,000 amu. It is highly sensitive (parts per billion to parts per trillion) and is excellent in isolating coeluting compounds in complex mixtures. It can be used for field evaluation, laboratory analysis, or fence post monitoring applications. The TMEC instrument is designed for ease of use. It can be powered by AC or DC (battery). It can be configured to operate with a PC-based data system, or as a stand alone device with display and data printout. The system is highly automated to minimize operator intervention, and can be easily configured for direct sampling or interface with gas or liquid chromatograph. There are no infrastructure considerations other than availability of prime power (about 1 KW). The TMEC ion trap mass spectrometer was specifically designed for field evaluation applications to measure very low levels of toxic contaminants. The original instrument was developed for the U.S. Army for military applications and to measure chemical and biological contaminants in the field. Approximately \$13M have been allocated for the R&D of this instrument. Initial field evaluations of the demonstration units are currently underway. Teledyne MEC is also developing, under an internal R&D program, an ion trap instrument for commercial applications related to real-time measurement of environmental contaminants. Initial demo units will be available by mid-1993. TMEC has filed for 8 patents on its ion trap technology, two of which have been allowed and will soon be issued. The other 6 filings are still under review by the U.S. Patent Office.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☒ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : X-Ray Fluorescence

Application : On-site Ex-situ

Brief Description : A quick, on-site determination of elemental inorganic contaminants in soils or other matrices. The results are qualitative and quantitative. Detection limits range from 5 to 90 parts per million. There are two instruments: one portable (Spectrace 9000), one transportable (Spectrace 6000). These instruments can handle samples of soil, sludge, powders, liquids, solids, or dust. Elements analyzed range from sodium to uranium on the periodic table.

Company Name/POC: TN Technologies/Spectrace Instruments/Rick Booth

Address : 2555 N. Interstate 35/Round Rock, Texas 78664

Phone Number : 512 388-9100

Fax Number : 512 388-9200

Technology Maturity : Commercial use experience

Performance History : EPA's Environmental Response Team

Many Jobs
Contact: Mark Bernick
Roy F. Weston
(908) 225-3990

Wright Patterson AFB
Clean Up
Contact: Mike Radi
Engineering Sciences
(615) 481-0451

Comments : Limitations of this technology include:

Inhomogeneous samples affect results.
Spectrace 9000 requires ambient air temperature not exceed 120 degrees Fahrenheit and 105 degree Fahrenheit for storage.
Spectrace 6000 must have AC power.

Weighing just 19 lbs, Spectrace 9000 is battery-operated with a field pack; this system accommodates almost any environment. The system does not require liquid nitrogen and yet provides very high resolution. The software interface and fundamental parameter analysis technique results in operator ease-of-use that is unparalleled. Spectrace 6000 can be installed in a mobile lab and provides laboratory SRF resolution and results on-site. Spectrace 6000 also has fundamental parameter software and menu driven user interfaces. The only challenge, in terms of field screening, is the required action levels for certain contaminants which may be lower than this technology can accommodate.

Source of Information : TechCon

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name: Chlorinated Hydrocarbon Monitor

Application: On-site Ex-situ

Brief Description: This unique rare-earth sensor detects and measures contaminants such as carbon tetrachloride, trichloroethylene, perchloroethylene, dichloromethane, and other chlorinated solvents commonly used in nuclear weapons production. The sensor has no interference from methane, gasoline, paint thinner, and other non-chlorinated compounds.

Company Name/POC: TRANSDUCER RESEARCH, INC./William J. Buttner

Address: 600 N. Commons Dr./Suite 117/Aurora, Illinois 60504

Phone Number: 708 978-8802

Fax Number: 708 978-885

Technology Maturity: Commercial use experience

Performance History: DOE - Hanford/Site Characterization/Cary Martin/Westinghouse 509 376-2648
 DOE - Hanford/Carbon Tetrachloride Removal (Vacuum Extraction Process)/Randy Coffman/Westinghouse/509 376-4263
 DOE - Hanford/Safety, Extraction Well Drilling/Tom Lazarski/Kaiser Engineering/509 373-4791
 Eastman - Kodak/Wastewater Treatment (Dichloropropane, Dichloromethane)/Tom Walton/Eastman
 Kodak/716 477-1633

Comments: This instrument detects and measures chlorinated hydrocarbon vapors only. It does not speciate (responds to all chlorinated hydrocarbons). It requires vapor dilution for concentrations above 50 ppm. Model MP-1 Gas Diluter is available from Transducer Research as separate product. Sensor life is inversely proportional to exposure concentration and exposure time. Model 2001-05 is currently being used for site characterization, safety monitoring, and clean-up process applications. Transducer Research is currently improving sensor performance through automatic dilution and pre-concentration modules. Real-time monitoring capability permits quick analysis of contamination situation. Instrument is less expensive to purchase, operate, and maintain than alternate technologies. Real-time measurement allows determination whether work can be continued. Unit can be used to monitor changes in safety conditions. Selective measurement of chlorinated solvents simplifies operating procedures and speeds up the decision process.

Source of Information: TechCon

CONTAMINANTS :

- ☒ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Gas Chromatograph/Mass Spectrometer (Field GC/MS)**Application :** On-site Ex-situ

Brief Description : Transportable GC/MS used to detect and identify complex mixtures of environmental pollutants and toxic substances in trace amounts. Based on Hewlett-Packard's 5971A mass selective detector, Viking's field GC/MS uses miniaturized components to achieve laboratory-grade results on-site in real-time. Features of the instrument include: a heated membrane separator made from dimethyl silicone for air sampling, internal cryofocusing options for analysis of light volatiles, and high-temperature ramping for analysis of semi-volatiles with higher boiling points. Field GC/MS analysis shortcuts the current process of collecting environmental samples, sending them to a lab for analysis, and waiting weeks for results.

Company Name/POC: Viking Instruments Corporation/Thomas J. Kuehn**Address :** 3800 Concord Parkway/Suite 1500/Chantilly, Virginia 22021**Phone Number :** 703 758-9339**Fax Number :** 703 968-0101**Technology Maturity :** Commercial use experience

Performance History : Viking's GC/MS has been field-proven by a number of large industrial firms and government agencies, including Tennessee Eastman, Martin Marietta, the EPA, the FBI, and the U.S. Army, for a variety of applications. The DOE, in conjunction with Sandia National Labs, uses the instrument for emergency response and on-site testing. Steve Thornberg is Viking's reference contact within the DOE (505) 846-8829.

Comments : Use of the instrument requires an operator who is skilled as a lab or field chemical technician and has completed Viking's Field GC/MS Introductory Training Course. The field GC/MS has many unique features designed into the system specifically to provide for flexibility and ease of use. Its rugged transport case, for example, permits operation in virtually any location that is accessible by jeep or plane. Once at a site, the field GC/MS can be unpacked and operational in about 15 minutes. The instrument also offers a number of sample inlet options for air, water, and soil gas and a user-friendly, Windows-based operating system. Finally, service contracts and telephone support are available with every instrument.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Laboratory Analysis*

Technology Name : Microwave Sample Digestion

Application : On-site
Off-site

Brief Description : The CEM Microwave Sample Preparation System, MDS-2000 series, combines the speed of microwave heating with proprietary sealed vessel technology to significantly reduce the sample preparation (acid digestion) process time. For environmental samples, the process time is reduced by a factor of 8-10. In addition to time savings, the technology provides performance (measure by elemental analysis), safety and cost advantages over traditional hot plate techniques.

Company Name/POC: CEM Corporation/Gregory N. LeBlanc

Address : 3100 Smith Farm Rd./P.O. Box 200/Matthews, N.C. 28105-200

Phone Number : 800 726-3331

Fax Number : 704 821-789

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

There are over 3000 Microwave Sample Preparation Systems in use worldwide. The systems are typically used for acid digestion of a variety of matrices for subsequent elemental analysis. It cuts across all industries. Its widest use is for environmental applications. It has proven highly successful as measured by its acceptance in the worldwide marketplace.

Comments : Skills associated with a chemical laboratory are all that is required to operate the system. Training can be completed in <2 hours. Complete procedures are supplied with the purchase of the instrument. The system can be set up and running within 1 hour of removal from the shipping box. It can be used in a mobile lab and a standard laboratory. The system operates on 115 vac. (No special requirements). It is applicable to a wide variety of sample types encountered in remediation efforts. A fume hood is not required.

Source of Information : TechCon

CONTAMINANTS :

- ☒ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Laboratory Analysis***Technology Name :** High Speed Capillary Column for GC**Application :** Off-site

Brief Description : Capillary column strategies for high-speed gas chromatography are techniques which are used to increase the performance or resolution of a high-speed separation as overall resolution is decreased as compared to conventional gas chromatography. Techniques include serial coupled columns which can shift unresolved pairs of peaks into open areas of a chromatogram, and high-speed column switching, which employs high-speed hardware used for multidimensional techniques. The techniques perform with a good level of precision and accuracy as they all incorporate high speed components.

Company Name/POC: Chromatofast, Inc./Robin Risser**Address :** 912 N. Main Street, Suite 14/Ann Arbor, Michigan 48104**Phone Number :** 313 662-3410**Fax Number :** 313 662-3462**Technology Maturity :**

Bench scale testing, only

Performance History : The Column Strategies technology has been utilized through a development contract from private industry for a speciation instrument to analyze automotive exhaust gases and in a fast, direct non-methane hydrocarbon analyzer development contract from a State of Michigan grant for automotive exhaust analysis. The speciation project was a 1 year contract providing \$525,000 of funds and the non-methane hydrocarbon project was a year contract providing \$75,000 of funds. A mid-point backflush procedure has been developed which reduces the cycle time of the instrument by a factor of 2.

Comments : The device, when combined with equipment for high-speed gas chromatography will require a single technician with familiarity in using a conventional gas chromatograph. The majority of the operation is automated.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Laboratory Analysis

Technology Name : Intact Subsurface Block Technology

Application : On-site Ex-situ
Off-site

Brief Description : ISB technology is a testing apparatus which enables in situ remediation techniques to be realistically tested at the laboratory scale. Over the last 4 years the company has performed between 20 - 40 experiments for clients to examine the fate and mobility of contaminants. Surpasses small-scale laboratory testing. Can replace (or supplement) field-scale testing of proposed remediation strategies.

Company Name/POC: Danish Geotechnical Institute/Rachel O'Brien

Address : Maglebjergvej 1/DK-2800 Lyngby, Denmark

Phone Number : 0045 4588 4444

Fax Number : 0045 4588 124

Technology Maturity : Commercial use experience

Performance History : Have been awarded more than 10 contracts involving ISB technology with the Danish EPA, the Strategic Environmental Research Programs, the Danish Technical University, the Danish Geological Survey and the University of Waterloo (Canada).

Comments : Current design allows for fully saturated groundwater conditions or "field capacity" saturation. Cannot systematically desaturate a sample yet. Very simple to operate. There is almost no limit to the types of testing that can be performed with the cell. Although ISM was conceived of for use in glacial deposits, any natural or man-made sediment can be tested. Consolidated rock (or a synthetic material) can also be installed in the cell. Sludge or tailings can also be installed in the cell for leaching or decontamination tests.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Laboratory Analysis*

Technology Name : On-Line Microwave Digestion

Application : Ex-situ

Brief Description : Continuous preparation of samples for analysis by AA, Fluorescence ICP, ICP-MS. Ideal for "Hot" samples. Replaces batch systems and robotics which are labor intensive and cumbersome.

Company Name/POC: Questron Corporation/Angelo Grillo

Address : 4044 Quakerbridge, RD./Mercerville, New Jersey 08619

Phone Number : 609 587-6898 **Fax Number :** 609 587-0513

Technology Maturity : Bench scale testing, only

Performance History : Technology is presently at the stage where beta site units will be manufactured. A DOE site would be ideal for such an evaluation.

Comments : The system can operate at high pressure, and high temperature. It would be applicable for all but some high-temperature refractory materials. Analysis has reached a high degree of automation. Sample preparation is still relatively tedious. This system would allow the sample preparation to match the speed and degree of automation of the analyzer. All of the developmental work has been completed. The remaining challenges deal with actual speed in a real environment, range of applicable samples, reliability in an adverse environment, and applicability to use in a mobile lab. This product is being developed for the Canadian Ministry of Environment by Questron with the assistance of Dr. F. Salin's group at the Chemistry Department of McGill University.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : Laboratory Analysis**Technology Name :** Ion Trap Mass Spectrometer**Application :** On-site Ex-situ

Brief Description : The Teledyne MEC (TMEC) Ion Trap Mass Spectrometer is one of the most sensitive mass spectrometers of its size in the world. It is designed to be transportable, rugged, and automated to minimize operator intervention. It is ideal for field evaluation of toxic contaminants. The TMEC Ion Trap Mass Spectrometer will permit field measurements of environmental contaminants in lieu of laboratory analysis.

Company Name/POC: Teledyne MEC/Mort Cohen**Address :** 1274 Terra Bella Ave./P.O. Box 7244/Mountain View, California 94039-7244**Phone Number :** 415 962-6989**Fax Number :** 415 967-435**Technology Maturity :** Field demo complete

Performance History : Field evaluations of the TMEC Ion Trap Mass Spectrometer are underway by the U.S. Army for military applications to detect chemical and biological toxins. Initial evaluation are positive. Point of contact is Dave Sickenberger, U.S. Army Chemical Research, Development, Engineering Center, (410) 671-5533.

Comments : Instrument is designed for direct sampling, or GC/LC input. The mass range is approximately 20 to 2,000 amu. It is highly sensitive (parts per billion to parts per trillion) and is excellent in isolating coeluting compounds in complex mixtures. It can be used for field evaluation, laboratory analysis, or fence post monitoring applications. The TMEC instrument is designed for ease of use. It can be powered by AC or DC (battery). It can be configured to operate with a PC-based data system, or as a stand alone device with display and data printout. The system is highly automated to minimize operator intervention, and can be easily configured for direct sampling or interface with gas or liquid chromatograph. There are no infrastructure considerations other than availability of prime power (about 1 KW). The TMEC ion trap mass spectrometer was specifically designed for field evaluation applications to measure very low levels of toxic contaminants. The original instrument was developed for the U.S. Army for military applications and to measure chemical and biological contaminants in the field. Approximately \$13M have been allocated for the R&D of this instrument. Initial field evaluations of the demonstration units are currently underway. Teledyne MEC is also developing, under an internal R&D program, an ion trap instrument for commercial applications related to real-time measurement of environmental contaminants. Initial demo units will be available by mid-1993. TMEC has filed for 8 patents on its ion trap technology, two of which have been allowed and will soon be issued. The other 6 filings are still under review by the U.S. Patent Office.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Laboratory Analysis***Technology Name :** Accelerator Mass Spectroscopy (AMS)**Application :** On-site Ex-situ
Off-site**Brief Description :** This instrument measures the relative abundance of carbon 14/12, Iodine 129/122, etc. to better than 1 part in 1E15.**Company Name/POC:** Triumph/Phillip Gardner**Address :** 4004 Wesbrook Mall/Vancouver, B.C, Canada, V6T 2A3**Phone Number :** 604 222-1047**Fax Number :** 604 222-1074**Technology Maturity :** Commercial use experience**Performance History :** AMS is a well known analytical technique worldwide - J.Vogel, L.L.B.L., CA, USA - E. Litherland, U. Toronto, Ont., Canada**Comments :** AMS is only appropriate for elements that make negative ions only. Positive ions must be done in conventional E-M mass spec.**Source of Information :** International TechCon

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Decision Support Tools***Technology Name:** Site Planner**Application:** Other Application**Brief Description:** Workstation-based software for decision support in site assessment and remediation. Site Planner replaces slow, low-productivity manual data management and visualization techniques and point solution software systems.**Company Name/POC:** ConSolve Inc./David Barber**Address:** 70 Westview St./Lexington, MA 02173**Phone Number:** 508 358-8061**Fax Number:** 508 358 806**Technology Maturity:** Commercial use experience**Performance History:** Site Planner is currently deployed on about 20 projects including use by four DOE laboratories.**Comments:** Two days on-site training required. Limited by normal computer hardware limitations. System runs on stand-alone Unix workstations.**Source of Information:** TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Decision Support Tools*

Technology Name : Environmental Knowledge base (EXPERT)

Application : Other Application

Brief Description : A user-friendly windows database of equipment suppliers and contacts inclusive and accessed via a clear hierarchical structure of technologies with on-line help for each technology category. Currently contains 1869 modules of effluent treatment equipment available under 71 categories. "Shell" is appropriate for containing clean up technology information as generated in Technology Search Program.

Company Name/POC: E.A. Technology Ltd./A. Tyson

Address : Capenhurst/Chester/CH16ES England

Phone Number : 151 347 2400

Fax Number : 151 347 2138

Technology Maturity : Commercial use experience

Performance History : In use by UK electricity companies to aid the distribution of environmental advice to industry.

Comments : Requires input of data relevant to environmental program specifics. Easily useable by any microsoft windows users. The information systems comprise X-Spurt, a computer system providing general information on effluent treatment techniques and equipment. The Environmental Knowledge Base (EKB), a database complementing X-Spurt with more detailed equipment information. X-Spurt asks relevant questions, defines existing practice and problems, generates summary reports; presents numerous screens of pertinent expert knowledge on relevant science and technology; suggests solutions, courses of action, technologies, or sources of advice. EKB contains details of 401 suppliers, 1869 'models' of 71 types of equipment, 3290 equipment 'attribute' values give detail on 974 of the models, there are 223 different topics in the 'Help' system, all indexed and interlinked as a hypertext system. This 'Environmental Knowledge Base' project is building and maintaining a database of facts, figures, energy consumption, costs, information in general, on the specifics of environmental technologies and the suppliers of those technologies. It collates the fragmentary information on treatment equipment and makes it readily available.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Decision Support Tools*

Technology Name : Environmental Knowledge base (EXPERT)

Application : Other Application

Brief Description : A user-friendly windows database of equipment suppliers and contacts inclusive and accessed via a clear hierarchical structure of technologies with on-line help for each technology category. Currently contains 1869 modules of effluent treatment equipment available under 71 categories. "Shell" is appropriate for containing clean up technology information as generated in Technology Search Program.

Company Name/POC: E.A. Technology Ltd./A. Tyson

Address : Capenhurst/Chester/CH16ES England

Phone Number : 151 347 2400

Fax Number : 151 347 213

Technology Maturity : Commercial use experience

Performance History : In use by UK electricity companies to aid the distribution of environmental advice to industry.

Comments : Requires input of data relevant to environmental program specifics. Easily useable by any microsoft windows users. The information systems comprise X-Spurt, a computer system providing general information on effluent treatment techniques and equipment. The Environmental Knowledge Base (EKB), a database complementing X-Spurt with more detailed equipment information. X-Spurt asks relevant questions, defines existing practice and problems, generates summary report; presents numerous screens of pertinent expert knowledge on relevant science and technology; suggests solutions, courses of action, technologies, or sources of advice. EKB contains details of 401 suppliers, 1869 'models' of 71 types of equipment, 3290 equipment 'attribute' values give detail on 974 of the models, there are 223 different topics in the 'Help' system, all indexed and interlinked as a hypertext system. This 'Environmental Knowledge Base' project is building and maintaining a database of facts, figures, energy consumption, costs, information in general, on the specifics of environmental technologies and the suppliers of those technologies. It collates the fragmentary information on treatment equipment and make it readily available.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☒ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Decision Support Tools***Technology Name :** Radwaste Cementation and Process Control**Application :** On-site Ex-situ
Off-site**Brief Description :** The quality of cemented waste has to be proven. Process control is preferable to end control. The advantage of process control is that during operation the system can be improved. Various on-line measuring techniques have been developed to check the mechanical, chemical and radiological properties during the cementation process.**Company Name/POC:** KEMA Nederland B.V./H.A.W. Cornelissen**Address :** P.O. Box 9035, NL-6800 ET/ARNHEM, The Netherlands**Phone Number :** 31 26 356 6104**Fax Number :** 31 26 351 5835**Technology Maturity :** Field demo complete**Performance History :** During a four year European project, measurement techniques and procedures were developed and validated at a radwaste campaign at a BWR power plant.**Comments :** None.**Source of Information :** International TechCon

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BY THE FOLLOWING DATE AND BY THE FOLLOWING AUTHORITY

Sediments in Surface Water

Characterization

Sediments in Surface Water

Characterization

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Physical Sampling*

Technology Name : Groundwater/Sludge Borehole Pumps

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Draws water/sludge for analysis, at variable, pre-determined rates, including abrasive solids/contaminants, & various temperatures. Ability to overcome system deficiencies, and specificalton to handle overout liquids.

Company Name/POC: H2O Waste-Tec/Mr. I. Hallows

Address : Horsfield Way,Bredbury Industrial Park/Stockport, SK6 2SU UK

Phone Number : 0161 406 7111

Fax Number : 0161 406 7222

Technology Maturity : Commercial use experience

Performance History : 1000's of unit installed worldwide for water, sludge abstraction.

Comments : 3,000m borehole depth; 100 degrees C temperature; sludges above 10% dissolved solids. H2O Waste-Tec water is a major part of the Dresser Group with US wide commitment to product support throughout USA.

Source of Information : International TechCon

CONTAMINANTS :	☐ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants
	☐ Petroleum Hydrocarbons	☒ Radionuclides	☐ SVOC	☐ Other Contaminant
	☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Energy Dispersive X-Ray Fluoresance - Thin Film

Application : On-site

Brief Description : The EDXRF does lab quality elemental analysis (Na to Pu) using proprietary technology that can meet EPA minimum detection requirements in near realtime; low ppb analysis of trace elements in solutions, low ppm for soils/solids (sub ppm with digestions) for an exceptional range of "total unknown" sample types (soils, ores, wastes, water, etc.) and concentrations (ppm to wt percent for solids). All done in one instrument with no prior knowledge of sample.

Company Name/POC: Advanced Analytical Products & Services/Jim Wrigley

Address : 1753 Cape Aston Court/San Jose, California 95133-1128

Phone Number : 408 926-4057 **Fax Number :** 408 926-405

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Small jobs mainly (10 to 50 samples). Exceptionally low detection levels and very good corroboration where available; customers report accuracy is better than CLP. References: Dr. Paul LaMothe, U.S. Geol. Survey 415 329 5258; Mrs. BiShia King, U.S. Geol. Survey 415 329 5288; Dr. Bill Walker, Walsh Associates 916 737 7240; Mr. Bill Cole, Lockheed Eng. Svc. 702 897 3226; Mr. Eric Lindgren, Sandia Nat. Lab 505 844 3820.

Comments : Sample prep is simple for solutions and soil/solid samples. Soils must be dried and ground (to about 300 mesh), then prepared as a thin film. The skill needed for EDXRF-spectroscopy is quite high. Therefore, the company is offering a service, not an instrument. Later they will develop an "expert system" to overcome this. Detects elements Na to Pu, but not H to F. Doesn't determine compounds. With digestions, can do some speciation (e.g., soluble chromates Cr+6 distinguished from total chrome) and get excellent results (.3-.5 ppm). Mobile, not portable. Two person team recommended for field operations, but can be done with one. The cost reduction implications for field operations are quite significant.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☒ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Sediment Probe

Application : In-situ (saturated zone)

Brief Description : The technology is a rugged compact probe that can locate areas where groundwater enters surface waters. The instrument is designed to be dragged behind a boat along the bottom sediment, the probe can detect: the variation in sediment temperature (plus/minus 0.2 degrees C); the temperature difference between sediment and overlying water; and the electrical conductivity of the sediment. It is the only instrument of its type for real-time monitoring. This method covers a large area quickly and cost effectively. It is meant to be a compliment to other technologies.

Company Name/POC: AECL Research/C. A. McDowall

Address : Whiteshell Laboratories/ Pinawa Manitoba, Canada R0E 1L0

Phone Number : 204 753-2311

Fax Number : 204 753-2922

Technology Maturity : Field demo complete

Performance History : (1) Performed a survey in the St. Mary's River, Ontario, for a government department, in order to identify areas with significantly increased electrical conductance (revealing contamination from discharges from a nearby metal operations). (2) Located sources of groundwater upwelling at a site of creosote contamination in Puget Sound, Washington State, for an environmental agency. (3) Located a source of alkaline groundwater in a Wisconsin lake used for acid rain studies, for a government department. (4) Performed a preliminary study of offshore gamma activity. (5) Located freshwater discharges to the sea off the coast of the U.S.A. and Northern Europe. References will be provided upon request.

Comments : Experienced hydrogeologists with skilled technical staff are required to use the probe. Familiarity with field based data logging systems and locating devices (triangulation systems) is essential. Limitations of the technology include: unseen obstacles in the water, ice, and water depth. Trained operators knowledgeable in field instrumentation would find the probe easy to use. Operator concern for safety considerations and site specific parameters, such as current and subsurface terrain, must be considered. Continuous monitoring while dragging the instrument behind a boat provides real-time readout. The instrument reduces the number of cores necessary as it identifies the area of possible contamination without coring. This in turn reduces the number of analysis that need to be performed. Locates all gamma emitting contaminants. The instrument locates all groundwater upwelling (which may contain contaminants into surface water). A minimum of 2 plus a surveyor to operate the positioning system.

Source of Information : International TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Mobile Laboratory for Chemical Weapons, Explosives and Propellants

Application : On-site Ex-situ

Brief Description : Mobile laboratory with all necessary chemical and physical equipment to detect and analyze chemical weapons, explosives, propellants and other toxic materials.

Company Name/POC: Alba Industrie Umweltschutz Service GmbH/Dr. K. Faber

Address : Rehrhoferweg 160/D29625 Munster/Germany

Phone Number : 051 92 96 3212

Fax Number : 051 92 96 3311

Technology Maturity : Commercial use experience

Performance History : In use for two years, e.g., in Russia and also in Germany.

Comments : None.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☒ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☒ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Monitoring of Chemical Weapons in Soil, Water, Air, Buildings

Application : On-site Ex-situ

Brief Description : Monitors all relevant parameters, like concentrations of chemical weapons in air, soil, water, and buildings.

Company Name/POC: Alba Industrie Umweltschutz Service GmbH/Dr. K. Faber

Address : Rehrhoferweg 160/D29625 Munster/Germany

Phone Number : 051 92 96 3212

Fax Number : 051 92 96 3311

Technology Maturity : Commercial use experience

Performance History : Refer to POC for performance history.

Comments : None.

Source of Information : International TechCon

CONTAMINANTS :	☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
	☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
	☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Fourier Transform Infrared Photoacoustic Spectrometry of Solids

Application : On-site Ex-situ
 Off-site

Brief Description : The FTIR unit identifies volatile organic compounds in vapor and liquid. It also has the potential for use in sampling vapor and liquid contained in soil. Modulating infrared light passes through the sample chamber where it is selectively absorbed by the vapor sample. Components in the vapor selectively absorb the light and an acoustic signal is produced that is proportional to the concentration in the sample. The detection limits for organic compounds are 0.1 ppm to 10 ppm.

Company Name/POC: Ames Laboratory/US DOE/John McClellan

Address : Iowa State University/Ames, IA 50011-3020

Phone Number : 515 294-7948 **Fax Number :** 515 294-474

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Comments : FTIR-PAS can analyze for any molecular or polyatomic component, such as organic solvents and polyatomic ions. Our most recent work has been on the measurement of nitrate, ferrocyanide and similar ions in tank sludges. FTIR-PAS has been used extensively for the analysis of various manufactured materials, but its application to environmental tasks is new. The technology group is presently involved in applying FTIR-PAS to waste-tank sludges (Reference: Dr. T. Rebagay, Westinghouse Hanford Co., 509 373-3174). For a recent broad discussion see "A Practical Guide to FT-IR Photoacoustic Spectroscopy" by J. McClelland, et al., in Practical Sampling Techniques for Infrared Analysis, P. B. Coleman, editor.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Mobile Environmental Mass Spectrometer

Application : On-site

Brief Description : The Mobile Environmental Mass Spectrometer (MEM) is a fully developed electron impact ionization quadrupole Mass Spectrometer designed specifically to be rugged and flexible for on-site analysis of organic compounds. It is tolerant to extreme changes of environmental conditions allowing for a wide range of Data Quality Objectives to be completed. This all-in-one system simplifies sample preparation techniques yielding rapid qualitative and quantitative results on a real-time basis with field uptime better than 95 percent.

Company Name/POC: Bruker Instruments, Inc./J. Wronka

Address : 19 Fortune Drive/Manning Park/Billerica, MA 01821

Phone Number : 508 667-9580

Fax Number : 508 667-5993

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

The MEM is successfully being used by the U.S. Army, state agencies, fire brigades, and environmental management firms for a wide variety of applications which include emergency response, site screening and assessment, and clean up monitoring of air, water and soil samples. References: U.S. Army CRDEC, D. Durst, (410) 671 2129; Del State DNREC, J. Rogers, (302) 323 4542; Env. Res Mngmt, D. Gallis, (215) 524 3786; SiteWorks, Inc., Albert J. Robbat, Jr., (617) 627 3474.

Comments :

The MEM is designed for simple operation. A one-week training course covering instrument operation, hardware components, and methodologies will enable personnel to successfully complete analytical measurements. Automatic routines simplify operation, and an internal diagnostic routine continuously monitors instrument performance and warns the operator of potential problems with calibration, temperature, power, and electronic malfunctions. Data interpretation requires some knowledge in mass spectroscopy to determine data integrity. The technology for characterizing environmental pollutants on-site is fully developed and readily available. The problem which exists is convincing people that, when implemented properly, the rapid generation of data which field analysis provides results in a dramatic savings of time and cost in comparison to conventional techniques of chemical detection.

Source of Information : TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Microwave Sample Digestion

Application :

On-site

Off-site

Brief Description : The CEM Microwave Sample Preparation System, MDS-2000 series, combines the speed of microwave heating with proprietary sealed vessel technology to significantly reduce the sample preparation (acid digestion) process time. For environmental samples, the process time is reduced by a factor of 8-10. In addition to time savings, the technology provides performance (measure by elemental analysis), safety and cost advantages over traditional hot plate techniques.

Company Name/POC: CEM Corporation/Gregory N. LeBlanc

Address : 3100 Smith Farm Rd./P.O. Box 200/Matthews, N.C. 28105-2001

Phone Number : 800 726-3331

Fax Number : 704 821-789

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Comments :

There are over 3000 Microwave Sample Preparation Systems in use worldwide. The systems are typically used for acid digestion of a variety of matrices for subsequent elemental analysis. It cuts across all industries. Its widest use is for environmental applications. It has proven highly successful as measured by its acceptance in the worldwide marketplace.

Skills associated with a chemical laboratory are all that is required to operate the system. Training can be completed in <2 hours. Complete procedures are supplied with the purchase of the instrument. The system can be set up and running within 1 hour of removal from the shipping box. It can be used in a mobile lab and a standard laboratory. The system operates on 115 vac. (No special requirements). It is applicable to a wide variety of sample types encountered in remediation efforts. A fume hood is not required.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Toxicity & Genotoxicity Screening

Application : On-site Ex-situ

Brief Description : Company manufactures and sells a range of field testing kits for the screening of environmental samples (water, soil, sediment, sludges, etc.) for both acute toxicity, and genotoxicity and mutagenicity. Technology uses genetically engineered strains of bacteria to produce distinct color changes in the media being tested to determine biological effect endpoints.

Company Name/POC: Environmental Biodection Products Inc./Dr. Ran Lifshitz

Address : 14 Abacus Road/Brampton, Ontario, Canada L6T 5B7

Phone Number : 905 794-2325

Fax Number : 905 794-2338

Technology Maturity : Commercial use experience

Performance History : Performance Data are Available.

Comments :

1. Survey of contaminated sediments and sludges around the Great Lakes basin. High correlation with much more costly comparable technologies. Contact: Dr. Barney Dutka, Canada Centre for Inland Waters, Environment Canada (905-336-4923; Fax 905-336-4989).
2. Survey of Rhine and Oder Rivers and North Sea sediments. Very favorable comparison with much more expensive and complex research technologies. Contact: Dr. Peter Hansen, Professor, Ecotoxicology, Technical University of Berlin (011-49-30-31421586; Fax 011-49-30-838113).

Full instructions provided with products. One-half day of practice for technologist is useful to become familiar with tests. Method details vary with parameter being measured. General procedure involves: (1) rehydration of freeze-dried bacteria; (2) placing the rehydrated testing bacteria into contact with a slurry of the material to be tested and allowing the mixture to incubate for one to two hours; and (3) reacting the bacterial test mixture with a chromogenic substrate and recording a color change as the biological effect endpoint. Tests have been designed to be easy to use. Quality control is done to a high degree in manufacturing, leaving little chance for variability in use resulting in a high degree of reproducibility. Tests are highly flexible for use in all types of test slurries and waters. A small (~\$300.00) 120V or 12V incubator is required for several tests. All consumable items come in the test kit. Kits are couriered to the site within two weeks of receipt of a purchase order.

Source of Information : International TechCon

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name: Gamma Ray/Neutron/X-Ray Detection Systems

Application: On-site Ex-situ
Off-site

Brief Description: The company provides x-ray, gamma ray and neutron detection in the gamma energy spectrum of 1KeV to 3MeV, with detection of radiation from 1 microR/hr. Equipment has capabilities of both spectral and total count detection; detector sizes range from 4.5 cu inches to 8800 cu inches. Detection is facilitated by a plastic scintillator medium and/or sodium iodine. Fixed, portable, vehicle mounted and airborne systems are available.

Company Name/POC: Exploranium G.S. Limited/Stan Boyington

Address: 264 Watline Ave./ Mississauga, Ontario, Canada L4Z 1P4

Phone Number: 905 712-3100

Fax Number: 905 712-310

Technology Maturity: Commercial use experience

Performance History: More than 200 GR-110 gamma ray scintillometers are currently in service. Approximately 40 GR-820 airborne multichannel gamma ray spectrometers with a variety of detector packs (ranging in size from 1024 cu. in. to 3840 cu. in.) are operating in both helicopter and fixed wing aircraft. List of operators is available on request.

Comments: Temperature ranges for Model GR-110: operating -24 C to +50 C; Storage -30 C to +70 C.
Temperature ranges for model GR-820: detectors -20 C to +40 C; Console: -10 C to +40 C.

Source of Information: International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Rapid Field Analysis of Mercury (RFA/Hg)

Application : On-site Ex-situ

Brief Description : Contaminant identified as Mercury.

Method for rapidly determining mercury concentrations in solids. Mercury is extracted from solids and concentration determined in solution at ppm level using electrochemical method in less than 1 hour.

Company Name/POC: General Electric, Corp. R&D/Mark Sneeringer

Address : P.O. Box 8, K1-3C3, Schenectady, New York 12301

Phone Number : 518 387-5334

Fax Number : 518 387-7611

Technology Maturity : Bench scale testing, only

Performance History : Performance data are available.

Laboratory development.

Comments :

The removal of mercury from environmental samples is a particularly difficult challenge. Mercury may be found in a myriad of species including the volatile, liquid elemental form, the very inert and insoluble sulfide, and deadly organic derivatives. In addition, mercury can interconvert between all of these forms in nature. Mercury also binds very tightly to soil, especially to the organic fraction. An aqueous extractant has been identified to remove all forms of mercury from soil as well as other media by oxidizing the contaminant, and converting it to a highly water soluble form. The extractant has a high affinity for mercury, but has little interaction with indigenous metals such as calcium, magnesium or iron. The result is that mercury is preferentially removed from the soil and other media. No acids or bases are required and thus the extractant has little reaction with the media. Through the optimization of processing parameters, a set of conditions has been developed to rapidly (in less than 30 minutes) and thoroughly remove mercury from solids. With the mercury in solution, analysis by traditional methods becomes a viable means of determining the extent of mercury contamination in environmental samples.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : MetPAD and MetPLATE Heavy Metal Toxicity Test Kits

Application : On-site Ex-situ

Brief Description : MetPAD and MetPLATE are rapid qualitative and quantitative microbial assays that are specific to heavy metal toxicity. The technological basis of the kits is the inhibition of a bacterial enzyme by toxic heavy metals in environmental samples. The sensitivity of these kits to heavy metals is generally higher than MICROTOX and is of the same order or better than Daphnia and fish bioassays. The MetPAD and MetPLATE greatly reduce the costs associated with determining toxicity characteristics. Using either the MetPAD and MetPLATE concurrent with other general toxicity assays would help determine the nature of chemicals causing toxicity.

Company Name/POC: Group 206 Technologies, Inc./J. Craig Watts

Address : 6705 NW 24th Place/Gainesville, Florida 32606

Phone Number : 800 869-8729

Fax Number : 904 376-9133

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

The MetPAD and MetPLATE have proved successful by research groups in the public and private sector. Oscar Pancorbo (State of MA, DEP, 508 682 5237) has used and is planning to use these kits for toxicity screening and identification at several sites throughout Massachusetts. These kits have been evaluated by at least two independent research groups. Rochelle Rabidue (3M, 612 778 7065) and Rosalind Wei (In Vitro, 714 851 8356) have performed separate evaluations of these kits with results supporting the Company's claims.

Comments : The MetPAD and MetPLATE are small, lightweight test kits; however, a portable incubator is required to complete either test. The MetPAD and MetPLATE test kits are designed to detect and measure toxic heavy metals in the ppm range. These kits will not detect heavy metals that carry a negative charge, e.g., cyanide and arsenic and will not differentiate among the various heavy metals found within a sample. The kits must be stored under refrigeration and must not be exposed to direct sunlight. The MetPAD and MetPLATE are simple to use and portable; flexible in the sense that it can be used on several types of samples (e.g., soils, sludge, water and wastewater). Each kit comes with easy-to-follow instructions.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : MetSOIL Direct Heavy Metal Toxicity Assay for Soils

Application : On-site Ex-situ

Brief Description : MetSOIL is a direct toxicity assay for soils, sediments, and sludges which is specific for heavy metal toxicity. In the test protocol, bacteria are exposed to the solids, then provided with an enzyme substrate. Absorbance of the reaction mixture is used as a measure of enzyme activity, thus toxicity. MetSOIL greatly reduces the high cost associated with determining toxicity characteristics. The MetSOIL minimizes the dilution of extractable heavy metals. MetSOIL incorporates a quantitative and repeatable means of controlling the interaction between the solid matrix and the enzyme substrate reaction. This is in contrast to the complex approach employed in the MICROTOX solid phase assay.

Company Name/POC: Group 206 Technologies, Inc./J. Craig Watts

Address : 6705 NW 24th Place/Gainesville, Florida 32606

Phone Number : 800 869-8729

Fax Number : 904 376-9135

Technology Maturity : Bench scale testing, only

Performance History : The MetSOIL technology has not been used outside the laboratory setting; however, the MetSOIL test kit is based on the same technology found in the proven MetPAD and MetPLATE. Until now, the inventors and their associates have been the only people to use the MetSOIL technology (Dr. Gaby Bitton, University of Florida 904 392 4409).

Comments : The MetSOIL is a small, lightweight test kit. A portable incubator is required to complete the test. The MetSOIL test kit is designed to detect and measure toxic heavy metals in the ppm range. These test kits will not detect heavy metals which carry a negative charge (e.g., cyanide and arsenic). This test kit will not differentiate among the various heavy metals found within a sample. This test kit must be stored under refrigeration and must not be exposed to direct sunlight. The MetSOIL test kit, upon completion, will provide advantages over expensive and time-consuming laboratory procedures. The MetSOIL makes it possible to screen soil, sediments, or sludge samples for heavy metal toxicity. The MetSOIL is ideal for either laboratory or field use. Final MetSOIL packaging issues are being resolved for commercialization.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : CPT Continuous Soil Gas Sampling

Application : In-situ (vadose zone)

In-situ (saturated zone)

Brief Description : Continuous soil gas sampling and analyzing with depth using modified CPT-rig, analyzing for VOC, CH₄, CO₂, O₂, continuously plus GC-PID analyses at specific depth directly on location. Maximum depth of penetration ~100 feet depending on geology. Maximum pressure 15 ton. Possible to add gamma log, electric log and soil and groundwater sampling at specific depth. Soil gas sampling works even below groundwater table due to special filter; performs very well - used on hundreds of sites. Hole is packed with bentonite after measurement.

Company Name/POC: Kampeax Geodan/Connie D. Johnsen

Address : Stamholmen 112/DK 2650 Hvidovre, Denmark

Phone Number : 45 36390737

Fax Number : 45 3677231

Technology Maturity : Commercial use experience

Performance History : Has been running very well the last 3 years. Used on hundreds of sites - mainly in Denmark; but also Sweden, Poland, and Germany. Only problem may be difficulties in penetrating soil due to large stones, very compacted sand etc.; but that counts for all penetrating methods, including drilling.

Comments : The truck is four wheel drive, but needs a fairly stable terrain. Different geology may limit depth; very low permeability soil may slow down the measured speed.

Source of Information : International TechCon.

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Mobil Radiological Analysis Laboratory (MRAL)

Application : On-site Ex-situ

Brief Description : The Mobile Radiological Analysis Laboratory was conceived to provide both qualitative and quantitative radioanalytical services for field operations. The system was designed to utilize commercially available technology, integrated with both standard and modified analytical procedures, to meet the specific needs of the customers. Los Alamos National Laboratory currently has two units in operation that have been supporting field operations for two years. Two additional mobile laboratories were to be in place for the field sampling season of fiscal year 1994. The advantages include proximal real-time analysis and reporting of samples at a fraction of the cost of fixed-base labs and high sample through-put. Disadvantages include higher detection limits and some non-specific analysis.

Company Name/POC: Los Alamos National Laboratory/George Brooks

Address : P.O. Box 1663/TSD-9/MS-K494/Los Alamos, New Mexico 87545

Phone Number : 505 665-2583

Fax Number : 505 665-5982

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

The Mobile Radiological Analysis Laboratories (two currently in operation) have been supporting the Environmental Restoration Program since March of 1992. They have supported approximately 15 separate Operable Projects for site characterization within LANL. Support is expanding to include equipment release programs. Total samples analyzed within the mobile laboratories for the above-mentioned programs exceed 3000, with each of the samples requiring up to as many as 10 separate analyses.

Comments : The Mobile Radiological Analysis Laboratory should not be utilized/deployed when the analytical requirements of the project cannot be met from the data generated from the lab.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Contaminated Land Measurements

Application : Non-intrusive

Brief Description : In-situ high resolution gamma spectrometry is used to perform large area radiological clearance surveys and plant inventory measurements. Characterization and quantification of gamma emitting nuclides are typically possible to well below UK de minimis standards (400 Bq/kg). Measurements of total dose rates from spectral determinations at less than 0.05 microSv/h are routine. By use of high resolution gamma spectrometry in large area surveys, adequate limits of detection can be confidently obtained with short count times enabling many points to be surveyed in a working day.

Company Name/POC: Nuclear Electric plc/Dr. R. Clayton

Address : Littlebrook Complex/Littlebrook Manorway/Dartford Kent DA1 5PY, UK

Phone Number : 44 1322 28 2800 **Fax Number :** 44 1322 28 281

Technology Maturity : Commercial use experience

Performance History : Many internal measurements on Nuclear Electric plant and site, experience in foreign plant measurements (PWRs in Spain and Belgium). Site surveys have been carried out, inter alia, at British Rail railheads and around the Trawsfynydd lake. Internal confidential reports may be made available on request.

Comments : On site supply to liquid nitrogen and electricity supply point for battery charging is required. Measurements are restricted to gamma emitting isotopes. However, the results are routinely extrapolated to non gamma-emitters by use of fingerprinting and radiochemistry techniques. Easy to use with minimal local support requirements.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Differential DIE Away For Induced Fission Using NeuSight

Application : Non-intrusive

Brief Description : Intense pulsed neutron source for use in induced fission characterization of waste through differential DIE away technique and neutron radiography (matrix correction). Excellent pulsing characteristic with negligible DAR current and intensity at least x10 nearest alternative transportable source (D-T Tube) significantly improved detection levels due to improved signal to noise.

Company Name/POC: Oxford Instruments/Nigel Boulding

Address : Accelerator Technology Group/Osney Mead/ Oxford OX2 ODX, UK

Phone Number : 44 1865 269500

Fax Number : 44 1865 269502

Technology Maturity : Commercial use experience

Performance History : Accelerator is already a proven product in medical and nuclear applications in fixed sites.

Comments : Lower limits of detection of fissile material yet to be determined. Can be configured as a mobile source/system for use at various sites. Minimal infrastructure requirements. Delivery of system within one year. Can collaborate with Rolls-Royce and could jointly provide x-ray/neutron interrogation systems for waste drum characterization.

Source of Information : International TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Germanium Sonde Operation

Application : ☐ On-site ☐ Ex-situ

Brief Description : The germanium "cryoprobe" or "cryosonde" uses a high purity Ge spectrometer cooled by a solid cryogen to make high resolution logs of gamma activity. The method is unsurpassed sensitivity and selectivity. The technology alternative is coring and lab assay.

Company Name/POC: Princeton Geophysical Services, Inc./J. Balcker

Address : P.O. Box 900/Rocky Hill, New Jersey 08553

Phone Number : 609 921-7061

Fax Number : 609 921-713

Technology Maturity : Commercial use experience

Performance History : Logged more than 100,000 feet in holes totaling more than 1.2 million feet. Clients include most uranium mining companies.

Comments : Operators are provided. Limited to gamma rays >60KeV. Logging trucks are available. No general challenges except quantitative calibration in DOE environments.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Prompt Gamma Neutron Activation Analysis (PGNAA)

Application : In-situ (vadose zone) Ex-situ

Brief Description : PGNAA performs a non-invasive characterization of concentration profiles of hazardous or radioactive elements; can be used in-situ in the natural environment, within isolated packages or objects, or, as appropriate, in process monitoring control. Sensitivity down to "clean" levels is generally achievable, and the technique applies throughout the periodic table. It leaves no residual radioactivity.

Company Name/POC: Scientific Ecology Group, Inc./C.P. Keegan

Address : 1501 Ardmore Boulevard/Pittsburgh, Pennsylvania 15221

Phone Number : 412 247-6255

Fax Number :

Technology Maturity : Field demo complete

Performance History : Bench scale testing and calibration for buried uranium.
Other elements in process.
Field application with uranium-contaminated soil (in-situ).

Comments : Limited to penetration of a few feet in packed soil for in situ environmental application (approximately 1-4 feet, depending upon contaminant sought).

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : SIGNATURE Gamma Radionuclide Detection and Analysis System

Application : On-site Ex-situ

Brief Description : Provides spectral analysis of a radioactive sample using sodium iodide scintillation detectors with greater efficiency than high purity germanium, and without complex and expensive cooling systems. Uses sophisticated digital signal processing techniques to provide measurement resolution comparable with high purity germanium at reduced cost of ownership. Original concept applied to reactor on-line fission product monitoring; further developed for environmental monitoring. Has undergone trials using blind and mixed radionuclide sources. Identification and quantification of component radionuclides has been achieved down to levels of a few becquerels. Use of sodium iodide well detector and automated sample changing will give further benefits. Suitable for initial evaluation of contamination or confirmation of satisfactory decontamination.

Company Name/POC: Siemens Environmental Systems Ltd./Dr. W.E. Croydon

Address : Sopers Lane, Poole/Dorset, BH 17 7ER/England

Phone Number : 44 1202 782648

Fax Number : 44 1202 78215

Technology Maturity : Field demo complete

Performance History : Performance Data are Available:

Trial systems monitoring reactor coolant have been installed on three UK power stations, both AGR and MAGNOX, and on other PWR nuclear plant. A 2 out of 4 voted hardware trip mode is available to shut down the reactor in the event of a significant increase of specific fission products. Typical measurements are of ~50 kBq/kg Kr-88 in a mixed power spectrum of ~50 MBq/kg N-16 and other isotopes, and agree with grab sample measurements made with a high purity germanium system to within 10 percent. A trial system for environmental monitoring has been configured to detect atmospheric contamination, suitable for the UK national RIMNET2 emergency response system. Laboratory evaluation has detected radionuclides at levels of a few Becquerels. Further improvements are under consideration.

Comments : Limited by detector characteristics, which must be designed for the particular application e.g., operating temperature, mechanical shock, weight of background radiation shielding. Flexible system which can be tailored to meet the needs of a specific application. Stand alone or connected to network for remote operation. Challenges are in optimization of system for ease of calibration and extension to variable geometries. Discussions are underway with the Geosciences Advisory unit at Southampton University, UK with a view to combining a sodium iodide well detector and automated sample changing stage with the SIGNATURE analysis system. This would provide improved automated equipment for analysis of radionuclide contamination for either field or laboratory use, and with low cost of ownership. Alternative detector systems could be designed to address other monitoring requirements. Trials have been carried out involving the following isotopes: Eu-155, Mn-54, Ba-133, Na-22, Zn-65, Am-241, Co-60, Cs-134, Cs-137, Eu-152, Ru-106, Co-58, Co-57, Sr-85, I-131, K-40, Gd-153, Sc-46, Tb-160, Ru-103, Cd-109, Ce-139, Sn-113, Y-88, Ra-226, Pb-214, Bi-214, Kr-88, N-16, O-19, Ar-41, Ir-192, Hg-203. However, the system is not limited to available test isotopes but should detect any gamma emitting radionuclide through the use of library emission data.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☐ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☒ SVOC	☐ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Rapid Screening Field Measurements of Organic Contaminants

Application : On-site Ex-situ

Brief Description : Provide rapid screening (5-10 min/sample) and more quantitative analysis (20-30 min/sample) for EPA listed VOCs and semi-VOCs including explosives. Conducted studies with Argonne National Laboratory, EPA (EMSL-Las Vegas) RSKERL - Ada; ERL - Narragansette Region 1) Tenneco, Navy and Army.

Company Name/POC: SiteWorks, Inc./Dr. L. John Hoover

Address : Suite 363/11160-F South Lakes Drive/Reston, Virginia 22091

Phone Number : 703 385-1549

Fax Number : 703 385-3658

Technology Maturity : Commercial use experience

Performance History : Performance Data are Available.

Tufts University/Site Works
Argonne National Laboratory; Candace Rose; Dr. Jacqueline Burton 1-708-252-8795
Currently providing service in support of VOC analysis

Army/2 months Fort Devens
Navy/3 weeks San Diego Harbor
Tenneco/1 month pipeline
4 EPA projects

Comments : Sample throughput dependent on sample matrix TDGC/MS. Analysis of full range of EPA listed organics reduces sample throughput; nonetheless, 2 times faster than fixed laboratory. Can have instruments ready for operation in 4 hrs including calibration. Personnel and mobile unit available to provide service immediately. Can analyze soil gas, direct and extracted soil, air and aqueous media.

3 publications have appeared in the peer-reviewed journals Analytical Chemistry and Journal of Chromatography. Conducted successful field validation studies with EPA, DOE, Army, Navy and private sector documenting data quality and cost/benefit.

Source of Information : TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Ion Trap Mass Spectrometer

Application : On-site Ex-situ

Brief Description : The Teledyne MEC (TMEC) Ion Trap Mass Spectrometer is one of the most sensitive mass spectrometers of its size in the world. It is designed to be transportable, rugged, and automated to minimize operator intervention. It is ideal for field evaluation of toxic contaminants. The TMEC Ion Trap Mass Spectrometer will permit field measurements of environmental contaminants in lieu of laboratory analysis.

Company Name/POC: Teledyne MEC/Mort Cohen

Address : 1274 Terra Bella Ave./P.O. Box 7244/Mountain View, California 94039-7244

Phone Number : 415 962-6989

Fax Number : 415 967-435

Technology Maturity :

Field demo complete

Performance History : Field evaluations of the TMEC Ion Trap Mass Spectrometer are underway by the U.S. Army for military applications to detect chemical and biological toxins. Initial evaluation are positive. Point of contact is Dave Sickenberger, U.S. Army Chemical Research, Development, Engineering Center, (410) 671-5533.

Comments :

Instrument is designed for direct sampling, or GC/LC input. The mass range is approximately 20 to 2,000 amu. It is highly sensitive (parts per billion to parts per trillion) and is excellent in isolating coeluting compounds in complex mixtures. It can be used for field evaluation, laboratory analysis, or fence post monitoring applications. The TMEC instrument is designed for ease of use. It can be powered by AC or DC (battery). It can be configured to operate with a PC-based data system, or as a stand alone device with display and data printout. The system is highly automated to minimize operator intervention, and can be easily configured for direct sampling or interface with gas or liquid chromatograph. There are no infrastructure considerations other than availability of prime power (about 1 KW). The TMEC ion trap mass spectrometer was specifically designed for field evaluation applications to measure very low levels of toxic contaminants. The original instrument was developed for the U.S. Army for military applications and to measure chemical and biological contaminants in the field. Approximately \$13M have been allocated for the R&D of this instrument. Initial field evaluations of the demonstration units are currently underway. Teledyne MEC is also developing, under an internal R&D program, an ion trap instrument for commercial applications related to real-time measurement of environmental contaminants. Initial demo units will be available by mid-1993. TMEC has filed for 8 patents on its ion trap technology, two of which have been allowed and will soon be issued. The other 6 filings are still under review by the U.S. Patent Office.

Source of Information : TechCon

CONTAMINANTS:

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

■ Petroleum Hydrocarbons

■ Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

☒ Halogenated VOC

■ N/A

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name : Chlorinated Hydrocarbon Monitor

Application :

On-site

Ex-situ

Brief Description :

This unique rare-earth sensor detects and measures contaminants such as carbon tetrachloride, trichloroethylene, perchloroethylene, dichloromethane, and other chlorinated solvents commonly used in nuclear weapons production. The sensor has no interference from methane, gasoline, paint thinner, and other non-chlorinated compounds.

Company Name/POC: TRANSDUCER RESEARCH, INC./William J. Buttner

Address : 600 N. Commons Dr./Suite 117/Aurora, Illinois 60504

Phone Number : 708 978-8802

Fax Number: 708 978-8854

Technology Maturity : Commercial use experience

Performance History :

DOE - Hanford/Site Characterization/Cary Martin/Westinghouse 509 376-2648
DOE - Hanford/Carbon Tetrachloride Removal (Vacuum Extraction Process)/Randy Coffman/Westinghouse/509 376-4263
DOE - Hanford/Safety, Extraction Well Drilling/Tom Lazarski/Kaiser Engineering/509 373-4791
Eastman - Kodak/Wastewater Treatment (Dichloropropane, Dichloromethane)/Tom Walton/Eastman Kodak/716 477-1633

Comments :

This instrument detects and measures chlorinated hydrocarbon vapors only. It does not speciate (responds to all chlorinated hydrocarbons). It requires vapor dilution for concentrations above 50 ppm. Model MP-1 Gas Diluter is available from Transducer Research as separate product. Sensor life is inversely proportional to exposure concentration and exposure time. Model 2001-05 is currently being used for site characterization, safety monitoring, and clean-up process applications. Transducer Research is currently improving sensor performance through automatic dilution and pre-concentration modules. Real-time monitoring capability permits quick analysis of contamination situation. Instrument is less expensive to purchase, operate, and maintain than alternate technologies. Real-time measurement allows determination whether work can be continued. Unit can be used to monitor changes in safety conditions. Selective measurement of chlorinated solvents simplifies operating procedures and speeds up the decision process.

Source of Information : TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Gas Chromatograph/Mass Spectrometer (Field GC/MS)

Application : On-site Ex-situ

Brief Description : Transportable GC/MS used to detect and identify complex mixtures of environmental pollutants and toxic substances in trace amounts. Based on Hewlett-Packard's 5971A mass selective detector, Viking's field GC/MS uses miniaturized components to achieve laboratory-grade results on-site in real-time. Features of the instrument include: a heated membrane separator made from dimethyl silicone for air sampling, internal cryofocusing options for analysis of light volatiles, and high-temperature ramping for analysis of semi-volatiles with higher boiling points. Field GC/MS analysis shortcuts the current process of collecting environmental samples, sending them to a lab for analysis, and waiting weeks for results.

Company Name/POC: Viking Instruments Corporation/Thomas J. Kuehn

Address : 3800 Concord Parkway/Suite 1500/Chantilly, Virginia 22021

Phone Number : 703 758-9339

Fax Number : 703 968-010

Technology Maturity : Commercial use experience

Performance History : Viking's GC/MS has been field-proven by a number of large industrial firms and government agencies, including Tennessee Eastman, Martin Marietta, the EPA, the FBI, and the U.S. Army, for a variety of applications. The DOE, in conjunction with Sandia National Labs, uses the instrument for emergency response and on-site testing. Steve Thornberg is Viking's reference contact within the DOE (505) 846-8829.

Comments : Use of the instrument requires an operator who is skilled as a lab or field chemical technician and has completed Viking's Field GC/MS Introductory Training Course. The field GC/MS has many unique features designed into the system specifically to provide for flexibility and ease of use. Its rugged transport case, for example, permits operation in virtually any location that is accessible by jeep or plane. Once at a site, the field GC/MS can be unpacked and operational in about 15 minutes. The instrument also offers a number of sample inlet options for air, water, and soil gas and a user-friendly, Windows-based operating system. Finally, service contracts and telephone support are available with every instrument.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☒ SVOC	☐ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Laboratory Analysis*

Technology Name : Characterization for Physical Separation (Soil Washing)

Application : On-site Ex-situ

Brief Description : Laboratory characterization procedures are used to assess the potential for reducing the volumes of contaminated material requiring downstream treatment, or disposal, by separating contaminated particles and coatings from the uncontaminated bulk. The procedures are based on using particle separation techniques to quantify the differential distribution of the contaminated and non-contaminated particles by using methods based on differences in grain size, abrasion, settling velocity, specific gravity, surface chemical properties, magnetic susceptibility and solubility/leachability. The results from the procedures can then be used to design a separation circuit where the characteristics of the contaminants and the soil can be matched to appropriate physical separation equipment (soil washing). Most soil washing laboratory characterization tests are not as detailed and do not provide as much information for eventual process circuit design. Many laboratory tests carried out by particular vendors are geared to their separation equipment and experience rather than determining the most appropriate separation route and commercial equipment for the task.

Company Name/POC: AEA Technology/Dr. Mark Neville

Address : Building 429, Harwell Lab/Near Didcot/Oxon, OX11 0RA, U.K.

Phone Number : 44 1235 432252

Fax Number : 44 1235 432278

Technology Maturity : Field demo complete

Performance History : (1) UK Department of the Environment: Contact: Judith Denner Tel: 44 71 276-8348. Research programs over years 1990-1994 into the physical separation of contaminants from a number (8) of contaminated soils. (2) US Environmental Protection Agency: Contact: Norma Lewis Tel: (513) 569-7665, Mary Stinson Tel: (908) 321-6683. Research program 1991-1994 using techniques from the mineral processing industry for the treatment of soil from a former gasworks. Contaminants included heavy metals, PAH and cyanide. (3) European Commission: Reprocessing of Beralit Mineral Tailings. (4) Other projects: commercially in confidence but include work with contaminated soils and dredged harbour sediment.

Comments : The test procedures need to be carried out in a well equipped laboratory. The results can indicate that differential particle separation can produce a low contaminant bulk and a concentrate but the bulk may not reach the required clean-up target. The concentrate requires further processing or disposal. No real problems in using the actual characterization methods as the tests have been developed from mineral processing tests that have been developed over the past 30 years. Individual soils may pose problems such as in the choice of suitable chemical for attrition scrubbing, froth flotation or flocculation. From the knowledge of the exploitable features it is possible to: (1) assess whether the appropriate target concentration of the cleaned material can be met. Where this is not possible the tests can be used with other treatment tests to ascertain whether a treatment train involving some physical separation can meet the desired target concentration; and/or (2) to configure a treatment circuit based on readily available separation equipment from the minerals processing industry. It is likely that this first circuit is a small throughput pilot scale demonstration circuit. The products from this circuit could also be characterized to monitor the performance in terms of sample heterogeneity, machine performance and to provide data for modification prior to designing the full scale plant.

Source of Information : International TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Laboratory Analysis

Technology Name : Microwave Sample Digestion

Application : On-site
Off-site

Brief Description : The CEM Microwave Sample Preparation System, MDS-2000 series, combines the speed of microwave heating with proprietary sealed vessel technology to significantly reduce the sample preparation (acid digestion) process time. For environmental samples, the process time is reduced by a factor of 8-10. In addition to time savings, the technology provides performance (measure by elemental analysis), safety and cost advantages over traditional hot plate techniques.

Company Name/POC: CEM Corporation/Gregory N. LeBlanc

Address : 3100 Smith Farm Rd./P.O. Box 200/Matthews, N.C. 28105-200

Phone Number : 800 726-3331

Fax Number : 704 821-789

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Comments : There are over 3000 Microwave Sample Preparation Systems in use worldwide. The systems are typically used for acid digestion of a variety of matrices for subsequent elemental analysis. It cuts across all industries. Its widest use is for environmental applications. It has proven highly successful as measured by its acceptance in the worldwide marketplace.

Skills associated with a chemical laboratory are all that is required to operate the system. Training can be completed in <2 hours. Complete procedures are supplied with the purchase of the instrument. The system can be set up and running within 1 hour of removal from the shipping box. It can be used in a mobile lab and a standard laboratory. The system operates on 115 vac. (No special requirements). It is applicable to a wide variety of sample types encountered in remediation efforts. A fume hood is not required.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides☒ Heavy Metals☒ PCB☒ Explosives/Propellants☒ Petroleum Hydrocarbons☒ Radionuclides☒ SVOC☒ Other Contaminant☒ Nonhalogenated VOC☒ Halogenated VOC☒ N/ATECHNOLOGY TYPE : *Laboratory Analysis*

Technology Name : High Speed Capillary Column for GC

Application : Off-site

Brief Description : Capillary column strategies for high-speed gas chromatography are techniques which are used to increase the performance or resolution of a high-speed separation as overall resolution is decreased as compared to conventional gas chromatography. Techniques include serial coupled columns which can shift unresolved pairs of peaks into open areas of a chromatogram, and high-speed column switching, which employs high-speed hardware used for multidimensional techniques. The techniques perform with a good level of precision and accuracy as they all incorporate high speed components.

Company Name/POC: Chromatofast, Inc./Robin Risser

Address : 912 N. Main Street, Suite 14/Ann Arbor, Michigan 48104

Phone Number : 313 662-3410

Fax Number : 313 662-3462

Technology Maturity :

Bench scale testing, only

Performance History : The Column Strategies technology has been utilized through a development contract from private industry for a speciation instrument to analyze automotive exhaust gases and in a fast, direct non-methane hydrocarbon analyzer development contract from a State of Michigan grant for automotive exhaust analysis. The speciation project was a 1 year contract providing \$525,000 of funds and the non-methane hydrocarbon project was a year contract providing \$75,000 of funds. A mid-point backflush procedure has been developed which reduces the cycle time of the instrument by a factor of 2.

Comments : The device, when combined with equipment for high-speed gas chromatography will require a single technician with familiarity in using a conventional gas chromatograph. The majority of the operation is automated.

Source of Information : TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Laboratory Analysis*

Technology Name : Intact Subsurface Block Technology

Application : On-site Ex-situ
Off-site

Brief Description : ISB technology is a testing apparatus which enables in situ remediation techniques to be realistically tested at the laboratory scale. Over the last 4 years the company has performed between 20 - 40 experiments for clients to examine the fate and mobility of contaminants. Surpasses small scale laboratory testing. Can replace (or supplement) field-scale testing of proposed remediation strategies.

Company Name/POC: Danish Geotechnical Institute/Rachel O'Brien

Address : Maglebjergvej 1/DK-2800 Lyngby, Denmark

Phone Number : 0045 4588 4444

Fax Number : 0045 4588 124

Technology Maturity : Commercial use experience

Performance History : Have been awarded more than 10 contracts involving ISB technology with the Danish EPA, the Strategic Environmental Research Programs, the Danish Technical University, the Danish Geological Survey and the University of Waterloo (Canada).

Comments : Current design allows for fully saturated groundwater conditions or "field capacity" saturation. Cannot systematically desaturate a sample yet. Very simple to operate. There is almost no limit to the types of testing that can be performed with the cell. Although ISM was conceived of for use in glacial deposits, any natural or man-made sediment can be tested. Consolidated rock (or a synthetic material) can also be installed in the cell. Sludge or tailings can also be installed in the cell for leaching or decontamination tests.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Laboratory Analysis*

Technology Name : On-Line Microwave Digestion

Application : Ex-situ

Brief Description : Continuous preparation of samples for analysis by AA, Fluorescence ICP, ICP-MS. Ideal for "Hot" samples. Replaces batch systems and robotics which are labor intensive and cumbersome.

Company Name/POC: Questron Corporation/Angelo Grillo

Address : 4044 Quakerbridge, RD./Mercerville, New Jersey 08619

Phone Number : 609 587-6898

Fax Number : 609 587-0513

Technology Maturity :

Performance History : Technology is presently at the stage where beta site units will be manufactured. A DOE site would be ideal for such an evaluation. Bench scale testing, only

Comments : The system can operate at high pressure, and high temperature. It would be applicable for all but some high temperature refractory materials. Analysis has reached a high degree of automation. Sample preparation is still relatively tedious. This system would allow the sample preparation to match the speed and degree of automation of the analyzer. All of the developmental work has been completed. The remaining challenges deal with actual speed in a real environment, range of applicable samples, reliability in an adverse environment, and applicability to use in a mobile lab. This product is being developed for the Canadian Ministry of Environment by Questron with the assistance of Dr. F. Salin's group at the Chemistry Department of McGill University.

Source of Information : TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Laboratory Analysis*

Technology Name : Ion Trap Mass Spectrometer

Application : On-site Ex-situ

Brief Description : The Teledyne MEC (TMEC) Ion Trap Mass Spectrometer is one of the most sensitive mass spectrometers of its size in the world. It is designed to be transportable, rugged, and automated to minimize operator intervention. It is ideal for field evaluation of toxic contaminants. The TMEC Ion Trap Mass Spectrometer will permit field measurements of environmental contaminants in lieu of laboratory analysis.

Company Name/POC: Teledyne MEC/Mort Cohen

Address : 1274 Terra Bella Ave./P.O. Box 7244/Mountain View, California 94039-7244

Phone Number : 415 962-6989

Fax Number : 415 967-435

Technology Maturity :

Field demo complete

Performance History : Field evaluations of the TMEC Ion Trap Mass Spectrometer are underway by the U.S. Army for military applications to detect chemical and biological toxins. Initial evaluation are positive. Point of contact is Dave Sickenberger, U.S. Army Chemical Research, Development, Engineering Center, (410) 671-5533.

Comments :

Instrument is designed for direct sampling, or GC/LC input. The mass range is approximately 20 to 2,000 amu. It is highly sensitive (parts per billion to parts per trillion) and is excellent in isolating coeluting compounds in complex mixtures. It can be used for field evaluation, laboratory analysis, or fence post monitoring applications. The TMEC instrument is designed for ease of use. It can be powered by AC or DC (battery). It can be configured to operate with a PC-based data system, or as a stand alone device with display and data printout. The system is highly automated to minimize operator intervention, and can be easily configured for direct sampling or interface with gas or liquid chromatograph. There are no infrastructure considerations other than availability of prime power (about 1 KW). The TMEC ion trap mass spectrometer was specifically designed for field evaluation applications to measure very low levels of toxic contaminants. The original instrument was developed for the U.S. Army for military applications and to measure chemical and biological contaminants in the field. Approximately \$13M have been allocated for the R&D of this instrument. Initial field evaluations of the demonstration units are currently underway. Teledyne MEC is also developing, under an internal R&D program, an ion trap instrument for commercial applications related to real-time measurement of environmental contaminants. Initial demo units will be available by mid-1993. TMEC has filed for 8 patents on its ion trap technology, two of which have been allowed and will soon be issued. The other 6 filings are still under review by the U.S. Patent Office.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Laboratory Analysis***Technology Name :** Accelerator Mass Spectroscopy (AMS)

Application :

On-site Ex-situ

Off-site

Brief Description : This instrument measures the relative abundance of carbon 14/12, Iodine 129/122, etc. to better than 1 part in 1E15.**Company Name/POC:** Triumph/Phillip Gardner**Address :** 4004 Wesbrook Mall/Vancouver, B.C, Canada, V6T 2A3**Phone Number :** 604 222-1047**Fax Number :** 604 222-1074**Technology Maturity :** Commercial use experience**Performance History :** AMS is a well known analytical technique worldwide - J.Vogel, L.L.B.L., CA, USA - E. Litherland, U. Toronto, Ont., Canada**Comments :** AMS is only appropriate for elements that make negative ions only. Positive ions must be done in conventional E-M mass spec.**Source of Information :** International TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☒ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Decision Support Tools*

Technology Name : Characterization for Physical Separation (Soil Washing)

Application : On-site Ex-situ

Brief Description : Laboratory characterization procedures are used to assess the potential for reducing the volumes of contaminated material requiring downstream treatment, or disposal, by separating contaminated particles and coatings from the uncontaminated bulk. The procedures are based on using particle separation techniques to quantify the differential distribution of the contaminated and non-contaminated particles by using methods based on differences in grain size, abrasion, settling velocity, specific gravity, surface chemical properties, magnetic susceptibility and solubility/leachability. The results from the procedures can then be used to design a separation circuit where the characteristics of the contaminants and the soil can be matched to appropriate physical separation equipment (soil washing). Most soil washing laboratory characterization tests are not as detailed and do not provide as much information for eventual process circuit design. Many laboratory tests carried out by particular vendors are geared to their separation equipment and experience rather than determining the most appropriate separation route and commercial equipment for the task.

Company Name/POC: AEA Technology/Dr. Mark Neville

Address: Building 429, Harwell Lab/Near Didcot/Oxon, OX11 0RA, U.K.

Phone Number : 44 1235 432252

Fax Number : 44 1235 43227

Technology Maturity :

Field demo complete

Performance History : (1) UK Department of the Environment: Contact: Judith Denner Tel: 44 71 276-8348. Research programs over years 1990-1994 into the physical separation of contaminants from a number (8) of contaminated soils. (2) US Environmental Protection Agency: Contact: Norma Lewis Tel: (513) 569-7665, Mary Stinson Tel: (908) 321-6683. Research program 1991-1994 using techniques from the mineral processing industry for the treatment of soil from a former gasworks. Contaminants included heavy metals, PAH and cyanide. (3) European Commission: Reprocessing of Beralit Mineral Tailings. (4) Other projects: commercially in confidence but include work with contaminated soils and dredged harbour sediment.

Comments :

The test procedures need to be carried out in a well equipped laboratory. The results can indicate that differential particle separation can produce a low contaminant bulk and a concentrate but the bulk may not reach the required clean-up target. The concentrate requires further processing or disposal. No real problems in using the actual characterization methods as the tests have been developed from mineral processing tests that have been developed over the past 30 years. Individual soils may pose problems such as in the choice of suitable chemical for attrition: scrubbing, froth flotation or flocculation. From the knowledge of the exploitable features it is possible to: (1) assess whether the appropriate target concentration of the cleaned material can be met. Where this is not possible the tests can be used with other treatment tests to ascertain whether a treatment train involving some physical separation can meet the desired target concentration; and/or (2) to configure a treatment circuit based on readily available separation equipment from the minerals processing industry. It is likely that this first circuit is a small throughput pilot scale demonstration circuit. The products from this circuit could also be characterized to monitor the performance in terms of sample heterogeneity, machine performance and to provide data for modification prior to designing the full scale plant.

Source of Information : International TechCon

CONTAMINANTS :

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☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Decision Support Tools*

Technology Name : Site Planner

Application :

Other Application

Brief Description : Workstation-based software for decision support in site assessment and remediation. Site Planner replaces slow, low-productivity manual data management and visualization techniques and point solution software systems.

Company Name/POC: ConSolve Inc./David Barber

Address : 70 Westview St./Lexington, MA 02173

Phone Number : 508 358-8061

Fax Number : 508 358 8065

Technology Maturity : Commercial use experience

Performance History : Site Planner is currently deployed on about 20 projects including use by four DOE laboratories.

Comments : Two days on-site training required. Limited by normal computer hardware limitations. System runs on stand-alone Unix workstations.

Source of Information : TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS: ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Decision Support Tools*

Technology Name : Radwaste Cementation and Process Control

Application : ☐ On-site ☐ Ex-situ
☐ Off-site

Brief Description : The quality of cemented waste has to be proven. Process control is preferable to end control. The advantage of process control is that during operation the system can be improved. Various on-line measuring techniques have been developed to check the mechanical, chemical and radiological properties during the cementation process.

Company Name/POC: KEMA Nederland B.V./H.A.W. Cornelissen

Address : P.O. Box 9035, NL-6800 ET/ARNHEM, The Netherlands

Phone Number : 31 26 356 6104

Fax Number : 31 26 351 5835

Technology Maturity :

Field demo complete

Performance History : During a four year European project, measurement techniques and procedures were developed and validated at a radwaste campaign at a BWR power plant.

Comments : None.

Source of Information : International TechCon

CONTAMINANTS :

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☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Decision Support Tools*

Technology Name : Optimizing Separation

Application : On-site Ex-situ

Brief Description : What: Optimizing the separation of clean vs non-clean soil through optimizing the performance of hydrocyclones for the specific soil and the contamination present by changing the shape and the operation of the hydrocyclones.
How: Run tests with plant (300-500 ton) for the different locations. Make information available for large scale operation (process data, efficiency, quantities clean and non-clean).
How well: Because of full-scale operation and "large" quantities, reliable answers are generated. The advantage of this technology is that the performance of existing soil cleaning technologies can be optimized.

Company Name/POC: Promeco B.V./ A.J. M. Broeders

Address : P.O. Box 94/5741 OAB/Beek En Donk, The Netherlands

Phone Number : 31 49 29 63 903

Fax Number : 31 49 24 65 025

Technology Maturity : Commercial use experience

Performance History : Contact Promeco for list of references.

Comments : Contaminants that stick to coarse material cannot be concentrated in the fines. Reduction of waste volumes are accomplished by optimization of the separation. In cooperation with KEMA hydrocyclones are very often used as part of a wet cleaning operation for contaminated soils. The efficiency of hydrocyclones is a very important part of the total efficiency of wet soil cleaning. The requirements for the most efficient removal of the contaminations must be met by looking for the desired cut point in the particles size separation. Particle size-distributions vary by site, and distribution of the contaminants. Choosing the cut point of the separation is a strategic decision for the cleaning strategy for each project. Searching the right cut point can only be done at a processing scale of 1:1, with relative high quantities. Once the optimum is found, the performance of hydrocyclones can be changed easily to meet the requirements of separation.

Source of Information : International TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : Geophysics/Hydrogeologic Measurements

Technology Name : High Resolution Shear & Compressional Reflection Seismic

Application : Non-intrusive

Brief Description : Utilizes compressional (P-) and shear (S-) reflection seismology to map/delineate subsurface lithostratigraphy and to delineate or discriminate clay aquicludes from saturated sand aquifers. Uses the principle that P-wave propagation through porous materials is controlled by the properties of the fluid in the pore spaces while S-wave propagation is not. Provides depth resolution of approximately 1 foot or less to depths of 250 feet and lateral resolution in the range of 2 to 5 feet.

Company Name/POC: Bay Geophysical Associates, Inc./John Clark

Address : 868 Robinwood Ct./Traverse City, Michigan 49686

Phone Number : 616 941-7660

Fax Number : 616 941-741

Technology Maturity :

Field demo complete

Performance History : Performance Data are Available.

Field demonstration of technology was completed at Cooke Crossroads, SC in Oct. 91. Excellent resolution was obtained (vertical 1 ft; horizontal approx. 3 ft). The primary problem encountered was that correlation of the P- and S-wave seismic sections is not possible without detailed P- and S-velocity information from a nearby borehole. Data quality and resolution far exceeded expectations. Contact: Dr. Mitchell D. Erickson, Argonne National Laboratory (708) 252-7772. Contract is currently under negotiation to utilize shear wave reflection seismology alone to delineate mine workings in an abandoned mine in Illinois. Approximately 300-ft of line is to be acquired.

Comments :

Technology benefit: (1) Noninvasive; therefore safer if subsurface contaminants are suspected. For large areas, provides much more subsurface information than drilling alone. Subsurface information for large area can provide continuous profile information, which borehole data cannot. (2) Potential collaboration with ARA using ECPT to obtain subsurface P- and S-Wave velocity information. Additionally, potential use of ARA truck as seismic source.

Source of Information : TechCon

Construction Materials/Debris

Characterization

Construction Materials/Debris

Characterization

CONTAMINANTS :

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☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Mobile Laboratory for Chemical Weapons, Explosives and Propellants

Application : On-site Ex-situ

Brief Description : Mobile laboratory with all necessary chemical and physical equipment to detect and analyze chemical weapons, explosives, propellants and other toxic materials.

Company Name/POC: Alba Industrie Umweltschutz Service GmbH/Dr. K. Faber

Address : Rehrhoferweg 160/D29625 Munster/Germany

Phone Number : 051 92 96 3212

Fax Number : 051 92 96 3311

Technology Maturity : Commercial use experience

Performance History : In use for two years, e.g., in Russia and also in Germany.

Comments : None.

Source of Information : International TechCon

**CONSTRUCTION
MATERIALS/DEBRIS**

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☒ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☒ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Monitoring of Chemical Weapons in Soil, Water, Air, Buildings

Application : ☐ On-site ☐ Ex-situ

Brief Description : Monitors all relevant parameters, like concentrations of chemical weapons in air, soil, water, and buildings.

Company Name/POC: Alba Industrie Umweltschutz Service GmbH/Dr. K. Faber

Address : Rehrhoferweg 160/D29625 Munster/Germany

Phone Number : 051 92 96 3212

Fax Number : 051 92 96 3311

Technology Maturity : Commercial use experience

Performance History : Refer to POC for performance history.

Comments : None.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Fourier Transform Infrared Photoacoustic Spectrometry of Solids

Application : On-site Ex-situ
Off-site

Brief Description : The FTIR unit identifies volatile organic compounds in vapor and liquid. It also has the potential for use in sampling vapor and liquid contained in soil. Modulating infrared light passes through the sample chamber where it is selectively absorbed by the vapor sample. Components in the vapor selectively absorb the light and an acoustic signal is produced that is proportional to the concentration in the sample. The detection limits for organic compounds are 0.1 ppm to 10 ppm.

Company Name/POC: Ames Laboratory/US DOE/John McClellan

Address : Iowa State University/Ames, IA 50011-3020

Phone Number : 515 294-7948

Fax Number : 515 294-4748

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

FTIR-PAS can analyze for any molecular or polyatomic component, such as organic solvents and polyatomic ions. Our most recent work has been on the measurement of nitrate, ferrocyanide and similar ions in tank sludges. FTIR-PAS has been used extensively for the analysis of various manufactured materials, but its application to environmental tasks is new. The technology group is presently involved in applying FTIR-PAS to waste-tank sludges (Reference: Dr. T. Rebagay, Westinghouse Hanford Co., 509 373-3174). For a recent broad discussion see "A Practical Guide to FT-IR Photoacoustic Spectroscopy" by J. McClelland, et al., in Practical Sampling Techniques for Infrared Analysis, P.B. Coleman, editor.

Comments :

FTIR-PAS is not applicable to volatile liquids and solids (unless only the volatiles need be analyzed). It is not readily applicable to large, intact objects. It cannot analyze components made of monatomic species (e.g., sodium chloride). It is not a trace analysis technique. FTIR-PAS draws its analysis from a very thin region at the surface of the sample. If this surface is not representative of the unit being analyzed, it is difficult to extrapolate from the analysis to the whole unit. FTIR-PAS determines infrared spectra (and related composition and physical properties) of non-volatile liquids and solids irrespective of their condition (e.g., sludge, powder, slab) and with minimal sample handling. Routine analysis only requires that a small sample be placed in the instrument, and the analysis takes less than 5 minutes. The minimal handling translates into faster and cheaper analyses. Minimum sample size is 1 to 10 milligrams, which limits worker exposure.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Rapid Field Analysis of Mercury (RFA/Hg)

Application : On-site Ex-situ

Brief Description : Contaminant identified as Mercury.

Method for rapidly determining mercury concentrations in solids. Mercury is extracted from solids and concentration determined in solution at ppm level using electrochemical method in less than 1 hour.

Company Name/POC: General Electric, Corp. R&D/Mark Sneeringer

Address : P.O. Box 8, K1-3C3, Schenectady, New York 12301

Phone Number : 518 387-5334

Fax Number : 518 387-761

Technology Maturity :

Bench scale testing, only

Performance History : Performance data are available.

Comments :

Laboratory development.

The removal of mercury from environmental samples is a particularly difficult challenge. Mercury may be found in a myriad of species including the volatile, liquid elemental form, the very inert and insoluble sulfide, and deadly organic derivatives. In addition, mercury can interconvert between all of these forms in nature. Mercury also binds very tightly to soil, especially to the organic fraction. An aqueous extractant has been identified to remove all forms of mercury from soil as well as other media by oxidizing the contaminant, and converting it to a highly water soluble form. The extractant has a high affinity for mercury, but has little interaction with indigenous metals such as calcium, magnesium or iron. The result is that mercury is preferentially removed from the soil and other media. No acids or bases are required and thus the extractant has little reaction with the media. Through the optimization of processing parameters, a set of conditions has been developed to rapidly (in less than 30 minutes) and thoroughly remove mercury from solids. With the mercury in solution, analysis by traditional methods becomes a viable means of determining the extent of mercury contamination in environmental samples.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides☐ Heavy Metals☐ PCB☐ Explosives/Propellants☐ Petroleum Hydrocarbons☒ Radionuclides☐ SVOC☐ Other Contaminant☐ Nonhalogenated VOC☐ Halogenated VOC☐ N/A**TECHNOLOGY TYPE :** *Sensors/Field Analysis Equipment***Technology Name :** Alpha Track Etch Detectors**Application :**

Non-intrusive

Brief Description :

Detectors using alpha track technology have been in widespread use for the past 15 years. These detectors are composed of a very pure and specific form of CR-39 type polycarbonate plastic. The material is not sensitive to interference from beta or gamma radiation and exhibits a 70 percent efficiency to alpha particles. The detectors are deployed. Alpha particles will penetrate the detector surface forming damage sites which, when etched in a caustic bath, are enhanced and visible under magnification. Evaluation of etched detectors will quantify levels of alpha contamination and characterize its distribution. Alpha track detectors have a nominal thickness of 1.0 mm and can be laser cut to various dimensions. Conventional radiation survey instruments employ probes which are large and cannot access irregular surfaces or crevices which may hold alpha contaminated material. It is questionable that conventional instrumentation can accurately measure the low levels of alpha contamination permitted under existing release levels.

Company Name/POC : Landauer, Inc./Sue Morrow**Address :** 2.Science Road/Glenwood, Illinois 60425**Phone Number :** 708 755-7000**Fax Number :** 708 755-7016**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.

Although the alpha track technology has been commercially available since 1978, its application to characterization of alpha contamination is new and the application's development effort has been conducted jointly with ORNL. Pilot tests have involved deployment inside crevices, valve and flange surfaces, contaminated floors, under hot cell/glove boxes. (Dr. Richard Gammage, Martin Marietta Energy Systems, Inc., (615) 574 6256). Initial tests have been completed to characterize the level of contamination gradients and form of suspension in ground water. (Dr. John McCarthy, ORNL (615) 576 6606).

Comments :

A technician could deploy individual detectors at hundreds of site locations in a day with retrieval on the same or following day. Little additional training is required beyond that already common to a person trained in taking radiation measurements. Specific etching and detector evaluation training require few basic skills beyond that of a high school graduate with general chemistry or physics background. Landauer's proprietary Lantrak (registered name) detector material and optimized processing protocols permit a low detection level and precise data. Technology is likely not appropriate for 100 percent monitoring of large surface areas of when live-time data is a prerequisite. It is expected that statistical sampling of surfaces with contamination levels at or below the regulatory release level will be a main value of this technology. Landauer, Inc., now processes some 1,000,000 detectors per month of various types including the alpha track type, and offers this service on a commercial basis. In situations where on-site processing is required, a satellite laboratory can be readily established using commercially available etching and analysis equipment. Landauer maintains current training and QC protocols for this technology.

Source of Information : TechCon

**CONSTRUCTION
MATERIALS/DEBRIS**

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Release Measurement (RM)

Application : ☒ On-site ☒ Ex-situ

Brief Description : Total gamma-measurement for release of large amounts of (very) low level residual materials for conventional reutilization of materials or disposal. The technology is designed for disclosure of hidden gamma-emitters.

Company Name/POC: NIS Ingenieurgesellschaft mbH/Ludwig Seyfferth

Address : DonaustraBe 23/D-63452 Hanau/Germany

Phone Number : 49 181 185 159

Fax Number : 011.49.6181 1200 3

Technology Maturity : Commercial use experience

Performance History : The development of the concept was sponsored within the R&D program of the European Commission. The first facility application was in 1988 for material from the dismantling of a nuclear power plants (NPP) in Niederaichbach. The mobilized version is being used for release measurements at operating NPP. Another facility has been installed at the NPP Greifswald for the dismantling program of 5 NPP units.

Comments : The technology is suitable for gamma-emitting radionuclides only. The concept can be adapted to specific requirements (e.g., size, specialized for specific material, other local requirements). So far the technology has not been applied in the U.S. The facility could be delivered directly or through a partner in the U.S. (e.g. NUS Corp). The existing facility achieves an average throughput of 10 t/d (depending on the kind of material). For application within the Wismut restoration program a facility for about 100 t/d is in the planning and licensing stage. A modified concept is being used for monitoring of trucks and railroad cars.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Contaminated Land Measurements

Application : Non-intrusive

Brief Description : In-situ high resolution gamma spectrometry is used to perform large area radiological clearance surveys and plant inventory measurements. Characterization and quantification of gamma emitting nuclides are typically possible to well below UK de minimis standards (400 Bq/kg). Measurements of total dose rates from spectral determinations at less than 0.05 microSv/h are routine. By use of high resolution gamma spectrometry in large area surveys, adequate limits of detection can be confidently obtained with short count times enabling many points to be surveyed in a working day.

Company Name/POC: Nuclear Electric plc/Dr. R. Clayton

Address : Littlebrook Complex/Littlebrook Manorway/Dartford Kent DA1 5PY, UK

Phone Number : 44 1322 28 2800

Fax Number : 44 1322 28 2819

Technology Maturity : Commercial use experience

Performance History : Many internal measurements on Nuclear Electric plant and site, experience in foreign plant measurements (PWRs in Spain and Belgium). Site surveys have been carried out, inter alia, at British Rail railheads and around the Trawsfynydd lake. Internal confidential reports may be made available on request.

Comments : On site supply to liquid nitrogen and electricity supply point for battery charging is required. Measurements are restricted to gamma emitting isotopes. However, the results are routinely extrapolated to non gamma-emitters by use of fingerprinting and radiochemistry techniques. Easy to use with minimal local support requirements.

Source of Information : International TechCon

**CONSTRUCTION
MATERIALS/DEBRIS**

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : Sensors/Field Analysis Equipment

Technology Name : Differential DIE Away For Induced Fission Using NeuSight

Application : Non-intrusive

Brief Description : Intense pulsed neutron source for use in induced fission characterization of waste through differential DIE away technique and neutron radiography (matrix correction). Excellent pulsing characteristic with negligible DAR current and intensity at least x10 nearest alternative transportable source (D-T Tube) significantly improved detection levels due to improved signal to noise.

Company Name/POC: Oxford Instruments/Nigel Boulding

Address : Accelerator Technology Group/Osney Mead/ Oxford OX2 ODX, UK

Phone Number : 44 1865 269500

Fax Number : 44 1865 26950

Technology Maturity : Commercial use experience

Performance History : Accelerator is already a proven product in medical and nuclear applications in fixed sites.

Comments : Lower limits of detection of fissile material yet to be determined. Can be configured as a mobile source/system for use at various sites. Minimal infrastructure requirements. Delivery of system within one year. Can collaborate with Rolls-Royce and could jointly provide x-ray/neutron interrogation systems for waste drum characterization.

Source of Information : International TechCon

CONTAMINANTS :

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

■ Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

Halogenated VOC

■ N/A

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name : Germanium Sonde Operation

Application :

On-site

Ex-situ

Brief Description :

The germanium "cryoprobe" or "cryosonde" uses a high purity Ge spectrometer cooled by a solid cryogen to make high resolution logs of gamma activity. The method is unsurpassed sensitivity and selectivity. The technology alternative is coring and lab assay.

Company Name/POC: Princeton Geophysical Services, Inc./J. Baicker

Address : P.O. Box 900/Rocky Hill, New Jersey 08553

Phone Number : 609 921-7061

Fax Number : 609 921-7132

Technology Maturity : Commercial use experience

Performance History : Logged more than 100,000 feet in holes totaling more than 1.2 million feet. Clients include most uranium mining companies.

Comments : Operators are provided. Limited to gamma rays >60KeV. Logging trucks are available. No general challenges except quantitative calibration in DOE environments.

Source of Information : TechCon

CONSTRUCTION MATERIALS/DEBRIS

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : SIGNATURE Gamma Radionuclide Detection and Analysis System

Application : On-site Ex-situ

Brief Description : Provides spectral analysis of a radioactive sample using sodium iodide scintillation detectors with greater efficiency than high purity germanium, and without complex and expensive cooling systems. Uses sophisticated digital signal processing techniques to provide measurement resolution comparable with high purity germanium at reduced cost of ownership. Original concept applied to reactor on-line fission product monitoring, further developed for environmental monitoring. Has undergone trials using blind and mixed radionuclide sources. Identification and quantification of component radionuclides has been achieved down to levels of a few becquerels. Use of sodium iodide well detector and automated sample changing will give further benefits. Suitable for initial evaluation of contamination or confirmation of satisfactory decontamination.

Company Name/POC: Siemens Environmental Systems Ltd./Dr. W.E. Croydon

Address : Sopers Lane, Poole/Dorset, BH 17 7ER/England

Phone Number : 44 1202 782648

Fax Number : 44 1202 78215

Technology Maturity : Field demo complete

Performance History : Performance Data are Available.

Trial systems monitoring reactor coolant have been installed on three UK power stations, both AGR and MAGNOX, and on other PWR nuclear plant. A 2 out of 4 voted hardware trip mode is available to shut down the reactor in the event of a significant increase of specific fission products. Typical measurements are of ~50 kBq/kg Kr-88 in a mixed power spectrum of ~50 MBq/kg N-16 and other isotopes, and agree with grab sample measurements made with a high purity germanium system to within 10 percent. A trial system for environmental monitoring has been configured to detect atmospheric contamination, suitable for the UK national RIMNET2 emergency response system. Laboratory evaluation has detected radionuclides at levels of a few Becquerels. Further improvements are under consideration.

Comments : Limited by detector characteristics, which must be designed for the particular application e.g., operating temperature, mechanical shock, weight of background radiation shielding. Flexible system which can be tailored to meet the needs of a specific application. Stand alone or connected to network for remote operation. Challenges are in optimization of system for ease of calibration and extension to variable geometries. Discussions are underway with the Geosciences Advisory unit at Southampton University, UK with a view to combining a sodium iodide well detector and automated sample changing stage with the SIGNATURE analysis system. This would provide improved automated equipment for analysis of radionuclide contamination for either field or laboratory use, and with low cost of ownership. Alternative detector systems could be designed to address other monitoring requirements. Trials have been carried out involving the following isotopes: Eu-155, Mn-54, Ba-133, Na-22, Zn-65, Am-241, Co-60, Cs-134, Cs-137, Eu-152, Ru-106, Co-58, Co-57, Sr-85, I-131, K-40, Gd-153, Sc-46, Tb-160, Ru-103, Cd-109, Ce-139, Sn-113, Y-88, Ra-226, Pb-214, Bi-214, Kr-88, N-16, O-19, Ar-41, Ir-192, Hg-203. However, the system is not limited to available test isotopes but should detect any gamma emitting radionuclide through the use of library emission data.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☒ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Laboratory Analysis***Technology Name :** Accelerator Mass Spectroscopy (AMS)**Application :** On-site Ex-situ
Off-site**Brief Description :** This instrument measures the relative abundance of carbon 14/12, Iodine 129/122, etc. to better than 1 part in 1E15.**Company Name/POC:** Triumph/Phillip Gardner**Address :** 4004 Wesbrook Mall/Vancouver, B.C, Canada, V6T 2A3**Phone Number :** 604 222-1047**Fax Number :** 604 222-1074**Technology Maturity :** Commercial use experience**Performance History :** AMS is a well known analytical technique worldwide - J.Vogel, L.L.B.L., CA, USA - E. Litherland, U. Toronto, Ont., Canada**Comments :** AMS is only appropriate for elements that make negative ions only. Positive ions must be done in conventional E-M mass spec.**Source of Information :** International TechCon

**CONSTRUCTION
MATERIALS/DEBRIS**

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : Decision Support Tools

Technology Name : Site Planner

Application :

Other Application

Brief Description : Workstation-based software for decision support in site assessment and remediation. Site Planner replaces slow, low-productivity manual data management and visualization techniques and point solution software systems.

Company Name/POC: ConSolve Inc./David Barber

Address : 70 Westview St./Lexington, MA 02173

Phone Number : 508 358-8061

Fax Number : 508 358 806

Technology Maturity : Commercial use experience

Performance History : Site Planner is currently deployed on about 20 projects including use by four DOE laboratories.

Comments : Two days on-site training required. Limited by normal computer hardware limitations. System runs on stand-alone Unix workstations.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Decision Support Tools*

Technology Name : Software for Decommissioning Planning (STILLKO)

Application : On-site Ex-situ
Off-site

Brief Description : The main functions and applications of this technology are:
 - calculation of costs for decommissioning of nuclear facilities,
 - evaluation of different decommissioning strategies and concepts, and
 - optimization of a specific concept and of working plans.

STILLKO delivers detailed costs, time schedules, required personal capacities, massflow, radwaste information and dose rates.

Company Name/POC: NIS Ingenieurgesellschaft mbH/Ludwig Seyfferth

Address : DonaustraBe 23/D-63452 Hanau/Germany

Phone Number : 49 181 185 159

Fax Number : 011 49 6181 1200 33

Technology Maturity : Commercial use experience

Performance History : First version was developed in the seventies; it is being used and has been updated since then. Authorized in Europe for cost calculations for creating future decommissioning funds. Applied for all commercial nuclear power plants in Germany and in other European countries, also for reprocessing plants, fast breeder reactor and other facilities.

Comments : The application of STILLKO for DOE's project would best be done on a cooperative basis with a U.S. partner.

Source of Information : International TechCon

**CONSTRUCTION
MATERIALS/DEBRIS**

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Geophysics/Hydrogeologic Measurements*

Technology Name : Magnetometry

Application :

Non-intrusive

Brief Description :

Provides subsurface image maps of magnetic anomalies; computer driven array of full field magnetometers with local navigation system contemporaneously processed. "Outstanding" per Sandia report, April 30, 1992. STOLS/MAG consists of an array of 7 cesium vapor magnetometers mounted to a 10 foot boom on a low magnetic signature platform towed by a low magnetic signature vehicle with integrated microwave navigation, data acquisition and a remote magnetometer station to track diurnal variations in the earth's field. A separate processing computer images the survey data. Interactive routines assist the operator in target analysis and output. Outputs include site survey maps, missed area maps, target maps, and landmark maps. Target lists give target ID, (X,Y) location, depth and category (small, medium large) estimates. STOLS/MAG can survey up to 20 acres/day with overnight results. Location accuracies are plus or minus 1m in (X,Y); depth and category estimates are a function of convergence to a magnetic dipole model.

Company Name/POC: GEO-CENTERS, Inc./Dr. Denis Reidy, Richard J. Russell

Address : 7 Wells Avenue/Newton Centre, Massachusetts 02159

Phone Number : 617 964-7070

Fax Number : 617 527-759

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

3 ~60 acre surveys at Aberdeen Proving Ground, MD for buried ordnance with excellent results - Contact: R. Robertson, NAVEODTECHCEN (301) 743-6850; 1~30 acre surveys at Edgewood Arsenal, MD for buried ordnance with excellent results - Contact: J. Arnold, USATHAMA (301) 671-4811; 3 sites approximately 30 acres, SNL, NM trenches, buried hazardous waste containers and objects - excellent results - Contact: J. Cochran (505) 844-7209

Comments :

Can be deployed in cleared areas with generally navigable off road vehicle type terrain. Performs best in dry weather, but can operate in light rain with supplemental weather protection. Equipment is presently in use virtually full time by DOD. It is a demonstration prototype system. A field & weather hardened preproduction prototype with updated hardware & navigation technique is required.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Geophysics/Hydrogeologic Measurements***Technology Name :** Focused Array Radar (FAR) Sensor Technology**Application :** Non-intrusive

Brief Description : A GPR technology which uses DSP-based controlling electronics triggers and an array of radar transmitters and receivers with the precise timing and control required to focus the radar energy more efficiently into the ground (even from high standoff). Produces real-time image display of radar reflections in position under the array and provides a bird's-eye-view of the area as the array moves horizontally across the ground, providing acceptability to radar data now presently available.

Company Name/POC: GEO-CENTERS, Inc./Richard J. Russell**Address :** 7 Wells Avenue/Newton Centre, Massachusetts 02159**Phone Number :** 617.964-7070**Fax Number :** 617 527-7592**Technology Maturity :** Field demo complete

Performance History : Presently being tested with GEO-CENTERS, Inc. 1 GHz TEMR horn antennas in a four-transmitter, 4-receiver array to locate buried mine simulants for DARPA under Tom Hafer (703 243-6680).

Comments : Limited to environmental conditions which allow the radar energy to pass into the ground and reflect back to array. Non-invasive, easy-to-use and to interpret data; requires only surface access to site. Software can be implemented to provide easy-to-read maps of radar targets over site and depth. Present prototype being tested with array of 1 GHz antennas for countermine applications; must be scaled to other frequencies.

Source of Information : TechCon

**CONSTRUCTION
MATERIALS/DEBRIS****CONTAMINANTS :**☐ Pesticides/Herbicides☐ Heavy Metals☐ PCB☐ Explosives/Propellants☐ Petroleum Hydrocarbons☐ Radionuclides☐ SVOC☐ Other Contaminant☐ Nonhalogenated VOC☐ Halogenated VOC☐ N/A**TECHNOLOGY TYPE : *Geophysics/Hydrogeologic Measurements*****Technology Name :** Multi-Frequency Ground Electromagnetic Sensor (GEM)**Application :**

Non-intrusive

Brief Description : Ground-based, hand-held, multi-frequency, digital, electromagnetic profiler; can detect buried objects, pits, trenches, certain contaminant plumes, and geologic conditions. Measures minute variations in the earth's electrical conductivity.**Company Name/POC:** Geophex, Ltd./I.J. Won**Address :** 605 Mercury Street/Raleigh, North Carolina 27603-2343**Phone Number :** 919 839-8515**Fax Number :** 919 839-852**Technology Maturity :** Commercial use experience**Performance History :** Have completed about 10 jobs typically in the range of tens of thousands of dollars; in all cases, highly successful in finding buried objects and, at times, contaminant plumes; DOE reference: Dr. James Aldrich, LANL, 505 667 1495.**Comments :** Cannot be used in densely-built areas or inside buildings; one-man field operation; internal electronic data memory that downloads to a laptop computer.**Source of Information :** TechCon

Containers/Equipment

Characterization

Containers/Equipment

Characterization

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☒ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Mobile Laboratory for Chemical Weapons, Explosives and Propellants**Application :** On-site Ex-situ**Brief Description :** Mobile laboratory with all necessary chemical and physical equipment to detect and analyze chemical weapons, explosives, propellants and other toxic materials.**Company Name/POC:** Alba Industrie Umweltschutz Service GmbH/Dr. K. Faber**Address :** Rehrhoferweg 160/D29625 Munster/Germany**Phone Number :** 051 92 96 3212**Fax Number :** 051 92 96 3311**Technology Maturity :** Commercial use experience**Performance History :** In use for two years, e.g., in Russia and also in Germany.**Comments :** None.**Source of Information :** International TechCon

CONTAINERS/EQUIPMENT

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Sensors/Field Analysis Equipment

Technology Name : Monitoring of Chemical Weapons in Soil, Water, Air, Buildings

Application : On-site Ex-situ

Brief Description : Monitors all relevant parameters, like concentrations of chemical weapons in air, soil, water, and buildings.

Company Name/POC: Alba Industrie Umweltschutz Service GmbH/Dr. K. Faber

Address : Rehrhoferweg 160/D29625 Munster/Germany

Phone Number : 051 92 96 3212

Fax Number : 051 92 96 3311

Technology Maturity : Commercial use experience

Performance History : Refer to POC for performance history.

Comments : None.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Chemical Sensing with TelecommLink**Application :** In-situ (vadose zone)

Brief Description : Ariano Technologies has developed a low-cost, centrally-managed environmental sensor and telecommunications system (Sen Tel), which will give multiple-tank owners (such as those owning thousands of service stations) real-time early warning of leaks in their gasoline and chemical storage tanks around the country. In addition, its centrally managed feature will guarantee the integrity of the record-keeping process, a critical issue when establishing environmental liability insurance rates and when it becomes necessary to provide a credible audit trail in the event of an environmental incident.

Company Name/POC: Ariano Technologies, Inc./Thomas J. Cody, Jr.**Address :** 91 Harvey St./Cambridge, MA 02140**Phone Number :** 617 661-6110**Fax Number :** 617 661-6030**Technology Maturity :**

Bench scale testing, only

Performance History : Contact company for performance data.**Comments :**

SenTel, which allows the reading of any type of commercially available sensor, features a novel hydrocarbon-vapor sensor, the company's first commercial application of a line of patented fiber-optic chemical sensors and related instrumentation for detecting the presence of hazardous chemicals in air, soil or groundwater. The sensor, including a site-specific RF-transmitter link, can be battery-powered to operate independently of electrical or fiber-optic conduit beyond the immediate vicinity of the sensor. The core of the company's chemical-sensor technology was developed at Tufts University in Boston. Ariano has exclusive, worldwide environmental rights to all related patents and know-how developed to date, and has certain rights to similar technology developed at Tufts in the future. The individual unit operations of the SenTel system have been built and tested successfully, and the Company now intends to fabricate six integrated commercial prototypes for more extensive demonstration in the field. The SenTel system is expected to be sold on an EOM basis at a price well below the cost-per-sensing-point level of environmental sensors currently on the market.

Source of Information : TechCon

CONTAINERS/EQUIPMENT

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : On Line Gamma Monitoring Systems

Application : On-site Ex-situ

Brief Description : On line gamma monitoring systems for discrimination of radioactively contaminated and uncontaminated materials.

Company Name/POC: KEMA Nederland B.V./J. van der Steen

Address : P.O. Box 9035 NL-6800 ET/ARNHEM The Netherlands

Phone Number : 31 26 356 6104

Fax Number : 31 26 351 5835

Technology Maturity : Field demo complete

Performance History : Contact company for performance history data.

Comments : High gamma background might present some problems with the detection limit. The system has been developed for the cleanup of disposal areas for low level radioactive waste at KEMA. It proved to be a quick and reliable system, which accelerated the cleanup operation considerably.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Alpha Track Etch Detectors

Application : Non-intrusive

Brief Description : Detectors using alpha track technology have been in widespread use for the past 15 years. These detectors are composed of a very pure and specific form of CR-39 type polycarbonate plastic. The material is not sensitive to interference from beta or gamma radiation and exhibits a 70 percent efficiency to alpha particles. The detectors are deployed. Alpha particles will penetrate the detector surface forming damage sites which, when etched in a caustic bath, are enhanced and visible under magnification. Evaluation of etched detectors will quantify levels of alpha contamination and characterize its distribution. Alpha track detectors have a nominal thickness of 1.0 mm and can be laser cut to various dimensions. Conventional radiation survey instruments employ probes which are large and cannot access irregular surfaces or crevices which may hold alpha contaminated material. It is questionable that conventional instrumentation can accurately measure the low levels of alpha contamination permitted under existing release levels.

Company Name/POC: Landauer, Inc./Sue Morrow
 Address : 2 Science Road/Glenwood, Illinois 60425

Phone Number : 708 755-7000 Fax Number : 708 755-7016

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Although the alpha track technology has been commercially available since 1978, its application to characterization of alpha contamination is new and the application's development effort has been conducted jointly with ORNL. Pilot tests have involved deployment inside crevices, valve and flange surfaces, contaminated floors, under hot cell/glove boxes. (Dr. Richard Gammage, Martin Marietta Energy Systems, Inc., (615) 574 6256). Initial tests have been completed to characterize the level of contamination gradients and form of suspension in ground water. (Dr. John McCarthy, ORNL (615) 576 6606).

Comments : A technician could deploy individual detectors at hundreds of site locations in a day with retrieval on the same or following day. Little additional training is required beyond that already common to a person trained in taking radiation measurements. Specific etching and detector evaluation training require few basic skills beyond that of a high school graduate with general chemistry or physics background. Landauer's proprietary Lantrak (registered name) detector material and optimized processing protocols permit a low detection level and precise data. Technology is likely not appropriate for 100 percent monitoring of large surface areas of when live-time data is a prerequisite. It is expected that statistical sampling of surfaces with contamination levels at or below the regulatory release level will be a main value of this technology. Landauer, Inc., now processes some 1,000,000 detectors per month of various types including the alpha track type, and offers this service on a commercial basis. In situations where on-site processing is required, a satellite laboratory can be readily established using commercially available etching and analysis equipment. Landauer maintains current training and QC protocols for this technology.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Release Measurement (RM)

Application : ☒ On-site ☒ Ex-situ

Brief Description : Total gamma-measurement for release of large amounts of (very) low level residual materials for conventional reutilization of materials or disposal. The technology is designed for disclosure of hidden gamma-emitters.

Company Name/POC: NIS Ingenieurgesellschaft mbH/Ludwig Seyffert

Address: Donaustraße 23/D-63452 Hanau/Germany

Phone Number : 49 181 185.159 **Fax Number :** 011 49 6181 1200 3

Technology Maturity : Commercial use experience

Performance History : The development of the concept was sponsored within the R&D program of the European Commission. The first facility application was in 1988 for material from the dismantling of a nuclear power plants (NPP) in Niederaichbach. The mobilized version is being used for release measurements at operating NPP. Another facility has been installed at the NPP Greifswald for the dismantling program of 5 NPP units.

Comments : The technology is suitable for gamma-emitting radionuclides only. The concept can be adapted to specific requirements (e.g., size, specialized for specific material, other local requirements). So far the technology has not been applied in the U.S. The facility could be delivered directly or through a partner in the U.S. (e.g. NUS Corp). The existing facility achieves an average throughput of 10 t/d (depending on the kind of material). For application within the Wismut restoration program a facility for about 100 t/d is in the planning and licensing stage: A modified concept is being used for monitoring of trucks and railroad cars.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Contaminated Land Measurements

Application : Non-intrusive

Brief Description : In-situ high resolution gamma spectrometry is used to perform large area radiological clearance surveys and plant inventory measurements. Characterization and quantification of gamma emitting nuclides are typically possible to well below UK de minimis standards (400 Bq/kg). Measurements of total dose rates from spectral determinations at less than 0.05 microSv/h are routine. By use of high resolution gamma spectrometry in large area surveys, adequate limits of detection can be confidently obtained with short count times enabling many points to be surveyed in a working day.

Company Name/POC: Nuclear Electric plc/Dr. R. Clayton

Address : Littlebrook Complex/Littlebrook Manorway/Dartford Kent DA1 5PY, UK

Phone Number : 44 1322 28 2800

Fax Number : 44 1322 28 2819

Technology Maturity : Commercial use experience

Performance History : Many internal measurements on Nuclear Electric plant and site, experience in foreign plant measurements (PWRs in Spain and Belgium). Site surveys have been carried out, inter alia, at British Rail railheads and around the Trawsfynydd lake. Internal confidential reports may be made available on request.

Comments : On site supply to liquid nitrogen and electricity supply point for battery charging is required. Measurements are restricted to gamma emitting isotopes. However, the results are routinely extrapolated to non gamma-emitters by use of fingerprinting and radiochemistry techniques. Easy to use with minimal local support requirements.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Differential DIE Away For Induced Fission Using NeuSight**Application :** Non-intrusive

Brief Description : Intense pulsed neutron source for use in induced fission characterization of waste through differential DIE away technique and neutron radiography (matrix correction). Excellent pulsing characteristic with negligible DAR current and intensity at least x10 nearest alternative transportable source (D-T Tube) significantly improved detection levels due to improved signal to noise.

Company Name/POC: Oxford Instruments/Nigel Boulding**Address :** Accelerator Technology Group/Osney Mead/Oxford OX2 ODX, UK**Phone Number :** 44 1865 269500**Fax Number :** 44 1865 26950**Technology Maturity :** Commercial use experience**Performance History :** Accelerator already proven product in medical and nuclear applications in fixed sites.

Comments : Lower limits of detection of fissile material yet to be determined. Can be configured as a mobile source/system for use at various sites. Minimal infrastructure requirements. Delivery of system within one year. Can collaborate with Rolls-Royce and could jointly provide x-ray/neutron interrogation systems for waste drum characterization.

Source of Information : International TechCon

COMMENTS:

Pesticides/Herbicides

Heavy Metals

PCB

Explosives/Propellants

Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

polymer-generated VOC

Halogenated VOC

N/A

TECHNOLOGY TYPE: *SensorField Analysis Equipment*

Technology Name : Germanium Sonde Operation

Application:	On-site	Ex-situ

Brief Description : The germanium "cryoprobe" or "cryosonde" uses a high purity Ge spectrometer cooled by a solid cryogen to make high resolution logs of gamma activity. The method is unsurpassed sensitivity and selectivity. The technology alternative is coring and lab assay.

Company Name/POC: Princeton Geophysical Services, Inc./J. Baicker

Address: P.O. Box 900 Rocky Hill, New Jersey 08553

Phone Number: 609 921-7061

Fax Number : 609 921-7132

Technology Maturity : Commercial use experience

Performance History : Logged more than 100,000 feet in holes totaling more than 1.2 million feet. Clients include most uranium mining companies.

Comments : Operators are provided. Limited to gamma rays >60KeV. Logging trucks are available. No general challenges except quantitative calibration in DOE environments.

Source of information: TechCon

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name: SIGNATURE Gamma Radionuclide Detection and Analysis System

Application: On-site ☒ Ex-situ ☒

Brief Description: Provides spectral analysis of a radioactive sample using sodium iodide scintillation detectors with greater efficiency than high purity germanium, and without complex and expensive cooling systems. Uses sophisticated digital signal processing techniques to provide measurement resolution comparable with high purity germanium at reduced cost of ownership. Original concept applied to reactor on-line fission product monitoring, further developed for environmental monitoring. Has undergone trials using blind and mixed radionuclide sources. Identification and quantification of component radionuclides has been achieved down to levels of a few becquerels. Use of sodium iodide well detector and automated sample changing will give further benefits. Suitable for initial evaluation of contamination or confirmation of satisfactory decontamination.

Company Name/POC: Siemens Environmental Systems Ltd./Dr. W.E. Croydon

Address: Sopers Lane, Poole/Dorset, BH 17 7ER/England

Phone Number: 44 1202 782648

Fax Number: 44 1202 78215

Technology Maturity: Field demo complete

Performance History: Performance Data are Available.

Trial systems monitoring reactor coolant have been installed on three UK power stations, both AGR and MAGNOX, and on other PWR nuclear plant. A 2 out of 4 voted hardware trip mode is available to shut down the reactor in the event of a significant increase of specific fission products. Typical measurements are of ~50 kBq/kg Kr-88 in a mixed power spectrum of ~50 MBq/kg N-16 and other isotopes, and agree with grab sample measurements made with a high purity germanium system to within 10 percent. A trial system for environmental monitoring has been configured to detect atmospheric contamination, suitable for the UK national RIMNET2 emergency response system. Laboratory evaluation has detected radionuclides at levels of a few Becquerels. Further improvements are under consideration.

Comments: Limited by detector characteristics, which must be designed for the particular application e.g., operating temperature, mechanical shock, weight of background radiation shielding. Flexible system which can be tailored to meet the needs of a specific application. Stand alone or connected to network for remote operation. Challenges are in optimization of system for ease of calibration and extension to variable geometries. Discussions are underway with the Geosciences Advisory unit at Southampton University, UK with a view to combining a sodium iodide well detector and automated sample changing stage with the SIGNATURE analysis system. This would provide improved automated equipment for analysis of radionuclide contamination for either field or laboratory use, and with low cost of ownership. Alternative detector systems could be designed to address other monitoring requirements. Trials have been carried out involving the following isotopes: Eu-155, Mn-54, Ba-133, Na-22, Zn-65, Am-241, Co-60, Cs-134, Cs-137, Eu-152, Ru-106, Co-58, Co-57, Sr-85, I-131, K-40, Gd-153, Sc-46, Tb-160, Ru-103, Cd-109, Ce-139, Sn-113, Y-88, Ra-226, Pb-214, Bi-214, Kr-88, N-16, O-19, Ar-41, Ir-192, Hg-203. However, the system is not limited to available test isotopes but should detect any gamma emitting radionuclide through the use of library emission data.

Source of Information: International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Laboratory Analysis***Technology Name :** Accelerator Mass Spectroscopy (AMS)**Application :** On-site Ex-situ
Off-site**Brief Description :** This instrument measures the relative abundance of carbon 14/12, Iodine 129/122, etc. to better than 1 part in 1E15.**Company Name/POC:** Triumph/Phillip Gardner**Address :** 4004 Wesbrook Mall/Vancouver, B.C, Canada, V6T 2A3**Phone Number :** 604 222-1047**Fax Number :** 604 222-1074**Technology Maturity :** Commercial use experience**Performance History :** AMS is a well known analytical technique worldwide - J.Vogel, L.L.B.L., CA, USA - E. Litherland, U. Toronto, Ont., Canada**Comments :** AMS is only appropriate for elements that make negative ions only. Positive ions must be done in conventional E-M mass spec.**Source of Information :** International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Decision Support Tools*

Technology Name : Site Planner

Application :

Other Application

Brief Description : Workstation-based software for decision support in site assessment and remediation. Site Planner replaces slow, low-productivity manual data management and visualization techniques and point solution software systems.

Company Name/POC: ConSolve Inc./David Barber**Address :** 70 Westview St./Lexington, MA 02173**Phone Number :** 508 358-8061**Fax Number :** 508 358 806**Technology Maturity :** Commercial use experience**Performance History :** Site Planner is currently deployed on about 20 projects including use by four DOE laboratories.

Comments : Two days on-site training required. Limited by normal computer hardware limitations. System runs on stand-alone Unix workstations.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Decision Support Tools*

Technology Name : Software for Decommissioning Planning (STILLKO)

Application : On-site Ex-situ
Off-site

Brief Description : The main functions and applications of this technology are:

- calculation of costs for decommissioning of nuclear facilities,
- evaluation of different decommissioning strategies and concepts, and
- optimization of a specific concept and of working plans.

STILLKO delivers detailed costs, time schedules, required personal capacities, massflow, radwaste information and dose rates.

Company Name/POC: NIS Ingenieurgesellschaft mbH/Ludwig Seyfferth

Address : DonaustraBe 23/D-63452 Hanau/Germany

Phone Number : 49 181 185 159

Fax Number : 011 49 6181 1200 33

Technology Maturity : Commercial use experience

Performance History : First version was developed in the seventies; it is being used and has been updated since then. Authorized in Europe for cost calculations for creating future decommissioning funds. Applied for all commercial nuclear power plants in Germany and in other European countries, also for reprocessing plants, fast breeder reactor and other facilities.

Comments : The application of STILLKO for DOE's project would best be done on a cooperative basis with a U.S. partner.

Source of Information : International TechCon

CONTAMINANTS: ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE: *Remote Sensing***Technology Name :** Inductive Transponder System**Application :**

Other Application

Brief Description : Inductive Transponder System (RF tags) are used for identifying and locating containers, vehicles and persons (reference control); guiding vehicles (automation).

A reader energizes the transponder by means of an electromagnetic field, which is emitted by the antenna. It then receives the code signal returned by the transponder and processes it.

Company Name/POC: Gotting KG/Hans-H. Gotting**Address :** Celler Str. 5/31275 Lehrte, Germany**Phone Number :** 0049 51 36 80 96 0**Fax Number :** 0049 51 36 80 96 8**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.

1987 - London and Venice. Tags used for subway identification.

1988 - And onwards, approximately 5,000 tags per year for automated guided vehicles.

1991 - Euro Tunnel (France-GB). Vehicle guiding: 2 x 50 km.

1992 - Guiding of cars at 120km/h.

1994 - First guidance of driverless 400t cranes.

1995 - Running project with more than 100,000 tags for container identification.

Comments : Tags either (1) attached to a container/vehicle or carried by a person (as identification); (2) lays in the ground (track guidance). Maximum reading distance 0.25-1m. Easily controlled by a PC giving the operator on-line access to vehicles and containers.**Source of Information :** International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : Other

Technology Name : Detection, Removal, Disassembling of Munitions (DRDM)

Application : On-site Ex-situ

Brief Description : Munitions detection and destruction. Munitions are detected using specific sensors and software. Removal and disassembling can be done in mobile containers. Destruction can be done by thermo catalytic cracking.

Company Name/POC: Alba Industrie Umweltschutz Service GmbH/Dr. K. Faber

Address : Rehrhoferweg 160/D29625 Munster/Germany

Phone Number : 051 92 96 3212

Fax Number : 051 92 96 3311

Technology Maturity : Commercial use experience

Performance History : Detection has been used for many years; however, the Koehler discrimination method has only been used one year. Disassembling methods are based on those used for ammunitions for many years but will be made mobile in containers (especially for use with old munitions).

Comments : Very old ammunitions situated on shooting grounds cannot be transported and therefore, must be disassembled on site. The Koehler mobile technology can perform this.

Source of Information : International TechCon

Vapor Phase

Characterization

Vapor Phase

Characterization

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Physical Sampling*

Technology Name : Soil Gas Tracking System

Application :
In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : This equipment provides automated sampling methods to obtain soil gases for analysis (helium and radon). The results have been used to detect subsurface (bedrock) fractures that are discharging groundwater. Current plans are to develop the technology with on-site analytical capability for the analysis of soil gases. The technique could be used to survey an area on a detailed or a broad grid to detect groundwater discharge, mineralization, or source of He, Rn and conceivable, H, CO, etc. Combining this technique with SpectraSmart would allow on-site sampling and analysis of volatile organic compounds. SpectrSmart has been used successfully, in the laboratory, to detect VOCs in groundwater samples.

Company Name/POC: AECL Research/C. A. McDowall

Address : Whiteshell Laboratories/ Pinawa Manitoba, Canada R0E 1L0

Phone Number : 204 753-2311

Fax Number : 204 753-2922

Technology Maturity : Field demo complete

Performance History : There has been one major contract (two phases) running from 1987-1991. Both phases were successful with no significant problems. Reference Contact: Dr. Kevin Butter/Her Majesty's Inspectorate of Pollution / U.K. Dept. of Environment/Tel: 71 276 8099.

Comments : Operation requires chemical technologist trained in mass spectrometry, radioactive counting, and organic analyses. Operation of the technology would be limited by frozen ground or bedrock at the surface. A sample vessel (for saturated soils) or an access tube (for unsaturated soils) is used at a preselected depth to collect the soil gas. The collected gas is then analyzed using a relevant method: Helium-a mass spectrometer; Radon - scintillation counting; VOCs - SpectraSmart or gas chromatography. Performance standards for specific gases are as follows: Helium - presently state-of-the-art technology with referenced journal articles to support this claim; Radon - state-of-the-art for unsaturated soils but untested, as yet, for saturated soils; VOCs - not field tested but comparable to gas chromatography. All sampling and analysis can be done in the field with a fast turn around of results. Results are comparable to other available techniques but you don't have to take samples back to the lab for analysis.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Physical Sampling*

Technology Name : "Non-Drilling" Hydraulic Probe Sampling and Mobile Lab Analysis

Application : In-situ (vadose zone) Ex-situ
 In-situ (saturated zone)

Brief Description : Combined "non-drilling" sampling technology for unconsolidated soils and field laboratory analysis of VOCs using lab-grade gas chromatography equipment. Rapid sample collection (soil-gas, soil and water) with minimal investigation-derived waste generation (e.g., no cutting or purge water), and real-time field analysis with a high level of QA/QC (e.g., HAZWRAP "Level B" DQO equiv.). Cost-effective, time efficient complement to traditional drill rig sample collection in unconsolidated sediment. No waste is generated and probe equipment is very safe to operate. Real-time analytical results (primarily headspace techniques) permit rapid decision-making and "one time" thorough site assessments.

Company Name/POC: EnviroSurv, Inc./Hunt Chapman

Address : 2800 C Dorr Ave./Fairfax, Virginia 22031

Phone Number : 703 204-3580

Fax Number : 703 204-358

Technology Maturity : Commercial use experience

Performance History : DOE Contact: Dr. Robert Siegrist, Oak Ridge National Lab.

Comments : Technology application requires experienced field chemists and hydrogeologists. The data generated equals, or exceeds, fixed lab quality. But the CLP bias must be overcome; namely the perception that such information is always superior to field analytical results. The field results can be self supporting in terms of spikes, duplicates, calibration data and supporting documentation. Probing equipment is limited to unconsolidated sediments. Also, technique is not amendable to continuous coring, or borehole logging. Large sample throughput is primarily limited to VOCs. Fewer analyses per day are possible when extractions are required. Analysis is "efficiency" limited to 10-15 target compounds. Full scan VOCs analyses are less cost-effective and time efficient. Rapid mobilization, equipment set-up and use by experienced personnel. Only a 2-person field team required for sample acquisition and on-site analysis. Flexibility for all media sample collection and analysis (soil-gas, soil and water). Regulatory agency awareness of data quality; overcoming the "fixed-lab bias." Acceptable as a complement to the traditional drill rig/fixed lab approach to environmental site characterization. The quality of data generated depends on the experience and knowledge of field personnel. Widespread technology use will increase as more people become aware of the sample quality problems associated with handling, shipment and delayed analysis.

Source of Information : TechCon

CONTAMINANTS :

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☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : SpectraSmart Ambient Air Analyser

Application : On-site Ex-situ

Brief Description : The SpectraSmart Ambient Air Analyzer is an ultraviolet spectrophotometer which is capable of measuring certain undesirable gases in ambient air and industrial environments. This technology has applications in the industrial hygiene, stack emissions, process monitoring and environmental protection markets. The technology performs quickly and accurately and can measure levels down to the threshold limit value. This technology can replace portable gas chromatographs and laboratory analysis of air samples. The advantages of this technology are: (1) provides real-time monitoring; (2) accurate; (3) has the ability to identify and measure individual components of complex gas samples and (4) easy to use.

Company Name/POC: AECL Research/C. A. McDowall

Address : Whiteshell Laboratories/ Pinawa Manitoba, Canada R0E 1L0

Phone Number : 204 753-2311

Fax Number : 204 753-2922

Technology Maturity : Pilot plant testing

Performance History : The technology is in the prototype development stage. It has been tested at lab scale using mixtures of gases. There has also been a limited amount of testing with ground water samples.

Comments : The technology is limited by: corrosive environments; temperatures less than 5 degrees C; temperatures more than 35 degrees C; spectrometer limited to wave lengths ranging from 200-400 nanometers. This technology is a prototype and the full operating conditions need to be evaluated. When the final product is developed, it will be extremely easy to use, it can be taken anywhere and no infrastructure will be required. Limits of detection are compound dependent. Examples: sensitivity range of toluene is 1 to 180 parts per million; sensitivity range for aniline is 40 parts per billion to 8 parts per million. Accuracy of results are plus or minus .1 percent of full scale. SpectraSmart has the ability to identify and measure individual components of complex gas samples if it contains ultraviolet absorbing compounds.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Mobile Laboratory for Chemical Weapons, Explosives and Propellants

Application : On-site Ex-situ

Brief Description : Mobile laboratory with all necessary chemical and physical equipment to detect and analyze chemical weapons, explosives, propellants and other toxic materials.

Company Name/POC: Alba Industrie Umweltschutz Service GmbH/Dr. K. Faber

Address : Rehrhoferweg 160/D29625 Munster/Germany

Phone Number : 051 92 96 3212 **Fax Number :** 051 92 96 3311

Technology Maturity : Commercial use experience

Performance History : In use for two years, e.g., in Russia and also in Germany.

Comments : None.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Monitoring of Chemical Weapons in Soil, Water, Air, Buildings

Application : On-site Ex-situ

Brief Description : Monitors all relevant parameters, like concentrations of chemical weapons in air, soil, water, and buildings.

Company Name/POC: Alba Industrie Umweltschutz Service GmbH/Dr. K. Faber

Address : Rehrhoferweg 160/D29625 Munster/Germany

Phone Number : 051 92 96 3212

Fax Number : 051 92 96 3311

Technology Maturity : Commercial use experience

Performance History : Refer to POC for performance history.

Comments : None.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Chemical Sensing with TelecommLink

Application : In-situ (vadose zone)

Brief Description : Ariano Technologies has developed a low-cost, centrally-managed environmental sensor and telecommunications system (Sen Tel), which will give multiple-tank owners (such as those owning thousands of service stations) real-time early warning of leaks in their gasoline and chemical storage tanks around the country. In addition, its centrally managed feature will guarantee the integrity of the record-keeping process, a critical issue when establishing environmental liability insurance rates and when it becomes necessary to provide a credible audit trail in the event of an environmental incident.

Company Name/POC: Ariano Technologies, Inc./Thomas J. Cody, Jr.

Address : 91 Harvey St./Cambridge, MA 02140

Phone Number : 617 661-6110

Fax Number : 617 661-6003

Technology Maturity :

Bench scale testing, only

Performance History : Contact company for performance data.

Comments : SenTel, which allows the reading of any type of commercially available sensor, features a novel hydrocarbon-vapor sensor, the company's first commercial application of a line of patented fiber-optic chemical sensors and related instrumentation for detecting the presence of hazardous chemicals in air, soil or groundwater. The sensor, including a site-specific RF-transmitter link, can be battery-powered to operate independently of electrical or fiber-optic conduit beyond the immediate vicinity of the sensor. The core of the company's chemical-sensor technology was developed at Tufts University in Boston. Ariano has exclusive, worldwide environmental rights to all related patents and know-how developed to date, and has certain rights to similar technology developed at Tufts in the future. The individual unit operations of the SenTel system have been built and tested successfully, and the Company now intends to fabricate six integrated commercial prototypes for more extensive demonstration in the field. The SenTel system is expected to be sold on an EOM basis at a price well below the cost-per-sensing-point level of environmental sensors currently on the market.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Gas Monitors**Application :**

On-site Ex-situ

Brief Description :

B&W has developed gas monitoring equipment for combustible, toxic gases and oxygen to keep personnel and equipment safe from leaks and other exposures. B&W has the longest warranties in the marketplace which is indicative of quality and performance, and provides the only solar powered and disposable gas monitors, in addition to fixed units and other portables. Fixed systems can be replaced with B&W solar powered systems which are more portable and more cost effective for remote and field applications.

Company Name/POC: B&W Technologies Ltd./Neil Campbell**Address :** #242, 3030 - 3rd Avenue N.E./Calgary, AB, Canada T2A 6T7**Phone Number :** 403 248-9226**Fax Number :** 403 273-3708**Technology Maturity :** Commercial use experience

Performance History : A key example of performance history is the use of a B&W Technologies Shack Rat at the Hanford site by Westinghouse Group. The equipment was purchased on the basis that it was unique and solved a problem that no other manufacturer could solve for the users. Contact: Kerry Martin/Westinghouse Hanford Company/P.O. Box 1970/Richland, Washington 99352/509-376-0777/Second Contact: Tory Webb.

Comments :

Physical size depends on type of equipment, the smallest system is telephone pager size and is worn on the belt. Others include fixed systems that weigh 2 lbs, and stand alone remote area systems that weigh up to 30 lbs. All systems are self-contained and need very little maintenance, but must be calibrated every 90 days with commercially available calibration gas. Calibration takes less than 5 minutes, thus support services from outside sources are not required. Limitations within the gas monitoring perimeters are few, in that this equipment is designed to work in the broad range of climatic conditions found throughout all parts of the United States. This testing and operation includes variation in temperature, humidity, precipitation and wind conditions. Ease of use has been a key focus in the design of the B&W gas monitoring line. The monitors are made as simple as possible, however, the range of different types of fixed, portable and stand alone (solar powered) monitors mean that each have a different level of operator interface. Infrastructure and training at the site are only nominally required. The general challenge is to provide the gas sensors for the type of monitoring that is required per site. B&W operates a large number of oxygen, toxic and combustible gas sensors, and a list is available upon request. Sensors not covered by this type of monitor must instead be monitored by different scientific pieces of equipment not designed and sold by B&W Technologies. B&W Technologies is the only company to provide a different type of solar powered gas monitors.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Boundary Layer Emission Monitoring

Application : On-site Ex-situ

Brief Description : This technology measures total gaseous emissions from large area sources such as hazardous waste sites. It does this by measuring total flux in the boundary layer immediately down wind of the source. This technology replaces flux chambers. The system has been used to measure VOCs, CH₄, formaldehyde, H₂S, SO₂, Methyl mercaptan, chloroform, styrene, ethyl mercaptan, dimethyl sulfide and methane. As opposed to FTIR or LIDAR/DIM, many different species can be measured at the same time.

Company Name/POC: British Columbia Research Corporation/Dr. James Hill

Address : 3650 Wesbrook Mall/Vancouver, Canada V6S 2L2

Phone Number : 604 224-4331

Fax Number : 604 224-054

Technology Maturity : Commercial use experience

Performance History : (1) Measured gaseous emissions from pulp mill effluent lagoons (3 mills) 1987, 1980 (Larry Olsen (604) 561-3622; Jack Nyland (604) 962-3397).
 (2) Measured toxic gases from chemical plant (Reichold Chemicals, Pat Moody).
 (3) Measured VOC emissions from different pulp mills in BC for Canadian pulp paper association (Mike Frost (514) 866-6621).

Comments : Wind speed should be between 1m/s and 10-15 m/s. Wind and atmospheric emissions should be fairly constant over the 1 hour sampling period. Should be no thermally buoyant plumes - only ground sources. Easy to use - samples can be analyzed on site using an instrumented trailer, or can be sent to a lab(s) for analysis. Small sites (100 ft across) - sample using a portable mast. Large sites (100 acres) - sample using a tethered balloon. Very large sites (square miles) - sample using ultralight or small aircraft. Site should be reasonably flat - complex terrain may invalidate the assumptions regarding the wind field.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Photoacoustic Spectroscopy (PAS)**Application :** On-site Ex-situ**Brief Description :** Analysis of gases and vapors; especially effective with halogenated hydrocarbons.**Company Name/POC:** Bruel and Kjaer A/S/Flemming Madsen/Michael Vecht**Address :** Skodsborgvej 307/DK-2850 Naerum, Denmark**Phone Number :** 45 42 80 05 00**Fax Number :** 45 45 80 68 84**Technology Maturity :** Commercial use experience**Performance History :** The PAS principle has been used for a number of years and are now deployed in more than 4,000 installations covering applications in medicine, space, chemical agent monitoring and with suitable sampling systems in monitoring and analysis of contaminated land. Reported in a number of DOE reports e.g., under contract DE-AC09-89SR/8035.

Comments :

Features: Big dynamic range; Battery Operation; Several sampling possibilities; User friendly; Data logging capability; Long intervals between calibrations ; Field ruggedness; and Small size and height.

Benefits: Low running costs; portability; well suited for field use; unattended long term monitoring.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Mobile Environmental Mass Spectrometer

Application : On-site

Brief Description : The Mobile Environmental Mass Spectrometer (MEM) is a fully developed electron impact ionization quadrupole Mass Spectrometer designed specifically to be rugged and flexible for on-site analysis of organic compounds. It is tolerant to extreme changes of environmental conditions allowing for a wide range of Data Quality Objectives to be completed. This all-in-one system simplifies sample preparation techniques yielding rapid qualitative and quantitative results on a real-time basis with field uptime better than 95 percent.

Company Name/POC: Bruker Instruments, Inc./J. Wronka

Address : 19 Fortune Drive/Manning Park/Billerica, MA 01821

Phone Number : 508 667-9580

Fax Number : 508 667-599

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

The MEM is successfully being used by the U.S. Army, state agencies, fire brigades, and environmental management firms for a wide variety of applications which include emergency response, site screening and assessment, and clean up monitoring of air, water and soil samples. References: U.S. Army CRDEC, D. Durst, (410) 671 2129; Del State DNREC, J. Rogers, (302) 323 4542; Env. Res Mngmt, D. Gallis, (215) 524 3786; SiteWorks, Inc., Albert J. Robbat, Jr., (617) 627 3474.

Comments : The MEM is designed for simple operation. A one-week training course covering instrument operation, hardware components, and methodologies will enable personnel to successfully complete analytical measurements. Automatic routines simplify operation, and an internal diagnostic routine continuously monitors instrument performance and warns the operator of potential problems with calibration, temperature, power, and electronic malfunctions. Data interpretation requires some knowledge in mass spectroscopy to determine data integrity. The technology for characterizing environmental pollutants on-site is fully developed and readily available. The problem which exists is convincing people that, when implemented properly, the rapid generation of data which field analysis provides results in a dramatic savings of time and cost in comparison to conventional techniques of chemical detection.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : FTIR Open Path Monitor

Application :

On-site Ex-situ

Brief Description :

Based on the fact that every gas has a unique absorption spectrum, FTIR can identify gases by their specific absorption characteristics and then quantify the amount present in the path of the beam. It identifies and quantifies multiple gases simultaneously. Replaces traditional gas monitors such as Summa canisters and other point samplers. Gives real-time results less expensively and more accurately.

Company Name/POC: Environmental Technologies Group, Inc./Kurt Webber

Address : 1400 Taylor Ave./P.O. Box 9840/Baltimore, Maryland 21284-9840

Phone Number : 410 321-5111

Fax Number : 410 321-5255

Technology Maturity : Commercial use experience

Performance History : This instrument is being used by EG&G in Idaho Falls, ID, at the INEL facility to characterize chemical emissions at treatment, storage, disposal facility (DOE application).

Comments : Operates in 32-104 degrees F; however, it can be configured to operate in extreme conditions. Beam cannot be completely blocked, however can be operated in rain, snow, fog, humidity. Temperature and pressure are accommodated. Can operate in a variety of orientations; transportable, requires two-person set up - time approx. 15-20 min. Software assisting operation has flexible uses depending on background of operator and application required. Normal 110 V power requirements.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Geoprobe/Mobile Lab

Application : In-situ (vadose zone) Ex-situ
In-situ (saturated zone)

Brief Description : Mobile Lab for rapid, low-cost analysis of soil gas, soil and groundwater samples for VOC's using a temperature programmed GC with PID-FID detectors operated in series. Soil and groundwater samples are analyzed semi-quantitatively using the manual static headspace method. Performs very well for preliminary site evaluation work. On-site analysis (screening) allows real-time interactive sampling decisions and minimizes the number of samples requiring more expensive off-site analysis. Eliminates down time waiting for analytical results from off-site laboratories.

Company Name/POC: Enviroscan Corp./Doug Shubring

Address : 303 West Military Rd./Rothschild, Wisconsin 54474

Phone Number : 715 359-7226

Fax Number : 715 355-322

Technology Maturity : Commercial use experience

Performance History : The Mobile Lab is used primarily to provide on-site VOC analysis of samples collected with the Geoprobe soil gas, soil, and groundwater sampling unit. Numerous projects have been completed throughout the midwest. Most projects range in size from one day to one week. The Geoprobe sampling system and Mobile Lab are generally successful at most sites. Sampling depth limited to about 15 ft., analysis limited to a select list of VOC's. The Mobile Lab and Geoprobe system are operated by trained and experienced Enviroscan personnel. Mobile Lab requires chemistry and GC experience.

Comments : Mobile Lab GC is set-up for relatively short (15-20 min) run time. To accommodate rapid analysis, early eluting compounds, such as vinyl chloride are usually not detected or quantitated. GC operating conditions and column type can be modified to meet project specific requirements. Certain types of geology and buried obstacles may limit use. Certification and approval requirements for Mobile Lab services may vary from state to state and from user to user. Service cost and lead time would be impacted if certification/approval requirements are substantial. Project specific QA/QC requirements will also affect cost and on-site productivity. Radioactive contamination of personnel and equipment is of great concern to the vendor. Enviroscan has no experience in handling this type of material.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** "Non-Drilling" Hydraulic Probe Sampling and Mobile Lab Analysis

Application : In-situ (vadose zone) Ex-situ
 In-situ (saturated zone)

Brief Description : Combined "non-drilling" sampling technology for unconsolidated soils and field laboratory analysis of VOCs using lab-grade gas chromatography equipment. Rapid sample collection (soil-gas, soil and water) with minimal investigation-derived waste generation (e.g., no cutting or purge water), and real-time field analysis with a high level of QA/QC (e.g., HAZWRAP "Level B" DQO equiv.). Cost-effective, time efficient complement to traditional drill rig sample collection in unconsolidated sediment. No waste is generated and probe equipment is very safe to operate. Real-time analytical results (primarily headspace techniques) permit rapid decision-making and "one time" thorough site assessments.

Company Name/POC: EnviroSurv, Inc./Hunt Chapman**Address :** 2800 C Dorr Ave./Fairfax, Virginia 22031**Phone Number :** 703 204-3580**Fax Number :** 703 204-3581**Technology Maturity :** Commercial use experience**Performance History :** DOE Contact: Dr. Robert Siegrist, Oak Ridge National Lab.

Comments : Technology application requires experienced field chemists and hydrogeologists. The data generated equals, or exceeds, fixed lab quality. But the CLP bias must be overcome; namely the perception that such information is always superior to field analytical results. The field results can be self supporting in terms of spikes, duplicates, calibration data and supporting documentation. Probing equipment is limited to unconsolidated sediments. Also, technique is not amendable to continuous coring, or borehole logging. Large sample throughput is primarily limited to VOCs. Fewer analyses per day are possible when extractions are required. Analysis is "efficiency" limited to 10-15 target compounds. Full scan VOCs analyses are less cost-effective and time efficient. Rapid mobilization, equipment set-up and use by experienced personnel. Only a 2-person field team required for sample acquisition and on-site analysis. Flexibility for all media sample collection and analysis (soil-gas, soil and water). Regulatory agency awareness of data quality; overcoming the "fixed-lab bias." Acceptable as a complement to the traditional drill rig/fixed lab approach to environmental site characterization. The quality of data generated depends on the experience and knowledge of field personnel. Widespread technology use will increase as more people become aware of the sample quality problems associated with handling, shipment and delayed analysis.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ VOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ HAP	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Multisensor Systems

Application : In-situ (vadose zone)

Brief Description : Measurement of explosive & toxic gases and vapor. A standard measurement delivers a signal of 4-20 mA for a variety of substances. System can be hooked to existing computers and measurement systems. Can be placed in highly aggressive and radioactive environments. In use for 3 years. No failures or inaccuracies have occurred.

Company Name/POC: J. Dittrich Elektronik/Jurgen Dittrich

Address : Bahnhofstr. 67/76532 Baden-Baden, Germany

Phone Number : 49 7221 64103

Fax Number : 49 7221 1710

Technology Maturity : Commercial use experience

Performance History : Numerous applications in the last two years.

Comments : Sensor heads have to be replaced after 2-3 years. **Very easy to use, no infrastructure needed.**
Not tested in high level radioactive environments.

Source of Information : International TechCon

CONTAMINANTS:

Pesticides/Herbicides

Heavy Metals

PCB

Explosives/Propellants

■ Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

■ Halogenated VOC

N/A

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name : Dynamic Oxygen Sensor

Application :

On-site

Ex-situ

Brief Description : Measurement of oxygen in air. Temperature range 280 degrees to 600 degrees Kelvin. Detects 0-100 percent oxygen. System delivers standard signal of 4-20mA with an accuracy 0.1 percent. Only existing fail safe sensor world wide, i.e. is self monitoring. Failure of the sensor will be detected immediately. No other fail safe sensors available.

Company Name/POC: J. Dittrick Elektronik/Jurgen Dittrich

Address : Bahnhofstr. 67/76532 Baden-Baden/Germany

Phone Number : 49 7221 64103

Fax Number : 49 7221 17103

Technology Maturity : Commercial use experience

Performance History : 500 units sold in last 3 years. Performance excellent. Dittrich Elektronik is OEM for Afriso and Gas Modul.

Comments : Very easy to install and use, no infrastructure needed. Not tested in high level radioactive environments.

Source of Information : International TechCon

CONTAMINANTS :

- ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☒ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Fast Short Column Gas Chromatography (GC/TID)

Application : On-site Ex-situ

Brief Description : Monitoring of volatile organic substances in air during remediation for health and safety as well as the evaluation of remediation progress; selective, reliable (<3 percent standard deviation), accurate.

Company Name/POC: Meta MESSTECHNIK/Erich Ludwig

Address : OSTSTR 7/48341 Altenberge, Germany

Phone Number : 49 02505 8706

Fax Number : 011 49 2505 300

Technology Maturity : Commercial use experience

Performance History : Used to monitor soil air suction for the remediation of (1) gasoline contaminated soil; (2) tetrachloroethylene contaminated soil.

Comments : Detection limit: 0.01 mg/m³ tetrachloroethylene.

Source of Information : International TechCon

CONTAMINANTS:

Pesticides/Herbicides

Heavy Metals

PCB

Explosives/Propellants

■ Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

Halogenated VOC

■ N/A

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name : MSI-301 Organic Vapor Monitor

Application :

On-site

Ex-situ

Brief Description :

The MSI-301 is a small, portable gas chromatograph combining a solid-state sensor, sample concentrator, capillary column (isothermal) and a powerful microcomputer. It can detect many hazardous organic vapors in the low ppb range and give automatic and continuous operation with very little operator training.

This will replace other portable gas chromatographs, as it has higher performance (sensitivity, no consumables, rugged, automatic operation). Full remote operation and control.

Company Name/POC: Microsensor Systems, Inc./Mark Klusty

Address : 62 Corporate Court/Bowling Green, KY 42103

Phone Number : 502 745-0099

Fax Number : 502 745-0095

Technology Maturity : Commercial use experience

Performance History : The MSI-301 has found many applications. It is the only monitor approved for benzene in marine vessel tanks (Mr. C. Bruce, 503 282 6920). It is used to monitor BTEX in the environment (D. Wayne Ott, EPA) and for indoor air quality monitoring (Dr. Ed Furtaw, 702 597 4124). It is also used to monitor other organics at ppb level-methane, ethylene oxide.

Comments :

The MSI-301 does not identify unknown compounds; it was designed to detect and monitor compounds for which it has been calibrated. It does not work well at extreme temperatures >365 degrees Celsius or <5 degrees Celsius.

The MSI-301 is basically a self-sufficient instrument, although it can be used with a PC or small printer to prepare reports of data stored in onboard data logger.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : MSI-301 Organic Vapor Monitor

Application : On-site Ex-situ

Brief Description : The MSI-301 is a small, portable gas chromatograph combining a solid-state sensor, sample concentrator, capillary column (isothermal) and a powerful microcomputer. It can detect many hazardous organic vapors in the low ppb range and give automatic and continuous operation with very little operator training.

This will replace other portable gas chromatographs, as it has higher performance (sensitivity, no consumables, rugged, automatic operation). Full remote operation and control.

Company Name/POC: Microsensor Systems, Inc./Mark Klusty

Address : 62 Corporate Court/Bowling Green, KY 42103

Phone Number : 502 745-0099

Fax Number : 502 745-009

Technology Maturity : Commercial use experience

Performance History : The MSI-301 has found many applications. It is the only monitor approved for benzene in marine vessel tanks (Mr. C. Bruce, 503 282 6920). It is used to monitor BTEX in the environment (D. Wayne Ott, EPA) and for indoor air quality monitoring (Dr. Ed Furtaw, 702 597 4124). It is also used to monitor other organics at ppb level-methane, ethylene oxide.

Comments: The MSI-301 does not identify unknown compounds; it was designed to detect and monitor compounds for which it has been calibrated. It does not work well at extreme temperatures >365 degrees Celsius or <5 degrees Celsius.

The MSI-301 is basically a self-sufficient instrument, although it can be used with a PC or small printer to prepare reports of data stored in onboard data logger.

Source of Information : TechCon

CONTAMINANTS :

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

Halogenated VOC

N/A

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name : MSI-301 Organic Vapor Monitor

Application :	On-site	Ex-situ

Brief Description :

The MSI-301 is a small, portable gas chromatograph combining a solid-state sensor, sample concentrator, capillary column (isothermal) and a powerful microcomputer. It can detect many hazardous organic vapors in the low ppb range and give automatic and continuous operation with very little operator training.

This will replace other portable gas chromatographs, as it has higher performance (sensitivity, no consumables, rugged, automatic operation). Full remote operation and control.

Company Name/POC: Microsensor Systems, Inc./Mark Klusty

Address : 62 Corporate Court/Bowling Green, KY 42103

Phone Number : 502 745-0099

Fax Number : 502 745-0095

Technology Maturity : Commercial use experience

Performance History : The MSI-301 has found many applications. It is the only monitor approved for benzene in marine vessel tanks (Mr. C. Bruce, 503 282 6920). It is used to monitor BTEX in the environment (D. Wayne Ott, EPA) and for indoor air quality monitoring (Dr. Ed Furtaw, 702 597 4124). It is also used to monitor other organics at ppb level-methane, ethylene oxide.

Comments :

The MSI-301 does not identify unknown compounds; it was designed to detect and monitor compounds for which it has been calibrated. It does not work well at extreme temperatures >365 degrees Celsius or <5 degrees Celsius.

The MSI-301 is basically a self-sufficient instrument, although it can be used with a PC or small printer to prepare reports of data stored in onboard data logger.

Source of Information : TechCon

CONTAMINANTS:-

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Micromachined Portable Gas Chromatography

Application : On-site Ex-situ

Brief Description : Separates and analyzes natural gas, fixed gas, environmental gas (aromatics, alcohols, halogenated hydrocarbons, solvents, etc.). Sample pump pulls sample into system which separates/analyzes compounds of interest. System employs micromachined injector and detector as well as analytical columns. Analytical time is 10 times faster than conventional GCs.

Company Name/POC: Microsensor Technology Inc. Analytical Instruments/David Sherve

Address : 41762 Christy Street/Fremont, California 94538

Phone Number : 510 490-0900

Fax Number : 510 490-0900

Technology Maturity : Commercial use experience

Performance History : MTI has an installed base of ~600 GCs.
Jack Zamenick: SRS 803 644-1164
Jeff Larson: Dow Chemical - 517 636-4157

Comments : 1 ppm sensitivity limit (anticipated ppb by 6/93). Gases only - no liquids. Sample temperature and pressure limits (see product specification). With prior GC experience, users can be trained within one day to use our GC. Otherwise, four days of training is recommended. Once trained, GC is very fast and easy to use. GC can have up to four analytical columns; unit can be taken nearly anywhere. Complete system includes the GC and a laptop computer with EZChrom 200 software. Injecting a liquid sample will damage the instrument. MTI GCs are used for:

Vent gas analysis/Soil gas analysis/Stack gas analysis/Monitoring VOCs in waste water/Landfill gas analysis/Sample screening/Natural gas analysis/Fixed gas analysis.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** In-Situ Soil Gas Monitoring by Gas Chromatograph**Application :** In-situ (vadose zone) Ex-situ

Brief Description : The system samples soil gas from wells/boreholes via a vacuum pump to inject automatically into a gas chromatograph column to monitor organic contaminants. The GC can be connected to a number of wells, each of which will be sampled in a predetermined order. A computer-controlled valving arrangement allows the system to sample from a designated well, resulting in a chromatogram. After one well is completed the next well cycles through continuously. The computer logs the data. Programmed calibration information for compounds of interest can be loaded to give results in concentration units. The system's performance is very good, allowing for very high sensitivity and good resolution for most contaminants. This alternative will replace the need for collecting soil samples for lab analysis of soil gases. The advantages include: faster analysis and turnaround time, less expensive in the long run, eliminates the handling/disruption of the soil, and most importantly, "continuous" monitoring provides more complete data for analysis of site contamination.

Company Name/POC: Morlock Environmental, Inc./Clayton Morlock**Address :** 23 Pine Street/Lebanon, New Hampshire 03766**Phone Number :** 603 448-4420**Fax Number :** 603 448-1771**Technology Maturity :****Performance History :** In 1993, Morlock Environmental, Inc. was in the process of installing the first system in the field at an Air Force base. Bench scale testing, only

Comments : Temperature extremes may limit use. Distance of well from mobile unit will influence cycling and response times. The physical setup of the system is flexible in that the sampling lines can run above ground or underground to the GC in the mobile unit. Implementation depends on the number of contaminants at the site needing characterization or quantification. Primary challenges are for sites with many different contaminants. Separation of many contaminants generally takes more time, which decreases the number of times each well can be sampled daily, thus decreasing the amount of data from each well.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : AB-4 Radon Measurement System

Application : On-site Ex-situ

Brief Description : AB-4 measures radon gas, continuously using a passive scintillation cell technology. Automatic field calibration, phone modem and alarm capabilities, optional internal printer and environmental sensors (humidity, pressure, temp) enhance the AB-4. Advantages include self-contained operation, removable cell, multi-function capabilities.

Company Name/POC: Pylon Electronics Inc./Fran Higginson

Address : 147 Colonnade Rd/Ottawa, Ontario K1E 7L9

Phone Number : 613 226-7920

Fax Number : 613 226-819

Technology Maturity: Commercial use experience

Performance History : Contact company for performance data.

Comments : The AB-4 is a repacked version of an AM-5 and continuous passive scintillation cell configuration, all in a stand alone package. Delivery was scheduled for the Dec. 1994 time frame. Condensing humidity is a problem. May be UHF/VHF shielded upon request. Operating temperatures -10 degrees C to 50 degrees C. Once AB-4 is set up initially, the AB-4 is simply turned on and the measurement started by use of cursor keys. The menus are user friendly. The cells may become contaminated over time if used in a high Rn level environment. It is recommended the background be monitored periodically and the cells replaced if background is unacceptable. The cells are removable to reduce down time.

Source of Information : International TechCon

CONTAMINANTS:

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

Petroleum Hydrocarbons

■ Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

Halogenated VOC

■ N/A

TECHNOLOGY TYPE:

Sensors/Field Analysis Equipment

Technology Name :

AB-5 Radiation Detector

Application:

On-site

Ex-situ

Brief Description :

An industry accepted standard for the measurement of radon gas in air, water and soil; working level; surface contamination of alpha and beta particles; gamma detection - using various probes such as zinc sulphide, scintillation cells, disks. Sensitivities range between 1 to 23 cpm/pCi/L depending on accessory use.

Company Name/POC:

Pylon Electronics Inc./Fran Higginson

Answer:

147 Colonnade Rd/Ottawa, Ontario K2E 7L9

Photo Number:

613 226-7920

Fax Number : 613 226-8195

Technology Maturity :

Commercial use experience

Performance History :

Number and size of jobs have been varied over the years. AB-5 used by DOE contractors (50), EPA offices and HP physicists (10) for various application. Ref. Doug Daniels/Fermco 513 738-6088

Comments:

8 digit display: information may be dumped on printer or retrieved via PC or obtained manually. Condensing humidity is a limitation. -10 degrees C to 50 degrees C operating temperature. AB-5 is delivered ready for use in the field; manual provides operating instructions on day to day operation. **QA includes** verifying background of cell and electronic noise; plateau curve and all efficiency may be verified annually using a standard. Initial use of equipment may be challenging, but manual describes fully the use and changing of accessories for various applications.

Source of information : International TechCon

CONTAMINANTS: ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name: WLX Working Level Measuring System

Application: ☐ On-site ☐ Ex-situ

Brief Description: A fully integrated radon and thoron working-level measurement system using alpha spectroscopic analysis to discriminate between Radon and Thoron. The detection technology is solid state with multi-channel analyzer. The WLX is a combination of continuous and grab sampling techniques.

Company Name/POC: Pylon Electronics Inc./Fran Higginson

Address: 147 Colonnade Rd/Ohaua, Ontario, Canada K2E 1L7

Phone Number: 613 226-7920

Fax Number: 613 226-819

Technology Maturity: Commercial use experience

Performance History: Used in and around mine sites, universities, and DOE projects. WLX is presently upgraded to offer additional software capabilities and methods. The WLX is the only such instrument for occupational health and safety. Prof. D. Daniels/FERMCO (513) 738-6088.

Comments: Condensing humidity is a limiting factor. The WLX is self-contained with printer and PC software. The measurements are performed automatically and so is the programming. Should the operator wish to use a different method/protocol a self-programming feature is available. Additional features include: programmable air flow is measured by air mass flow sensor. Converted to volumetric flow by an algorithm which compensates for air temperature and barometric pressure. Multi-channel analyzer. Software provides file management tools. Relative uncertainty calculated. Internal alarm and external alarm capability. Graphic display feature on LCD. AC/battery operation.

Source of Information: International TechCon

CONTAMINANTS:

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE: *Sensors/Field Analysis Equipment*

Technology Name : SIGNATURE Gamma Radionuclide Detection and Analysis System

Application :	On-site	Ex-situ

Brief Description : Provides spectral analysis of a radioactive sample using sodium iodide scintillation detectors with greater efficiency than high purity germanium, and without complex and expensive cooling systems. Uses sophisticated digital signal processing techniques to provide measurement resolution comparable with high purity germanium at reduced cost of ownership. Original concept applied to reactor on-line fission product monitoring, further developed for environmental monitoring. Has undergone trials using blind and mixed radionuclide sources. Identification and quantification of component radionuclides has been achieved down to levels of a few becquerels. Use of sodium iodide well detector and automated sample changing will give further benefits. Suitable for initial evaluation of contamination or confirmation of satisfactory decontamination.

Company Name/POC: Siemens Environmental Systems Ltd./Dr. W.E. Croydon

Address : Sopers Lane, Poole/Dorset, BH 17 7ER/England

Phone Number : 44 1202 782648

Fax Number : 44 1202 782157

Technology Maturity :

Field demo complete

Performance History : Performance Data are Available.

Trial systems monitoring reactor coolant have been installed on three UK power stations, both AGR and MAGNOX, and on other PWR nuclear plant. A 2 out of 4 voted hardware trip mode is available to shut down the reactor in the event of a significant increase of specific fission products. Typical measurements are of ~50 kBq/kg Kr-88 in a mixed power spectrum of ~50 MBq/kg N-16 and other isotopes, and agree with grab sample measurements made with a high purity germanium system to within 10 percent. A trial system for environmental monitoring has been configured to detect atmospheric contamination, suitable for the UK national RIMNET2 emergency response system. Laboratory evaluation has detected radionuclides at levels of a few Becquerels. Further improvements are under consideration.

Comments : Limited by detector characteristics, which must be designed for the particular application e.g., operating temperature, mechanical shock, weight of background radiation shielding. Flexible system which can be tailored to meet the needs of a specific application. Stand alone or connected to network for remote operation. Challenges are in optimization of system for ease of calibration and extension to variable geometries. Discussions are underway with the Geosciences Advisory unit at Southampton University, UK with a view to combining a sodium iodide well detector and automated sample changing stage with the SIGNATURE analysis system. This would provide improved automated equipment for analysis of radionuclide contamination for either field or laboratory use, and with low cost of ownership. Alternative detector systems could be designed to address other monitoring requirements. Trials have been carried out involving the following isotopes: Eu-155, Mn-54, Ba-133, Na-22, Zn-65, Am-241, Co-60, Cs-134, Cs-137, Eu-152, Ru-106, Co-58, Co-57, Sr-85, I-131, K-40, Gd-153, Sc-46, Tb-160, Ru-103, Cd-109, Ce-139, Sn-113, Y-88, Ra-226, Pb-214, Bi-214, Kr-88, N-16, O-19, Ar-41, Ir-192, Hg-203. However, the system is not limited to available test isotopes but should detect any gamma emitting radionuclide through the use of library emission data.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Rapid Screening Field Measurements of Organic Contaminants

Application : On-site Ex-situ

Brief Description : Provide rapid screening (5-10 min/sample) and more quantitative analysis (20-30 min/sample) for EPA listed VOCs and semi-VOCs including explosives. Conducted studies with Argonne National Laboratory, EPA (EMSL-Las Vegas) RSKERL - Ada; ERL - Narragansette Region 1) Tenneco, Navy and Army.

Company Name/POC: SiteWorks, Inc./Dr. L. John Hoover

Address : Suite 363/11160-F South Lakes Drive/Reston, Virginia 22091

Phone Number : 703 385-1549

Fax Number : 703 385-365

Technology Maturity : Commercial use experience

Performance History : Performance Data are Available.

Tufts University/Site Works
 Argonne National Laboratory; Candace Rose; Dr. Jacqueline Burton 1-708-252-8795
 Currently providing service in support of VOC analysis

Army/2 months Fort Devens
 Navy/3 weeks San Diego Harbor
 Tenneco/1 month pipeline
 4 EPA projects

Comments : Sample throughput dependent on sample matrix TDGC/MS. Analysis of full range of EPA listed organics reduces sample throughput; nonetheless, 2 times faster than fixed laboratory. Can have instruments ready for operation in 4 hrs including calibration. Personnel and mobile unit available to provide service immediately. Can analyze soil gas, direct and extracted soil, air and aqueous media.

3 publications have appeared in the peer-reviewed journals Analytical Chemistry and Journal of Chromatography. Conducted successful field validation studies with EPA, DOE, Army, Navy and private sector documenting data quality and cost/benefit.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Ion Trap Mass Spectrometer**Application :** On-site Ex-situ**Brief Description :** The Teledyne MEC (TMEC) Ion Trap Mass Spectrometer is one of the most sensitive mass spectrometers of its size in the world. It is designed to be transportable, rugged, and automated to minimize operator intervention. It is ideal for field evaluation of toxic contaminants. The TMEC Ion Trap Mass Spectrometer will permit field measurements of environmental contaminants in lieu of laboratory analysis.**Company Name/POC:** Teledyne MEC/Mort Cohen**Address :** 1274 Terra Bella Ave./P.O. Box 7244/Mountain View, California 94039-7244**Phone Number :** 415 962-6989**Fax Number :** 415 967-4353**Technology Maturity :** Field demo complete**Performance History :** Field evaluations of the TMEC Ion Trap Mass Spectrometer are underway by the U.S. Army for military applications to detect chemical and biological toxins. Initial evaluation are positive. Point of contact is Dave Sickenberger, U.S. Army Chemical Research, Development, Engineering Center, (410) 671-5533.

Comments : Instrument is designed for direct sampling, or GC/LC input. The mass range is approximately 20 to 2,000 amu. It is highly sensitive (parts per billion to parts per trillion) and is excellent in isolating coeluting compounds in complex mixtures. It can be used for field evaluation, laboratory analysis, or fence post monitoring applications. The TMEC instrument is designed for ease of use. It can be powered by AC or DC (battery). It can be configured to operate with a PC-based data system, or as a stand alone device with display and data printout. The system is highly automated to minimize operator intervention, and can be easily configured for direct sampling or interface with gas or liquid chromatograph. There are no infrastructure considerations other than availability of prime power (about 1 KW). The TMEC ion trap mass spectrometer was specifically designed for field evaluation applications to measure very low levels of toxic contaminants. The original instrument was developed for the U.S. Army for military applications and to measure chemical and biological contaminants in the field. Approximately \$13M have been allocated for the R&D of this instrument. Initial field evaluations of the demonstration units are currently underway. Teledyne MEC is also developing, under an internal R&D program, an ion trap instrument for commercial applications related to real-time measurement of environmental contaminants. Initial demo units will be available by mid-1993. TMEC has filed for 8 patents on its ion trap technology, two of which have been allowed and will soon be issued. The other 6 filings are still under review by the U.S. Patent Office.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Chlorinated Hydrocarbon Monitor

Application : On-site Ex-situ

Brief Description : This unique rare-earth sensor detects and measures contaminants such as carbon tetrachloride, trichloroethylene, perchloroethylene, dichloromethane, and other chlorinated solvents commonly used in nuclear weapons production. The sensor has no interference from methane, gasoline, paint thinner, and other non-chlorinated compounds.

Company Name/POC: TRANSDUCER RESEARCH, INC./William J. Buttner

Address : 600 N. Commons Dr./Suite 117/Aurora, Illinois 60504

Phone Number : 708 978-8802

Fax Number : 708 978-885

Technology Maturity : Commercial use experience

Performance History : DOE - Hanford/Site Characterization/Cary Martin/Westinghouse 509 376-2648
 DOE - Hanford/Carbon Tetrachloride Removal (Vacuum Extraction Process)/Randy Coffman/Westinghouse/509 376-4263
 DOE - Hanford/Safety, Extraction Well Drilling/Tom Lazarski/Kaiser Engineering/509 373-4791
 Eastman - Kodak/Wastewater Treatment (Dichloropropane, Dichloromethane)/Tom Walton/Eastma Kodak/716 477-1633

Comments : This instrument detects and measures chlorinated hydrocarbon vapors only. It does not speciate (responds to all chlorinated hydrocarbons). It requires vapor dilution for concentrations above 50 ppm. Model MP-1 Gas Diluter is available from Transducer Research as separate product. Sensor life is inversely proportional to exposure concentration and exposure time. Model 2001-05 is currently being used for site characterization, safety monitoring, and clean-up process applications. Transducer Research is currently improving sensor performance through automatic dilution and pre-concentration modules. Real-time monitoring capability permits quick analysis of contamination situation. Instrument is less expensive to purchase, operate, and maintain than alternate technologies. Real-time measurement allows determination whether work can be continued. Unit can be used to monitor changes in safety conditions. Selective measurement of chlorinated solvents simplifies operating procedures and speeds up the decision process.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Gas Chromatograph/Mass Spectrometer (Field GC/MS)**Application :** On-site Ex-situ

Brief Description : Transportable GC/MS used to detect and identify complex mixtures of environmental pollutants and toxic substances in trace amounts. Based on Hewlett-Packard's 5971A mass selective detector, Viking's field GC/MS uses miniaturized components to achieve laboratory-grade results on-site in real-time. Features of the instrument include: a heated membrane separator made from dimethyl silicone for air sampling, internal cryofocusing options for analysis of light volatiles, and high-temperature ramping for analysis of semi-volatiles with higher boiling points. Field GC/MS analysis shortcuts the current process of collecting environmental samples, sending them to a lab for analysis, and waiting weeks for results.

Company Name/POC: Viking Instruments Corporation/Thomas J. Kuehn**Address :** 3800 Concord Parkway/Suite 1500/Chantilly, Virginia 22021**Phone Number :** 703 758-9339**Fax Number :** 703 968-0101**Technology Maturity :** Commercial use experience

Performance History : Viking's GC/MS has been field-proven by a number of large industrial firms and government agencies, including Tennessee Eastman, Martin Marietta, the EPA, the FBI, and the U.S. Army, for a variety of applications. The DOE, in conjunction with Sandia National Labs, uses the instrument for emergency response and on-site testing. Steve Thornberg is Viking's reference contact within the DOE (505) 846-8829.

Comments : Use of the instrument requires an operator who is skilled as a lab or field chemical technician and has completed Viking's Field GC/MS Introductory Training Course. The field GC/MS has many unique features designed into the system specifically to provide for flexibility and ease of use. Its rugged transport case, for example, permits operation in virtually any location that is accessible by jeep or plane. Once at a site, the field GC/MS can be unpacked and operational in about 15 minutes. The instrument also offers a number of sample inlet options for air, water, and soil gas and a user-friendly, Windows-based operating system. Finally, service contracts and telephone support are available with every instrument.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : On-Line Gas Chromatograph/Mass Spectrometer for Continuous Emission Monitoring

Application : On-site Ex-situ

Brief Description : On-line continuous emission monitor (CEM) used to detect and identify complex mixtures of environmental pollutants and toxic substances, specifically in air. Based on Hewlett-Packard's 5971A mass selective detector, Viking's CEM includes on-line analysis software, multi-port sampling valves, remote control, and networking capability. The CEM delivers laboratory-grade performance on site in real time. On-line continuous emission monitoring consolidates the barrage of single-purpose instruments currently in use to ensure worker safety and comply with legislative reporting requirements. More important, the new Clean Air Act Amendments make on-line GC/MS monitoring the only practical and cost-effective means of tracking regulated toxins.

Company Name/POC: Viking Instruments Corporation/Thomas J. Kuehn

Address : 3800 Concord Parkway/Suite 1500/Chantilly, Virginia 22021

Phone Number : 703 758-9339

Fax Number : 703 968-010

Technology Maturity : Commercial use experience

Performance History : Although the on-line CEM is ready for commercial production, its predecessor, the Viking Field GC/MS, has experienced great success. Current users of the field GC/MS include Tennessee Eastman, 3M, Martin Marietta, the EPA, FBI, U.S. Army and Sandia National Laboratory.

Comments : Use of the instrument requires an operator who is skilled as a lab technician and has completed Viking's On-Line CEM Introductory Training Course. Viking's on-line CEM is specifically designed for flexibility and ease of use. Its rugged housing, for example, can withstand outdoor use as a fence-line monitor or a long lifetime on the factory floor. The instrument itself offers a number of sample inlet options for air, water and soil gas, and a user-friendly, Windows-based operating system. Finally, service contracts and telephone support are available with every instrument.

Source of Information : TechCon

CONTAMINANTS:

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE: Laboratory Analysis**Technology Name:** Cold Trap Inlet System for GC**Application:** Off-site**Brief Description:**

The cold trap inlet system is used to first cryofocus organic samples (as a frozen plug) and then rapidly deliver the sample to a capillary column for a high speed separation. The cold trap is continuously cooled with a stream of cold gas. Typical trapping temperatures range from -50 degree Celsius to -150 degrees Celsius. After the sample is cryofocused on the metal coated trap, the trap tube is electrically heated which rapidly vaporizes the frozen sample and delivers it to the mouth of the separation column as a small vapor plug. The cold trap inlet works extremely well for compounds with volatilities as high as pentane. This technology will replace inlet systems used in conventional Gas Chromatography. This will allow for reduction in analysis times from tens of minutes to tens of seconds as compared to conventional chromatography.

Company Name/POC: Chromatofast, Inc./Robin Risser**Address:** 912 N. Main Street, Suite 14/Ann Arbor, Michigan 48104**Phone Number:** 313 662-3410**Fax Number:** 313 662-3462**Technology Maturity:**

Bench scale testing, only

Performance History:

The cold trap inlet system has been utilized through a development contract from private industry for a speciation instrument to analyze automotive exhaust gases. The device has been successfully applied towards cryofocusing a gas sample over several minutes, this proving a means to concentrate the sample and improve detectability within the system.

Comments:

The device, when combined with equipment for high-speed gas chromatography will require a single technician with familiarity in using a conventional gas chromatograph. The majority of the operation is automated. The only required procedure would be a method of sample introduction, i.e., syringe injection. The current system employs LN2-cooled N2 gas to achieve the necessary trapping temperatures. While this is satisfactory for a research instrument, alternative cooling is desirable for a commercial instrument. Additionally, smaller more portable ovens capable of quicker temperature programming need to be constructed. For the final instrument, all components must be rugged and packaged into a portable case. Computer software for acquisition and analysis along with appropriate digital displays will also be incorporated.

Source of information: TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Laboratory Analysis*

Technology Name : Gas Valve Inlet System for GC

Application : Off-site

Brief Description :

The gas valve inlet system is used for extremely fast injections which are required for high-speed gas chromatography. A sample gas travels through an injection tube which is positioned inside a metal block. A small hole in the tube continuously leaks sample gas. The tube is traversed perpendicularly to the capillary separation column so that the leak of sample gas will pass directly over the column opening, thus accomplishing sample introduction. The gas valve inlet system works well for gas sample streams where extremely small injection band widths are desired. This technology will replace inlet systems used in conventional Gas Chromatography. This will allow for reduction in analysis times from tens of minutes to tens of seconds as compared to conventional chromatography.

Company Name/POC: Chromatofast, Inc./Robin Risser

Address : 912 N. Main Street, Suite 14/Ann Arbor, Michigan 48104

Phone Number : 313 662-3410

Fax Number : 313 662-346

Technology Maturity :

Bench scale testing, only

Performance History :

The gas valve inlet system is currently being used as a research device at the University of Michigan. It can provide analysis time as short as 2 seconds with very good reproducibility. It has been operated tens of thousands of times with no sign of wear. Project directed under Dr. Richard Sacks, Professor, (313) 764 7373.

Comments :

The device, when combined with equipment for high-speed gas chromatography will require a single technician with familiarity in using a conventional gas chromatograph. The majority of the operation is automated. The current gas valve inlet system requires a pressurized sample stream. Techniques need to be developed in order to apply the inlet system to a wider range of samples and media. The device is currently implemented on conventional gas chromatographs modified for high speed operation. Steps for ruggedization of the instrument must be developed.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Laboratory Analysis*

Technology Name : High Speed Capillary Column for GC

Application : Off-site

Brief Description : Capillary column strategies for high-speed gas chromatography are techniques which are used to increase the performance or resolution of a high-speed separation as overall resolution is decreased as compared to conventional gas chromatography. Techniques include serial coupled columns which can shift unresolved pairs of peaks into open areas of a chromatogram, and high-speed column switching, which employs high-speed hardware used for multidimensional techniques. The techniques perform with a good level of precision and accuracy as they all incorporate high speed components.

Company Name/POC: Chromatofast, Inc./Robin Risser

Address : 912 N. Main Street, Suite 14/Ann Arbor, Michigan 48104

Phone Number : 313 662-3410

Fax Number : 313 662-3462

Technology Maturity :

Bench scale testing, only

Performance History : The Column Strategies technology has been utilized through a development contract from private industry for a speciation instrument to analyze automotive exhaust gases and in a fast, direct non-methane hydrocarbon analyzer development contract from a State of Michigan grant for automotive exhaust analysis. The speciation project was a 1 year contract providing \$525,000 of funds and the non-methane hydrocarbon project was a year contract providing \$75,000 of funds. A mid-point backflush procedure has been developed which reduces the cycle time of the instrument by a factor of 2.

Comments : The device, when combined with equipment for high-speed gas chromatography will require a single technician with familiarity in using a conventional gas chromatograph. The majority of the operation is automated.

Source of Information : TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Laboratory Analysis*

Technology Name : Ion Trap Mass Spectrometer

Application : On-site Ex-situ

Brief Description : The Teledyne MEC (TMEC) Ion Trap Mass Spectrometer is one of the most sensitive mass spectrometers of its size in the world. It is designed to be transportable, rugged, and automated to minimize operator intervention. It is ideal for field evaluation of toxic contaminants. The TMEC Ion Trap Mass Spectrometer will permit field measurements of environmental contaminants in lieu of laboratory analysis.

Company Name/POC: Teledyne MEC/Mort Cohen

Address : 1274 Terra Bella Ave./P.O. Box 7244/Mountain View, California 94039-7244

Phone Number : 415 962-6989

Fax Number : 415 967-435

Technology Maturity : Field demo complete

Performance History : Field evaluations of the TMEC Ion Trap Mass Spectrometer are underway by the U.S. Army for military applications to detect chemical and biological toxins. Initial evaluation are positive. Point of contact is Dave Sickenberger, U.S. Army Chemical Research, Development, Engineering Center, (410) 671-5533.

Comments : Instrument is designed for direct sampling, or GC/LC input. The mass range is approximately 20 to 2,000 amu. It is highly sensitive (parts per billion to parts per trillion) and is excellent in isolating coeluting compounds in complex mixtures. It can be used for field evaluation, laboratory analysis, or fence post monitoring applications. The TMEC instrument is designed for ease of use. It can be powered by AC or DC (battery). It can be configured to operate with a PC-based data system, or as a stand alone device with display and data printout. The system is highly automated to minimize operator intervention, and can be easily configured for direct sampling or interface with gas or liquid chromatograph. There are no infrastructure considerations other than availability of prime power (about 1 KW). The TMEC ion trap mass spectrometer was specifically designed for field evaluation applications to measure very low levels of toxic contaminants. The original instrument was developed for the U.S. Army for military applications and to measure chemical and biological contaminants in the field. Approximately \$13M have been allocated for the R&D of this instrument. Initial field evaluations of the demonstration units are currently underway. Teledyne MEC is also developing, under an internal R&D program, an ion trap instrument for commercial applications related to real-time measurement of environmental contaminants. Initial demo units will be available by mid-1993. TMEC has filed for 8 patents on its ion trap technology, two of which have been allowed and will soon be issued. The other 6 filings are still under review by the U.S. Patent Office.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Laboratory Analysis***Technology Name :** Accelerator Mass Spectroscopy (AMS)**Application :** On-site Ex-situ
 Off-site**Brief Description :** This instrument measures the relative abundance of carbon 14/12, Iodine 129/122, etc. to better than 1 part in 1E15.**Company Name/POC:** Triumph/Phillip Gardner**Address :** 4004 Wesbrook Mall/Vancouver, B.C, Canada, V6T 2A3**Phone Number :** 604 222-1047**Fax Number :** 604 222-1074**Technology Maturity :** Commercial use experience**Performance History :** AMS is a well known analytical technique worldwide - J.Vogel, L.L.B.L., CA, USA - E. Litherland, U. Toronto, Ont., Canada**Comments :** AMS is only appropriate for elements that make negative ions only. Positive ions must be done in conventional E-M mass spec.**Source of Information :** International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Decision Support Tools***Technology Name :** Site Planner**Application :**

Other Application

Brief Description : Workstation-based software for decision support in site assessment and remediation. Site Planner replaces slow, low-productivity manual data management and visualization techniques and point solution software systems.

Company Name/POC: ConSolve Inc./David Barber**Address :** 70 Westview St./Lexington, MA 02173**Phone Number :** 508 358-8061**Fax Number :** 508 358 806**Technology Maturity :** Commercial use experience**Performance History :** Site Planner is currently deployed on about 20 projects including use by four DOE laboratories.

Comments : Two days on-site training required. Limited by normal computer hardware limitations. System runs on stand-alone Unix workstations.

Source of Information : TechCon

Free Product

Characterization

Free Product

Characterization

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Partitioning Interwell Tracer TEST (PITT)**Application :** In-situ (vadose zone)
In-situ (saturated zone)**Brief Description :** The purposes of PITT are to (1) locate subsurface NAPL pools, lenses and residuals; (2) estimate the NAPL saturation within these zones and (3) provide a means of assessing the performance of NAPL remediation systems. PITT consists of simultaneous injection of several tracers with different partition coefficients at one or more injection wells, and the subsequent measurement of tracer concentrations at one or more production or monitor wells. There are four principal methods of NAPL zone characterization available for site investigation: core sampling, cone penetrometer testing, geophysical logging, and tracer test methods. The primary advantage of tracer test methods over the other methods is that they can sample much larger volumes of the aquifer (or vadose zone) and yield more reliable estimates of NAPL.**Company Name/POC :** INTERA, Inc./Dick Jackson**Address :** 6850 Austin Center Boulevard, Suite 300/Austin, Texas 78731**Phone Number :** 512 346-2000**Fax Number :** 512 346-9436**Technology Maturity :** Field demo complete**Performance History :** INTERA is currently collaborating with the University of Texas at Austin on a PITT project at Sandia National Laboratories Chemical Waste Landfill in Albuquerque N.M. To date, column studies to select the appropriate tracers have been conducted and the test implementation is scheduled for the summer of 1994.**Comments :** Geological medium needs to have sufficient permeability such that the travel time between tracer injection and withdrawal wells is not prohibitively long. Hydraulic conductivity of geologic material must be $>10E-5$ m/sec. The PITT is applicable to a wide variety of sites because it is capable of detecting NAPLs in both the vadose and saturated zones. In addition, because most sites, particularly DOE sites, already have monitor wells installed, these wells can also be used in the implementation of a PITT.**Source of Information :** TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Decision Support Tools***Technology Name :** Site Planner**Application :**

Other Application

Brief Description : Workstation-based software for decision support in site assessment and remediation. Site Planner replaces slow, low-productivity manual data management and visualization techniques and point solution software systems.

Company Name/POC: ConSolve Inc./David Barber**Address :** 70 Westview St./Lexington, MA 02173**Phone Number :** 508 358-8061**Fax Number :** 508 358 806**Technology Maturity :** Commercial use experience**Performance History :** Site Planner is currently deployed on about 20 projects including use by four DOE laboratories.

Comments : Two days on-site training required. Limited by normal computer hardware limitations. System runs on stand-alone Unix workstations.

Source of Information : TechCon

Landfills

Characterization

Landfills

Characterization

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment***Technology Name :** Ultra-Sonic Ranging and Data Systems (USRADS)**Application :** Non-intrusive

Brief Description : USRADS automates the tracking and mapping of field survey data. It uses ultrasonics to locate the surveyor each second to +/-6", radio-frequency to transmit field data for each location, and micro-computers to record, display, and analyze the data in real-time. USRADS replaces the conventional gridding, manual reading and recording, and related data input/reduction tasks. Its advantages include more data per \$, less time, fewer errors, and quality graphics. USRADS is independent of the detection package and is designed for ease of changing detectors while at a site.

Company Name/POC: Chemrad Tennessee Corporation/Chuck Flynn**Address :** 739 Emory Valley Road/Oak Ridge, Tennessee 37830**Phone Number :** 615 481-2511**Fax Number :** 615 483-9528**Technology Maturity :** Commercial use experience

Performance History : Numerous jobs have been successfully completed for DOE and DOD projects. Objectives include: mapping radioactive contamination and dose rates over several hundred acres, mapping unexploded ordnance at abandoned and active test ranges, mapping underground burial trenches, and identifying heavy metal contamination in surface soils.

Comments : Training requires a minimum of one week. Proficient deployment and optimum productivity is reached within 4 to 6 weeks by new hires working along-side experienced operators. Tight spaces such as alleys or hallways that are only 3' in separation between walls require careful deployment. Extremely noisy environments can raise the ultrasonic noise floor such that USRADS operating range is reduced. USRADS is not yet user-friendly. Proper operation is dependent on trained operators and access to qualified experts. However, implementation through USRADS is immediate. USRADS needs vehicle support for deployment to and operation on the site, liaison to technical staff or data reporting, and USRADS supply maintenance support.

Source of Information : TechCon

CONTAMINANTS: ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : Decision Support Tools**Technology Name :** Site Planner**Application :**

Other Application

Brief Description : Workstation-based software for decision support in site assessment and remediation. Site Planner replaces slow, low-productivity manual data management and visualization techniques and point solution software systems.

Company Name/POC: ConSolve Inc./David Barber**Address :** 70 Westview St./Lexington, MA 02173**Phone Number :** 508 358-8061**Fax Number :** 508 358 806**Technology Maturity :** Commercial use experience**Performance History :** Site Planner is currently deployed on about 20 projects including use by four DOE laboratories.

Comments : Two days on-site training required. Limited by normal computer hardware limitations. System runs on stand-alone Unix workstations.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Geophysics/Hydrogeologic Measurements***Technology Name :** Crosshole Seismic Scanning System**Application :** Non-intrusive

Brief Description : Technology characterizes subsurface rocks and fractures by measuring the velocity of rock between two boreholes and preparing velocity tomograms. The technology sends a seismic signal from one borehole and measures the arrival time at another borehole. The data collected are inverted as geophysical tomograms. The technology performs very well for velocity tomograms and developments are under way for amplitude tomography.

Company Name/POC: AECL Research/C. A. McDowall**Address :** Whiteshell Laboratories/ Pinawa Manitoba, Canada R0E 1L0**Phone Number :** 204 753-2311**Fax Number :** 204 753-2922**Technology Maturity :** Commercial use experience

Performance History : CHARTS - a project for the AECL Research waste management program involving successful site characterization for high level waste. MINI CHARTS - a successful project for the AECL Research waste management program and for ANDRA of France: Jan Marie Potier (Project Manager)/Tel: 33 1 46 54 98 17.

Comments : A 1-3 month training period for a professional geophysicist with a background in seismic methods is required. The boreholes must have a diameter greater than 56 millimeters. The technology is easy to use for 2-3 people in existing boreholes with diameters greater than 56 millimeters. Amplitude tomography is already in the R&D stage and reflection tomography is at the R&D planning stage. This is a non-intrusive technique (it doesn't damage the borehole walls). The technology characterizes rocks and fracture joints between boreholes up to separations of 400 meters in crystalline rock.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Geophysics/Hydrogeologic Measurements*

Technology Name : Ground Penetrating Radar

Application :

Non-intrusive

Brief Description : Ground Penetrating Radar (GPR) is a generally well known technology. Where ground conditions are favorable, the method provides the highest resolution of any geophysical technique commercially available today. Real-time subsurface profiles can be obtained with the method, making this tool very cost-effective. The main problem with the GPR method is interpretation. Our research has placed emphasis on improving its interpretability through 3-dimensional analysis. The method reduces the need for intrusive sampling of the shallow subsurface and allows for a more focused program of exploration.

Company Name/POC: D'Appolonia Environmental Service, Inc./William J. Johnson, Dave Leitze

Address : 275 Center Rd./Monroeville, Pennsylvania 15146-1451

Phone Number : 412 856-9440

Fax Number : 412 856-953

Technology Maturity :

Field demo complete

Performance History : GPR is a commonly applied technique. What D'Appolonia has done is to use commercial equipment and software to improve the method through the acquisition and interpretation of 3D data sets. We have conducted this work as research in association with Michigan Technological University and as a field demonstration for Ames Laboratory's first expedited site characterization (ESC) conducted at the Marshalltown Former Manufactured Gas site in Iowa. Contact David Wonder at Ames - 515 294 1780 for additional information.

Comments : The method requires that soil conditions allow for penetration of the GPR signal. Dry, sandy soils are best. Wet clayey soils are worst. Although some clay was encountered at the Marshalltown, Iowa ESC, we achieved a penetration in excess of 75 feet in a common midpoint profile experiment, but this was exceptional. The method is easy to deploy in the field and can be operated out of the back of a van. Data processing can now be conducted in the field.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Geophysics/Hydrogeologic Measurements***Technology Name :** Magnetometry**Application :** Non-intrusive

Brief Description : Provides subsurface image maps of magnetic anomalies; computer driven array of full field magnetometers with local navigation system contemporaneously processed. "Outstanding" per Sandia report, April 30, 1992. STOLS/MAG consists of an array of 7 cesium vapor magnetometers mounted to a 10 foot boom on a low magnetic signature platform towed by a low magnetic signature vehicle with integrated microwave navigation, data acquisition and a remote magnetometer station to track diurnal variations in the earth's field. A separate processing computer images the survey data. Interactive routines assist the operator in target analysis and output. Outputs include site survey maps, missed area maps, target maps, and landmark maps. Target lists give target ID, (X,Y) location, depth and category (small, medium large) estimates. STOLS/MAG can survey up to 20 acres/day with overnight results. Location accuracies are plus or minus 1m in (X,Y); depth and category estimates are a function of convergence to a magnetic dipole model.

Company Name/POC: GEO-CENTERS, Inc./Dr. Denis Reidy, Richard J. Russell**Address :** 7 Wells Avenue/Newton Centre, Massachusetts 02159**Phone Number :** 617 964-7070**Fax Number :** 617 527-7592**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.

3 ~60 acre surveys at Aberdeen Proving Ground, MD for buried ordnance with excellent results - Contact: R. Robertson, NAVEODTECHCEN (301) 743-6850; 1~30 acre surveys at Edgewood Arsenal, MD for buried ordnance with excellent results - Contact: J. Arnold, USATHAMA (301) 671-4811; 3 sites approximately 30 acres; SNL, NM trenches, buried hazardous waste containers and objects - excellent results - Contact: J. Cochran (505) 844-7209

Comments : Can be deployed in cleared areas with generally navigable off road vehicle type terrain. Performs best in dry weather, but can operate in light rain with supplemental weather protection. Equipment is presently in use virtually full time by DOD. It is a demonstration prototype system. A field & weather hardened preproduction prototype with updated hardware & navigation technique is required.

Source of Information : TechCon

LANDFILLS

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

LANDFILLS

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Geophysics/Hydrogeologic Measurements*

Technology Name : Multi-Frequency Ground Electromagnetic Sensor (GEM)

Application : Non-intrusive

Brief Description : Ground-based, hand-held, multi-frequency, digital, electromagnetic profiler; can detect buried objects, pits, trenches, certain contaminant plumes, and geologic conditions. Measures minute variations in the earth's electrical conductivity.

Company Name/POC: Geophex, Ltd./J. Won

Address : 605 Mercury Street/Raleigh, North Carolina 27603-2343

Phone Number : 919 839-8515

Fax Number : 919 839-852

Technology Maturity : Commercial use experience

Performance History : Have completed about 10 jobs typically in the range of tens of thousands of dollars; in all cases, highly successful in finding buried objects and, at times, contaminant plumes; DOE reference: Dr. James Aldrich, LANL, 505-667 1495.

Comments : Cannot be used in densely-built areas or inside buildings; one-man field operation; internal electronic data memory that downloads to a laptop computer.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Geophysics/Hydrogeologic Measurements*

Technology Name : Electromagnetic Interpretation Technique (EMIT)

Application : Non-intrusive

Brief Description : The electromagnetic interpretation technique allows greater vertical resolution of layered earth response, such as in plume/leak detection, than present available time-domain electromagnetic (TDEM) methods. EMIT is applied to the high frequency portion of the spectrum collected during in-situ impedance spectroscopy (IIS) surveys. Interpretation and modeling are performed on personal computers. EMIT may replace TDEM methods in areas where cultural interference is not great. EMIT allows higher vertical resolution of earth layers and better resolution of layer parameters. The advantage is that lower-frequency impedance spectroscopy data may be extracted from the spectrum, which TDEM cannot detect.

Company Name/POC: hydroGEOPHYSICS/Dr. James B. Fink

Address : 5865 S. Old Spanish Trail, Tucson, AZ 85747

Phone Number : 520 647-3315

Fax Number : 520 647-3428

Technology Maturity : Commercial use experience

Performance History : EMIT was proven viable at Exxon Production Research by J.B. Fink during the late 1970s. Personal computer programs have subsequently been developed to improve modeling but more should be done. EMIT has documented success in academic research (J.B. Fink PhD dissertation). EMIT has been successfully applied in proprietary industry research programs.

Comments : Requires highly skilled technicians to collect, process, and interpret data. Field data collection has the most difficulty because of multi-path and cross-talk interference. Equipment is available off-the-shelf. Although equipment is available off-the-shelf, special purpose equipment should be built based on current technology and specific requirements. The method is difficult to implement in the field because of the myriad problems encountered with conductive cultural features and electromagnetic interference with presently available equipment.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Geophysics/Hydrogeologic Measurements*

Technology Name : High-Res 3-D Resistivity

Application : Non-intrusive

Brief Description : High-resolution 3-D resistivity uses existing technology to electrically map the Earth's surface using a 2-D grid allowing 3-D interpretation. Its advantage is greater lateral resolution (in a 2-D sense) than linear arrays. Interpretation is straightforward and can be performed on higher-powered personal computers. It is not restricted to any particular instrument, however, it would be advantageous to assemble personal-computer-based data collection platforms using off-the-shelf components. Large amounts of data allow the use of digital image processing techniques for extended interpretation.

It is very applicable to shallow, plume/leak problems, and may be used in high density culture. It does not eliminate the cultural problems, but high density measurements allow precise discrimination between culture and target. It also permits fracture and fault detection and mapping.

Company Name/POC: hydroGEOPHYSICS/Dr. James B. Fink

Address : 5865 S. Old Spanish Trail/Tucson, AZ 85747

Phone Number : 520 647-3315

Fax Number : 520 647-342

Technology Maturity : Commercial use experience

Performance History : High-resolution resistivity has been neglected over the decades because of the lack of convenient methods to collect large amounts of data. The method has been successfully applied on a point-by-point basis for medium-sized grids. Time requirements and manpower costs have been the main drawbacks. Existing micro-computer capabilities for multichannel data collection have significantly decreased the time and manpower requirements.

Comments : Data collection is technician level work. Subsequent data quality control, processing and interpretation require some degree of expertise in conventional resistivity methods. Modeling may be done on personal computers.

The method is ready to go today and can be performed on a point-by-point basis, immediately. Multichannel data collection platforms need only be assembled with off-the-shelf components.

The biggest challenge for high-resolution resistivity to overcome is the industry attitude toward a low-tech, simple-to-use, well understood method.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Geophysics/Hydrogeologic Measurements*

Technology Name : In-Situ Impedance Spectroscopy (IIS)

Application : Non-intrusive

Brief Description : IIS measures the combined inductive and conductive electrical and electromagnetic response of the earth over a broad spectrum using grounded transmitting and receiving dipoles. It is nearly equivalent to Spectral Complex Resistivity or Spectral Induced Polarization with special emphasis on obtaining a smooth and complete spectrum. The electromagnetic portion of the spectral response may be modeled to determine the underlying earth geometry more accurately than other electrical methods. The lowest frequencies (<10 Hz) may be used to determine presence of clays in aquifers up to 15% content, beyond which saturation occurs. Under ideal conditions, particle size information may be obtained. Applications are strongly site dependent.

Company Name/POC: hydroGEOPHYSICS/Dr. James B. Fink

Address : 5865 S. Old Spanish Trail/Tucson, AZ 85747

Phone Number : 520 647-3315

Fax Number : 520 647-3428

Technology Maturity : Pilot plant testing

Performance History : IIS has seen limited use because of the limited understanding and availability of necessary interpretation aids. It has been used successfully approximately a dozen times under strict proprietary research. It has been informally published in a 1989 PhD dissertation after previous successful uses. Most significant drawback is interference from existing culture, such as wire fences, pipelines, and other grounded conductive materials.

Comments : Field data collection requires highly skilled personnel from the standpoint of solving multi-path and cross-talk problems. Actual operation of the equipment is relatively straightforward and can be performed at the technician level. Since few groups attempt to collect full-spectrum data, there are few geophysicists with adequate skills. Because the method depends on both inductive and conductive electrical paths, there is a multitude of interferences in highly developed areas. The method is probably best applied in open fields away from dense, conductive culture. Good electrical ground contact is essential, which hampers, but does not exclude, data collection in frozen ground. The method is easy to use (with the aforementioned caveats). It is extremely flexible and can be used for very small scale measurements (soil studies) to extremely large measurements (crustal studies). Appropriate equipment has been developed and is available off-the-shelf. Interpretation software is very limited and represents the weakest aspect. The biggest challenge in using IIS is necessary understanding of multi-path and cross-talk problems that typically occur during collection. Newer instrumentation should be developed that is more amenable to collecting the broad range of frequencies necessary.

Source of Information : TechCon

CONTAMINANTS:

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE: *Geophysics/Hydrogeologic Measurements*

Technology Name: Radio Imaging Method (RIM)

Application: Non-intrusive

Brief Description: The technology is based on the principle of mapping electrical conductivity. It is a minimally intrusive characterization and monitoring method for detection and quantification of subsurface waste forms including metals, acids, LNAPLs, aqueous plumes. It uses a 2" diameter tool, 14 feet in length, which is lowered down each borehole with fiber optic cable. Under proper conditions data can be correlated to stratigraphic profile, plume definition and plume migration, and trench boundary delineation. RIM can be applied between paired vertical, horizontal or slant boreholes and between a borehole and the surface. Data can be used with tomographic inversion software to produce subsurface images. Borehole-to-borehole imaging can be conducted at significant depths. Spacing between boreholes can be on the order of 10X the size of the object or feature to be mapped. Repeated surveys over time can give an accurate picture of contaminant movement. RIM is effective whenever there is a measurable difference in electrical conductivities between the host media and the object or feature to be mapped.

Company Name/POC: New Mexico State University/Greg Moran

Address: Physical Science Lab/P.O. Box 30002/Las Cruces, New Mexico 88003-8002

Phone Number: 505 522-9276

Fax Number: 505 522-943

Technology Maturity: Commercial use experience

Performance History: The technology has been commercially applied in the coal mining industry, for >10 years, to delineate mining hazards. Subsurface geology and chromic acid plume definition at 1m resolution has been successfully field demonstrated at Sandia National Laboratory Chemical Waste Landfill. [David Borns (505) 844-7333]. Mapping of fluid flow through fractured media has recently been demonstrated for the USGS. Delineation of LNAPL plumes has been successfully field demonstrated at a major refinery and former paint factory. Sensitivity to trench boundaries has been successfully demonstrated at the Rocky Flats Plant. Demonstrations for monitoring of injected grout barrier performance at Fernald and for tank monitoring applications at Hanford are planned [Susan Eberlein (509) 373-6595].

Comments: Field operation is straightforward and well developed. Two-to-three technicians are required to run the field survey. Data collection is accomplished via van-mounted computer. Final data reduction and image production is performed at the laboratory or office. At least one borehole is needed; borehole cannot be cased in a metal or conducting material. Other electromagnetic systems cannot be operated at the same time. The baseline is not sensitive to organic contamination unless high-frequency radio signals are used. Technology is ready for environmental applications. Desirable advancements being explored include (1) 3-D subsurface imaging; (2) automated data collection capability for long-term monitoring programs, (3) coupling of instrumentation with cone penetrometer, (4) surface-to-surface surveys for environmental applications.

Source of Information: TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Geophysics/Hydrogeologic Measurements*

Technology Name : Diffraction Tomography and Maximum Likelihood Estimations

Application : Non-intrusive

Brief Description : This technology uses a crosshole imaging method employing seismic or radar waves to locate known objects in the subsurface.

Company Name/POC: Norwave Development A.S./Ingvild Johansen

Address : Gjerdrums vei 12, N-0486 /Oslo, Norway

Phone Number : 47 22 95 10 26

Fax Number : 47 22 18 16 53

Technology Maturity : Commercial use experience

Performance History : Contact company for performance history data.

Comments : Physical limitations in wave penetration distance.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Geophysics/Hydrogeologic Measurements***Technology Name :** Ground Penetrating Radar (GPR)**Application :**

Non-intrusive

Brief Description : GPR is used to non-destructively map subsurface or structural features. Depths range from a few inches to hundreds of feet depending on material conductivities.**Company Name/POC:** Sensors & Software Inc./Steve Cosway**Address :** 1091 Brevik Place/Mississauga, ON L4W 3R7 Canada**Phone Number :** 905 624-8909**Fax Number :** 905 624-936**Technology Maturity :** Commercial use experience**Performance History :** Used by many consulting engineers, geophysical and educational institutions world wide.**Comments :**

Data collection requires very little skill.

Data interpretation requires some training and experience.

The higher the resistivity of the material you are trying to penetrate the better the results.

One person can operate; very portable and easy to use.

Operates using a PC computer (notebook).

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Remote Sensing*

Technology Name : Model 4350 Depth Moisture/Density Gauge

Application : In-situ (vadose zone)

Brief Description : The Model 4350 probe uses neutron moderation to measure hydrogen content (moisture) and gamma ray attenuation to measure density. These readings are typically taken in a non-perforated polyethylene pipe installed during initial construction beneath a waste disposal facility (landfill, lagoon, etc.) to determine the presence of a leak through the bottom liner. The probe has been shown to detect volumetric moisture changes of 1 pound per cubic foot. Gamma attenuation for density measurements is used in conjunction with the moisture measurements to determine if the detected moisture is inside or outside the pipe. Moisture inside the pipe would be due to a leak in the pipe. The Model 4350 probe reduces or eliminates the need for leak detection lysimeters beneath the bottom liner. It also reduces the size and expense of the groundwater monitoring program at a site. Use of the Model 4350 is superior to GW monitoring because it detects a leak before it reaches the groundwater. The access tubing also offers promise for future sampling and remediation activities at the site by providing a means of access to the underside of the line.

Company Name/POC: Troxler Electronic Laboratories/Eric Dunlap

Address : P.O. Box 12057/Research Triangle Park, North Carolina 27709

Phone Number : 919 549-8661

Fax Number : 919 549-0761

Technology Maturity : Commercial use experience

Performance History :

- (a) Used successfully on two different occasions at a municipal waste landfill in Calaveras County, CA. During a test in 11/91 the probe discovered a large moisture concentration at this site. Movement of probe through pipe was limited by an inadequate winching system. A new winch transport system has since been developed. Contact: Dr. Lorne Everett, Geraghty & Miller, Santa Barbara, CA 805 893-2887 or John Kramer, U of CA, Santa Barbara, CA 805 893-8441 for further information.
- (b) The probe is being tested by Sandia National Labs to determine its application for that facility's specific needs. Results are incomplete. Contact: Dr. Robert Knowlton, DOE SNL 505 848-0425.
- (c) The probe has been used for downhole density measurements of household waste at an inactive municipal waste landfill in Illinois. The actual density of the waste is still being determined. This will resolve whether the Model 4350 can be used for this application. This application is for a private concern so no references can be given.

Comments : The Model 4350 is designed for use in the vadose zone. Because of the neutron moderation technology that is used to detect changes in moisture content, the probe cannot be used in conditions that would bring it within one (1) foot of the groundwater table. This requirement greatly reduces the possibility of a false positive condition by minimizing detected moisture from high groundwater. Without large improvements in the accuracy of horizontal drilling techniques, the Model 4350 can only be utilized in new waste disposal construction due to installation of the access pipe beneath the bottom liner. With an access tube and a permanent towing cable installed during construction, the model 4350 probe and its winching system can be readied for daily operation in one hour by one technician. One 2000 foot access tube can be monitored in an 8-hour day. At a waste containment facility with the required infrastructure installed, the Model 4350 will be capable of immediate implementation. However, the access tube must be installed such that sharp changes in direction are avoided and in such a way that the pipe follows the underside contour of the bottom liner.

Source of Information : TechCon

 

[illegible]

 

[illegible]

 

[illegible][illegible]

• **Surface Impoundment**

Characterization

Surface Impoundment

Characterization

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Ultra-Sonic Ranging and Data Systems (USRADS)

Application : Non-intrusive

Brief Description : USRADS automates the tracking and mapping of field survey data. It uses ultrasonics to locate the surveyor each second to +/-6", radio-frequency to transmit field data for each location, and micro-computers to record, display, and analyze the data in real-time. USRADS replaces the conventional gridding, manual reading and recording, and related data input/reduction tasks. Its advantages include more data per \$, less time, fewer errors, and quality graphics. USRADS is independent of the detection package and is designed for ease of changing detectors while at a site,

Company Name/POC: Chemrad Tennessee Corporation/Chuck Flynn

Address : 739 Emory Valley Road/Oak Ridge, Tennessee 37830

Phone Number : 615 481-2511

Fax Number : 615 483-9528

Technology Maturity : Commercial use experience

Performance History : Numerous jobs have been successfully completed for DOE and DOD projects. Objectives include: mapping radioactive contamination and dose rates over several hundred acres, mapping unexploded ordnance at abandoned and active test ranges, mapping underground burial trenches, and identifying heavy metal contamination in surface soils.

Comments : Training requires a minimum of one week. Proficient deployment and optimum productivity is reached within 4 to 6 weeks by new hires working along-side experienced operators. Tight spaces such as alleys or hallways that are only 3' in separation between walls require careful deployment. Extremely noisy environments can raise the ultrasonic noise floor such that USRADS operating range is reduced. USRADS is not yet user-friendly. Proper operation is dependent on trained operators and access to qualified experts. However, implementation through USRADS is immediate. USRADS needs vehicle support for deployment to and operation on the site, liaison to technical staff or data reporting, and USRADS supply maintenance support.

Source of Information : TechCon

CONTAMINANTS :☐ Pesticides/Herbicides☐ Heavy Metals☐ PCB☐ Explosives/Propellants☐ Petroleum Hydrocarbons☐ Radionuclides☐ SVOC☐ Other Contaminant☐ Nonhalogenated VOC☐ Halogenated VOC☐ N/A**TECHNOLOGY TYPE : Decision Support Tools****Technology Name :** Site Planner**Application :**

Other Application

Brief Description : Workstation-based software for decision support in site assessment and remediation. Site Planner replaces slow, low-productivity manual data management and visualization techniques and point solution software systems.**Company Name/POC:** ConSolve Inc./David Barber**Address :** 70 Westview St./Lexington, MA 02173**Phone Number :** 508 358-8061**Fax Number :** 508 358 806**Technology Maturity :** Commercial use experience**Performance History :** Site Planner is currently deployed on about 20 projects including use by four DOE laboratories.**Comments :** Two days on-site training required. Limited by normal computer hardware limitations. System runs on stand-alone Unix workstations.**Source of Information :** TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Remote Sensing .*

Technology Name : Model 4350 Depth Moisture/Density Gauge

Application : In-situ (vadose zone)

Brief Description : The Model 4350 probe uses neutron moderation to measure hydrogen content (moisture) and gamma ray attenuation to measure density. These readings are typically taken in a non-perforated polyethylene pipe installed during initial construction beneath a waste disposal facility (landfill, lagoon, etc.) to determine the presence of a leak through the bottom liner. The probe has been shown to detect volumetric moisture changes of 1 pound per cubic foot. Gamma attenuation for density measurements is used in conjunction with the moisture measurements to determine if the detected moisture is inside or outside the pipe. Moisture inside the pipe would be due to a leak in the pipe. The Model 4350 probe reduces or eliminates the need for leak detection lysimeters beneath the bottom liner. It also reduces the size and expense of the groundwater monitoring program at a site. Use of the Model 4350 is superior to GW monitoring because it detects a leak before it reaches the groundwater. The access tubing also offers promise for future sampling and remediation activities at the site by providing a means of access to the underside of the line.

Company Name/POC: Troxler Electronic Laboratories/Eric Dunlap

Address : P.O. Box 12057/Research Triangle Park, North Carolina 27709

Phone Number : 919 549-8661

Fax Number : 919 549-0761

Technology Maturity : Commercial use experience

Performance History :

- (a) Used successfully on two different occasions at a municipal waste landfill in Calaveras County, CA. During a test in 11/91 the probe discovered a large moisture concentration at this site. Movement of probe through pipe was limited by an inadequate winching system. A new winch transport system has since been developed. Contact: Dr. Lorne Everett, Geraghty & Miller, Santa Barbara, CA 805 893-2887 or John Kramer, U of CA, Santa Barbara, CA 805 893-8441 for further information.
- (b) The probe is being tested by Sandia National Labs to determine its application for that facility's specific needs. Results are incomplete. Contact: Dr. Robert Knowlton, DOE SNL 505 848-0425.
- (c) The probe has been used for downhole density measurements of household waste at an inactive municipal waste landfill in Illinois. The actual density of the waste is still being determined. This will resolve whether the Model 4350 can be used for this application. This application is for a private concern so no references can be given.

Comments : The Model 4350 is designed for use in the vadose zone. Because of the neutron moderation technology that is used to detect changes in moisture content, the probe cannot be used in conditions that would bring it within one (1) foot of the groundwater table. This requirement greatly reduces the possibility of a false positive condition by minimizing detected moisture from high groundwater. Without large improvements in the accuracy of horizontal drilling techniques, the Model 4350 can only be utilized in new waste disposal construction due to installation of the access pipe beneath the bottom liner. With an access tube and a permanent towing cable installed during construction, the model 4350 probe and its winching system can be readied for daily operation in one hour by one technician. One 2000 foot access tube can be monitored in an 8-hour day. At a waste containment facility with the required infrastructure installed, the Model 4350 will be capable of immediate implementation. However, the access tube must be installed such that sharp changes in direction are avoided and in such a way that the pipe follows the underside contour of the bottom liner.

Source of Information : TechCon

Drums/Tanks/Piping

Characterization

Drums/Tanks/Piping

Characterization

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☒ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Alpha Track Etch Detectors

Application : Non-intrusive

Brief Description : Detectors using alpha track technology have been in widespread use for the past 15 years. These detectors are composed of a very pure and specific form of CR-39 type polycarbonate plastic. The material is not sensitive to interference from beta or gamma radiation and exhibits a 70 percent efficiency to alpha particles. The detectors are deployed. Alpha particles will penetrate the detector surface forming damage sites which, when etched in a caustic bath, are enhanced and visible under magnification. Evaluation of etched detectors will quantify levels of alpha contamination and characterize its distribution. Alpha track detectors have a nominal thickness of 1.0 mm and can be laser cut to various dimensions. Conventional radiation survey instruments employ probes which are large and cannot access irregular surfaces or crevices which may hold alpha contaminated material. It is questionable that conventional instrumentation can accurately measure the low levels of alpha contamination permitted under existing release levels.

Company Name/POC: Landauer, Inc./Sue Morrow

Address : 2 Science Road/Glenwood, Illinois 60425

Phone Number : 708 755-7000

Fax Number : 708 755-7016

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Although the alpha track technology has been commercially available since 1978, its application to characterization of alpha contamination is new and the application's development effort has been conducted jointly with ORNL. Pilot tests have involved deployment inside crevices, valve and flange surfaces, contaminated floors, under hot cell/glove boxes. (Dr. Richard Gammage, Martin Marietta Energy Systems, Inc., (615) 574 6256). Initial tests have been completed to characterize the level of contamination gradients and form of suspension in ground water. (Dr. John McCarthy, ORNL (615) 576 6606).

Comments : A technician could deploy individual detectors at hundreds of site locations in a day with retrieval on the same or following day. Little additional training is required beyond that already common to a person trained in taking radiation measurements. Specific etching and detector evaluation training require few basic skills beyond that of a high school graduate with general chemistry or physics background. Landauer's proprietary Lantrak (registered name) detector material and optimized processing protocols permit a low detection level and precise data. Technology is likely not appropriate for 100 percent monitoring of large surface areas of when live-time data is a prerequisite. It is expected that statistical sampling of surfaces with contamination levels at or below the regulatory release level will be a main value of this technology. Landauer, Inc., now processes some 1,000,000 detectors per month of various types including the alpha track type, and offers this service on a commercial basis. In situations where on-site processing is required, a satellite laboratory can be readily established using commercially available etching and analysis equipment. Landauer maintains current training and QC protocols for this technology.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Sensors/Field Analysis Equipment*

Technology Name : Germanium Sonde Operation

Application : On-site Ex-situ

Brief Description : The germanium "cryoprobe" or "cryosonde" uses a high purity Ge spectrometer cooled by a solid cryogen to make high resolution logs of gamma activity. The method is unsurpassed sensitivity and selectivity. The technology alternative is coring and lab assay.

Company Name/POC: Princeton Geophysical Services, Inc./J. Baicker

Address : P.O. Box 900/Rocky Hill, New Jersey 08553

Phone Number : 609 921-7061

Fax Number : 609 921-713

Technology Maturity : Commercial use experience

Performance History : Logged more than 100,000 feet in holes totaling more than 1.2 million feet. Clients include most uranium mining companies.

Comments : Operators are provided. Limited to gamma rays >60KeV. Logging trucks are available. No general challenges except quantitative calibration in DOE environments.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Decision Support Tools*

Technology Name : Site Planner

Application : Other Application

Brief Description : Workstation-based software for decision support in site assessment and remediation. Site Planner replaces slow, low-productivity manual data management and visualization techniques and point solution software systems.

Company Name/POC: ConSolve Inc./David Barber

Address : 70 Westview St./Lexington, MA 02173

Phone Number : 508 358-8061 **Fax Number :** 508 358 8065

Technology Maturity : Commercial use experience

Performance History : Site Planner is currently deployed on about 20 projects including use by four DOE laboratories.

Comments : Two days on-site training required. Limited by normal computer hardware limitations. System runs on stand-alone Unix workstations.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Decision Support Tools*

Technology Name : Software for Decommissioning Planning (STILLKO)

Application : On-site Ex-situ
Off-site

Brief Description : The main functions and applications of this technology are:
 - calculation of costs for decommissioning of nuclear facilities,
 - evaluation of different decommissioning strategies and concepts, and
 - optimization of a specific concept and of working plans.

STILLKO delivers detailed costs, time schedules, required personal capacities, massflow, radwaste information and dose rates.

Company Name/POC: NIS Ingenieurgesellschaft mbH/Ludwig Seyfferth

Address : DonaustraBe 23/D-63452 Hanau/Germany

Phone Number : 49 181 185 159

Fax Number : 011 49 6181 1200 3

Technology Maturity : Commercial use experience

Performance History : First version was developed in the seventies; it is being used and has been updated since then. Authorized in Europe for cost calculations for creating future decommissioning funds. Applied for all commercial nuclear power plants in Germany and in other European countries, also for reprocessing plants, fast breeder reactor and other facilities.

Comments : The application of STILLKO for DOE's project would best be done on a cooperative basis with a U. S. partner.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Geophysics/Hydrogeologic Measurements*

Technology Name : Ground Penetrating Radar

Application : Non-intrusive

Brief Description : Ground Penetrating Radar (GPR) is a generally well known technology. Where ground conditions are favorable, the method provides the highest resolution of any geophysical technique commercially available today. Real-time subsurface profiles can be obtained with the method, making this tool very cost-effective. The main problem with the GPR method is interpretation. Our research has placed emphasis on improving its interpretability through 3-dimensional analysis. The method reduces the need for intrusive sampling of the shallow subsurface and allows for a more focused program of exploration.

Company Name/POC: D'Appolonia Environmental Service, Inc./William J. Johnson, Dave Leitze

Address : 275 Center Rd./Monroeville, Pennsylvania 15146-1451

Phone Number : 412 856-9440

Fax Number : 412 856-9535

Technology Maturity : Field demo complete

Performance History : GPR is a commonly applied technique. What D'Appolonia has done is to use commercial equipment and software to improve the method through the acquisition and interpretation of 3D data sets. We have conducted this work as research in association with Michigan Technological University and as a field demonstration for Ames Laboratory's first expedited site characterization (ESC) conducted at the Marshalltown Former Manufactured Gas site in Iowa. Contact David Wonder at Ames - 515 294 1780 for additional information.

Comments : The method requires that soil conditions allow for penetration of the GPR signal. Dry, sandy soils are best. Wet clayey soils are worst. Although some clay was encountered at the Marshalltown, Iowa ESC, we achieved a penetration in excess of 75 feet in a common midpoint profile experiment, but this was exceptional. The method is easy to deploy in the field and can be operated out of the back of a van. Data processing can now be conducted in the field.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : Geophysics/Hydrogeologic Measurements

Technology Name : Magnetometry

Application : Non-intrusive

Brief Description : Provides subsurface image maps of magnetic anomalies; computer driven array of full field magnetometers with local navigation system contemporaneously processed. "Outstanding" per Sandia report, April 30, 1992. STOLS/MAG consists of an array of 7 cesium vapor magnetometers mounted to a 10 foot boom on a low magnetic signature platform towed by a low magnetic signature vehicle with integrated microwave navigation, data acquisition and a remote magnetometer station to track diurnal variations in the earth's field. A separate processing computer images the survey data. Interactive routines assist the operator in target analysis and output. Outputs include site survey maps, missed area maps, target maps, and landmark maps. Target lists give target ID, (X,Y) location, depth and category (small, medium large) estimates. STOLS/MAG can survey up to 20 acres/day with overnight results. Location accuracies are plus or minus 1m in (X,Y); depth and category estimates are a function of convergence to a magnetic dipole model.

Company Name/POC: GEO-CENTERS, Inc./Dr. Denis Reidy, Richard J. Russell

Address : 7 Wells Avenue/Newton Centre, Massachusetts 02159

Phone Number : 617.964-7070

Fax Number : 617 527-759

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

3~60 acre surveys at Aberdeen Proving Ground, MD for buried ordnance with excellent results - Contact: R. Robertson, NAVEODTECHCEN (301) 743-6850; 1~30 acre surveys at Edgewood Arsenal, MD for buried ordnance with excellent results - Contact: J. Arnold, USATHAMA (301) 671-4811; 3 sites approximately 30 acres, SNL, NM trenches, buried hazardous waste containers and objects - excellent results - Contact: J. Cochran (505) 844-7209

Comments : Can be deployed in cleared areas with generally navigable off road vehicle type terrain. Performs best in dry weather, but can operate in light rain with supplemental weather protection. Equipment is presently in use virtually full time by DOD. It is a demonstration prototype system. A field & weather hardened preproduction prototype with updated hardware & navigation technique is required.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Geophysics/Hydrogeologic Measurements***Technology Name :** Focused Array Radar (FAR) Sensor Technology**Application :** Non-intrusive

Brief Description : A GPR technology which uses DSP-based controlling electronics triggers and an array of radar transmitters and receivers with the precise timing and control required to focus the radar energy more efficiently into the ground (even from high standoff). Produces real-time image display of radar reflections in position under the array and provides a bird's-eye-view of the area as the array moves horizontally across the ground, providing acceptability to radar data now presently available.

Company Name/POC: GEO-CENTERS, Inc./Richard J. Russell**Address :** 7 Wells Avenue/Newton Centre, Massachusetts 02159**Phone Number :** 617 964-7070**Fax Number :** 617 527-7592**Technology Maturity :** Field demo complete

Performance History : Presently being tested with GEO-CENTERS, Inc. 1 GHz TEMR horn antennas in a four-transmitter, 4-receiver array to locate buried mine simulants for DARPA under Tom Hafer (703 243-6680).

Comments : Limited to environmental conditions which allow the radar energy to pass into the ground and reflect back to array. Non-invasive, easy-to-use and to interpret data; requires only surface access to site. Software can be implemented to provide easy-to-read maps of radar targets over site and depth. Present prototype being tested with array of 1 GHz antennas for countermining applications; must be scaled to other frequencies.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Geophysics/Hydrogeologic Measurements*

Technology Name : Multi-Frequency Ground Electromagnetic Sensor (GEM)

Application : Non-intrusive

Brief Description : Ground-based, hand-held, multi-frequency, digital, electromagnetic profiler; can detect buried objects, pits, trenches, certain contaminant plumes, and geologic conditions. Measures minute variations in the earth's electrical conductivity.

Company Name/POC: Geophex, Ltd/I.J. Won

Address : 605 Mercury Street/Raleigh, North Carolina 27603-2343

Phone Number : 919 839-8515

Fax Number: 919 839-852

Technology Maturity : Commercial use experience

Performance History : Have completed about 10 jobs typically in the range of tens of thousands of dollars; in all cases, highly successful in finding buried objects and, at times, contaminant plumes; DOE reference: Dr. James Aldrich,, LANL, 505 667 1495.

Comments : Cannot be used in densely-built areas or inside buildings; one-man field operation; internal electronic data memory that downloads to a laptop computer.

Source of Information : TechCon

CONTAMINANTS :

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☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Remote Sensing*

Technology Name : 3-D Object Tracking Vision System

Application :

Other Application

Brief Description : Eagle Eye is a 3-D machine vision system which can locate and track passive optical markers in a video image. The system uses a computer, video board, CCD camera and special software. The system detects marker edges, performs photogrammetry, outlines the location and orientation of the marker. Target location accuracy is 0.1 mm. Telephoto lens can stop CCD radiation damage. Eagle Eye is an inexpensive position and orientation measurement system which is also capable of tracking unconstrained motion. Eagle Eye is ideal for controlling robot motion, and locating objects (e.g. inside a tank).

Company Name/POC: Kinetic Sciences Inc./David Kauffman

Address : 3250 E. Mall/Vancouver, B.C. V6T 1W5

Phone Number : 604 822-2144

Fax Number : 604 822-6188

Technology Maturity : Commercial use experience

Performance History : A prototype KSI was delivered to International Submarine Engineering for control of a robot in hazardous environments. A second system will be delivered to the Canadian Space Agency for evaluation as a sensor for control of autonomous robots. A third system will be implemented on a mobile robot owned by TRIUMF Meson (physics) research facility.

Comments : The Eagle Eye vision system requires the attachment of special optical markers to the wrist of the robot or to other objects in the work volume of the robot. Current technology provides a frame rate of 4 frames per second for object location. The introduction of RISC computing hardware will increase the frame rate to 30 frames per second within a year. Also CCD cameras cannot be used in high radiation fields, requiring the use of telephoto lenses. The KSI 3-D Eagle Eye vision system can be carried by a mobile robot. In addition, if cameras are deployed to view into a waste tank, for example, then any object or robot with an optical marker can be accurately located within the volume of the tank. Such a location system will allow repeated, accurate navigation within the tank, aiding the cleanup of the tank. The Eagle Eye vision system may require adaptation to be suited for use in high radiation fields. If one or more cameras are positioned remotely, then telephoto lenses can be used to keep CCDs away from radiation. Position accuracy determination of the target will not be reduced if a two camera system is used, provided that cameras with telephoto lenses are firmly mounted so that vibration does not cause errors.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Remote Sensing*

Technology Name : Range Camera Vessel Internal Inspection

Application : Other Application

Brief Description : Using laser based range cameras, this technology is appropriate to inspect the inside of large storage vessels for deformation and defects. The device has an accuracy of plus or minus 1/8" over a 13' scanning distance.

Company Name/POC: Range Vision Inc./Gareth Jones

Address : 4003 Graveley Street/Burnaby, B.C., Canada V5C 3T5

Phone Number : 604 473-9411

Fax Number : 604 299-445

Technology Maturity : Commercial use experience

Performance History : Implementation of the system has been through Custom Industrial Automation Inc., 2399 Golf Club Road, Hannon, Ontario, Canada LOR IPO. Contact Mr. Rick Clark / 905 692-3678.

Comments : Maximum temperature range is 40 degrees C. Vapor or airborne contaminants which obscure laser beam are a problem. System is self contained and the only connection required is site power. The challenge for Hanford applications will be radiation hardening of the range camera head.

Source of Information : International TechCon

CONTAMINANTS :

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☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Remote Sensing*

Technology Name : Model 4350 Depth Moisture/Density Gauge

Application : In-situ (vadose zone)

Brief Description : The Model 4350 probe uses neutron moderation to measure hydrogen content (moisture) and gamma ray attenuation to measure density. These readings are typically taken in a non-perforated polyethylene pipe installed during initial construction beneath a waste disposal facility (landfill, lagoon, etc.) to determine the presence of a leak through the bottom liner. The probe has been shown to detect volumetric moisture changes of 1 pound per cubic foot. Gamma attenuation for density measurements is used in conjunction with the moisture measurements to determine if the detected moisture is inside or outside the pipe. Moisture inside the pipe would be due to a leak in the pipe. The Model 4350 probe reduces or eliminates the need for leak detection lysimeters beneath the bottom liner. It also reduces the size and expense of the groundwater monitoring program at a site. Use of the Model 4350 is superior to GW monitoring because it detects a leak before it reaches the groundwater. The access tubing also offers promise for future sampling and remediation activities at the site by providing a means of access to the underside of the line.

Company Name/POC: Troxler Electronic Laboratories/Eric Dunlap

Address : P.O. Box 12057/Research Triangle Park, North Carolina 27709

Phone Number : 919 549-8661

Fax Number : 919 549-0761

Technology Maturity : Commercial use experience

Performance History : (a) Used successfully on two different occasions at a municipal waste landfill in Calaveras County, CA. During a test in 11/91 the probe discovered a large moisture concentration at this site. Movement of probe through pipe was limited by an inadequate winching system. A new winch transport system has since been developed. Contact: Dr. Lorne Everett, Geraghty & Miller, Santa Barbara, CA 805 893-2887 or John Kramer, U of CA, Santa barbara, CA 805 893-8441 for further information.
 (b) The probe is being tested by Sandia National Labs to determine its application for that facility's specific needs. Results are incomplete. Contact: Dr. Robert Knowlton, DOE SNL 505 848-0425.
 (c) The probe has been used for downhole density measurements of household waste at an inactive municipal waste landfill in Illinois. The actual density of the waste is still being determined. This will resolve whether the Model 4350 can be used for this application. This application is for a private concern so no references can be given.

Comments : Contaminant identified as Moisture and Density.

The Model 4350 is designed for use in the vadose zone. Because of the neutron moderation technology that is used to detect changes in moisture content, the probe cannot be used in conditions that would bring it within one (1) foot of the groundwater table. This requirement greatly reduces the possibility of a false positive condition by minimizing detected moisture from high groundwater. Without large improvements in the accuracy of horizontal drilling techniques, the Model 4350 can only be utilized in new waste disposal construction due to installation of the access pipe beneath the bottom liner. With an access tube and a permanent towing cable installed during construction, the model 4350 probe and its winching system can be readied for daily operation in one hour by one technician. One 2000 foot access tube can be monitored in an 8-hour day. At a waste containment facility with the required infrastructure installed, the Model 4350 will be capable of immediate implementation. However, the access tube must be installed such that sharp changes in direction are avoided and in such a way that the pipe follows the underside contour of the bottom liner.

Source of Information : TechCon

Extraction/Delivery/Materials Handling

Extraction/Delivery/Materials Handling

Soil

Extraction/Delivery/Materials Handling

Soil

Extraction/Delivery/Materials Handling

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Pneumatic Fracturing*

Technology Name : Pneumatic Fracturing Extraction (PFE)

Application : In-situ (vadose zone)

Brief Description : The PFE/HGI (Hot Gas Injection) process is an in-situ source removal remediation technology. The process consists of injecting pressurized air through a proprietary downhole injection system. The pressurized air creates fractures or air flow channels emanating from the injection source. Once the permeability of the formation has been increased, Hot gas and/or biological media is circulated through the formation to recover and/or treat the contaminated compounds. The process has been shown to affect a radial distance as much as 40 feet from an injection source. Air demonstration results indicated flow extraction rates and contaminant mass removal increases as much as several hundred times as compared to "pre-fracture" conditions. The process is highly applicable and cost effective when applied at sites where the geology consists of silts, clay, or fractured bedrock. These types of geologic formations limit the effectiveness of other in-situ processes. Soil vapor extraction (SVE), in-situ bioremediation and other in-situ processes have been shown to be limited in their effectiveness when applied at sites with "tight" geology due to the inability of generating sufficient and uniform subsurface airflow.

Company Name/POC: Accutech Remedial Systems Incorp./John J. Liskowitz

Address : Cass Street, Hwy 35/Keyport, N.J. 07735

Phone Number : 908 739-6444

Fax Number : 908 739-0451

Technology Maturity : Field demo complete

Performance History : Performance data are available. As of 1/1/93, seven pilot scale demonstrations lasting 1 week or less. Two demonstrations lasted greater than 1 month. Demonstration sites varied by contaminant type and type of geology, i.e., silts, clay, or fractured rock. All demonstrations exhibited significant increases in permeability and containment mass removal.

Comments : The borehole/well must be non-screened across the interval to fracture. If extraction is desired from an existing screened well, a borehole to apply PFE must be installed adjacent to the existing well. The PFE was used in Phase I SITE demonstration at an industrial park in Summerville, N.J. The PFE, used on shale, increased air flow 600 percent and increased the contaminant removal rate 675 percent. Accutech is supplying the technology for Phase II where SVE will be used in conjunction with catalytic oxidation. The resulting gas effluent will be reinjected (Hot Gas Injection) into the subsurface to enhance the SVE.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Pneumatic Fracturing

Technology Name : Pneumatic Fracturing

Application : In-situ (vadose zone)

Brief Description : Creates fractures in unconsolidated and consolidated strata using a high pressure air stream. The fractures allow contaminants to migrate or be easily extracted with a vacuum. Pilot test showed 300% increase in removal efficiency.

Company Name/POC: Malcolm Pirnie, Inc./David L. Pry

Address : 1 International Blvd./ Mahwah, NJ 07495

Phone Number : 201 529-4700

Fax Number : 201 529-141

Technology Maturity : Field demo complete

Performance History : Used on one job where soil vapor extraction was the preferred technology; however, the soil was too impermeable to permit air flow. After pneumatic fracturing, air flow increased 25 times. Volatile organic removal increased 10 fold. Reference: Mr. J. R. Beltram, Interedge Industries, 201 515 5200 (a customer)

Comments : Need room to get small drill rig into place. Need high pressure air source (i.e., compressor, bottled gas). May damage old underground pipes because of the displacement due to fracturing. Easy to use and transport. Two people to insert and fracture. Equipment varies depending on the amount of subsurface information desired.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Excavation, Retrieval, and Off-Site Disposal*

Technology Name : Safe Excavation, Soft Trencher

Application : On-site

Brief Description : This technology uses a combination of supersonic jets of air and pneumatic vacuum transport to dislodge and remove soil. The supersonic jets of air are extremely effective at penetrating most types of soil, but are harmless to non-porous buried objects like pipes or cables. The pneumatic transfer system has several unique features which allow soil, which is not an easily vacuumed material, to be handled effectively. "Safe Excavation" technology has several distinct advantages for environmental waste remediation. First, since the danger of puncture is significantly reduced by the nature of the excavation process, the operator can dig more easily and effectively at a typical waste site where, due to previous random burial practices, the precise location of the buried waste containers are generally unknown. Furthermore, the non-contacting nature of the jets is advantageous with respect to avoiding more damage to the waste containers which typically are already in varying states of deterioration.

Company Name/POC: Concept Engineering Group, Inc./R.D. Nathanson

Address : 610 William Pitt Way/Pittsburgh, PA 15238

Phone Number : 412 826-3191

Fax Number : 412 826-3193

Technology Maturity : Field demo complete

Performance History : To date the safe excavation technology has been used only in utility excavation. CEG has recently completed the design and construction of a prototype trenching machine for The Electric Power Research Institute (EPRI) which utilizes this safe excavation technology. This unit aims at reducing electrical transmission cable installation construction costs by as much as 30%. The unit has been performed well to date and is currently undergoing a program of testing and utility field trials. Inquiries should be directed to CEG.

Comments : The prototype Soft Trencher described above is self-contained and powered by a single diesel engine. It is 31 feet long by 8'6" wide x 11'5" high and weighs 30,000 lbs. It is self-propelled with an on-site speed of about 4 mph. Over the road it is transported via low-boy trailer. At this stage, the basic aspects of the safe excavation technology have been established for environmental remediation applications. It is a matter of engineering design and prototype construction to determine the best configuration for site waste work.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Directional Wells*

Technology Name : Horizontal Drilling

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Drilex Systems, Inc. has developed a horizontal drilling system for use as a remediation tool. The principal involves drilling a borehole by directional or horizontal drilling into contaminated areas that are otherwise difficult or impossible to reach due to surface obstructions; or to drill extended lengths of borehole into contaminated areas to expose more area to a given treatment technology.

Company Name/POC: Drilex Systems, Inc./Vernon Robin

Address: 15151 Sommermeyer/P.O. Box 801114/Houston, Texas 77280-1114

Phone Number: 713 937-8888

Fax Number : 713 849-239

Technology Maturity : Commercial use experience

Performance History : Initial pilot project was undertaken in February 1990 at a site in Michigan. Two horizontal boreholes were drilled - one into the contaminant source to pump and treat, and the other into the down stream plume to stop the migration. Drilling rig is available for full scale operations. Drilex has over 10 years experience in directional and horizontal drilling.

Comments : The rig is mounted on four truck trailers and is a fully transportable, non-permit, self-powered setup that can be moved with ease. The only outside source needed is for water to mix drilling fluids. Wells can be installed at depths from 12 feet to 250 feet. The horizontal section can be up to 2500 feet long. There are no limitations on specific contaminants. However, the type of contaminant does limit the types the hardware that can be used in the well.

Source of Information : VISITT 3.0

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Directional Wells*

Technology Name : Curved Horizontal Wells with Ductile Porous Polyethylene

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : It is patented procedure to install curved horizontal wells with specially developed porous screens and drilling services (mud, navigation, precision). It is used for soil vapor extraction, groundwater extration, bioremediation, monitoring, etc.

Company Name/POC: FlowTex GUT GmbH/Dr. Ingo Sass

Address : Gesellschaft fur GroBbohr- und Umwelttechnik/ChausseestraBe 1/D-06317 Amsdorf, Post
Roblingen, Germany

Phone Number : 34601 40 164

Fax Number : 34601 40 159

Technology Maturity : Commercial use experience

Performance History : 1989 : first field test performed. 1990 : first porous pipes introduced. 1991 - 1993 : technical operations. Since 1993 : commercial use (55 wells in operation up to now in Germany alone).
Portsmouth site horizontal well recirculation system with ORNL.

Comments : Maximum screen diameter: 12 inch, max. length 2000 meters, maximum depth 300 meters. Six different qualities of porous pipes; different mud designs; drill systems from 8 to 400 metric tons (pulling force) available; very high precision drilling; porous screens much more efficient; higher clogging and colmation resistivity; use of shelter casing procedure for well completion and filter cake destruction; hydrophobic screens.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Directional Wells*

Technology Name : Horizontal Guided Drilling

Application : In-situ (vadose zone)
 In-situ (saturated zone)

Brief Description : Horizontal guided drilling is a technology used for groundwater plume control. Hydrostatic pressures in aquifers under polluted sites are controlled by installing specially designed production pipes; polluted groundwater can be recovered for treatment; or airsparging/venting used for in situ treatment.

Company Name/POC: Rasmussen & Shiotz Anlaeg A/S

Address : Industriholmen 82/2650 Hvidovre/Denmark

Phone Number : 3677 0899

Fax Number : 3677 212

Technology Maturity : Commercial use experience

Performance History : Originally the technology was used to drill under roads and highways (for installation of cables, sewers, water supplies etc.). Precise design of position of wells is prerequisite as well as detailed geological description of the ground in which the wells are to be drilled.

Comments : While drilling and installing production pipe, only the drilling rig is needed as well as ordinary construction equipment, including freshwater supply and power supply. The technology is difficult to use in very rocky soils. The hydraulics of the groundwater formation in relation to the position of the pollution have to be suitable for the use of the technology. Easy and flexible to use for a well trained staff. The technology is available everywhere. Need precise geological/hydrogeological description of site.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Size reduction*

Technology Name : Microfluidizer (TM)

Application : On-site Ex-situ

Brief Description : Microfluidizer equipment employs high energy mixing, involving shear impact and cavitation in a patented interaction chamber. Size reduction and deagglomeration to submicron structures are routinely achieved, continuously and predictably. Devices are air-driven (or by explosion-proof motor driven systems at user's option). Enormous surface area is created under extremely turbulent conditions by collision of high velocity streams at high pressure in a controlled, confined small space.

Company Name/POC: Microfluidics Corp./Irwin Gruverman

Address : 30 Ossipee Rd./ Newton, Massachusetts 02164-9101

Phone Number : 617 969-5452

Fax Number : 617 965-1213

Technology Maturity : Pilot plant testing

Performance History : Not available.

Comments : None.

Source of Information : VISITT 3.0

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Dewatering*

Technology Name : Mini-Miser (TM) Dewatering System

Application : On-site Ex-situ

Brief Description : The Mini-Miser Dewatering System mechanically extracts liquids from sludges, sediments, and solids. The system incorporates a patented press design that previously has been applied for the extraction of fruit and vegetable juices in the food processing industry. This design allows for the dewatering of materials with varying particle sizes and viscosities, including non-pumpable solids and sludges as well as material containing grit, gravel, vegetation or debris. The unit can operate as a secondary dewatering unit or as an alternative to filter presses, sludge drying beds, and thermal dryers and is particularly suited for materials with high solids content (i.e., sediments).

Company Name/POC: Recra Environmental, Inc./James F. LaDue

Address : 10 Hazelwood Drive/Amherst, New York 14228-2298

Phone Number : 716 691-2600

Fax Number : 716 691-261

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Dry cakes in excess of 60 percent solids with a 75 percent reduction in volume have been produced. The full-scale system is available in manual or automated, semi-continuous or batch feed systems designs with processing capacities up to 30 tons per hour. The system has shown successful results in pressing low solids content sludges (2 - 5 percent). In 1990, development and testing began on waste related applications and the first unit was installed on a commercial basis for a lagoon sludge remediation project in 1992.

Comments : Since this equipment was originally used for juice extraction from fruit and vegetable pulp, it is designed primarily to process sludges and materials with a relatively high solids content (>15 percent). The equipment incorporates hydraulic cylinders to exert, uniformly distributed high pressure to mechanically extract free liquid from the wastes resulting in greater reduction of volume and weight without chemicals or polymers.

Source of Information : VISITT 3.0

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Injection/Delivery Systems*

Technology Name : Cone Penetrometer

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : The Lightweight static cone penetrometer was specially designed to perform geotechnical investigations in areas or locations which are not accessible to other equipment. Aspects such as weight, ease of operation and simplicity have played an important role during the design phase. Several applications can be realized with the basic system such as mechanical and electrical cone tests or soil sampling. In order to compensate for the reaction forces while testing, four solid ground anchors give sufficient grip, even at greater depths.

Company Name/POC: A.P. van den Berg B.V./ Engbert Welling

Address : 8440 AB Heerenveen/Ijzerweg 4/The Netherlands.

Phone Number : 31 5130 31355

Fax Number : 31 5130 31212

Technology Maturity : Commercial use experience

Performance History : Contact company for performance data.

Comments : Two models are available - the Hyson 50 kN and Hyson 100kN with pushing capacity of 5.5 US tons and 11 US tons respectively.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Injection/Delivery Systems*

Technology Name : Cone Penetrometer Platform

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Technology combines cone penetrometer and surface geophysics to permit a real-time, three-dimensional site characterization approach on soil sites.

Company Name/POC: Applied Research Associates, Inc./Terry Steinborn

Address : 4300 San Mateo, NE/Suite A-200/Albuquerque, New Mexico 87110

Phone Number : 505 883-3636

Fax Number : 505 883-367

Technology Maturity : Commercial use experience

Performance History : Performance Data are Available.

Demonstrations at Savannah River and Hanford. Components of technology are in daily use. Full on-site characterization from start to remediation awaiting an appropriate project. Demonstrations at Hanford and Savannah River involved hazardous, mixed wastes, and low-level nuclear waste.

Comments : The technology is completely ready to be applied on accessible soil sites having contaminated groundwater or buried contaminant materials at depths up to 300 ft. This is a very comprehensive and adaptable system which can be used to solve specific site problems or can provide a broad, rapid site characterization which permits site characterization tactical planning and data acquisition planning in real time (the observation approach). Little characterization-related contaminant is brought to the surface. Cost and schedule savings may be very large in appropriate cases. Site characterization, installation of monitoring wells and instruments and inception of remediation can be integrated through this technology. An integrated three-dimensional database and data archive provides support for site hydrogeology analysis, hydrologic modeling, remedial planning, site activity documentation and generation of presentation and report graphics.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Injection/Delivery Systems*

Technology Name : SEAMIST

Application : In-situ (vadose zone)

Brief Description : SEAMIST is a borehole lining and instrumentation system which uses an inverting impermeable tubular membrane to deploy sensors into the borehole. Its demonstrated uses are unsaturated zone vapor and liquid sampling, and borehole lining.

Company Name/POC: Eastman Cherrington Environmental/Carl Keller

Address : 1640 Old Pecos Trail/Suite H/Santa Fe, New Mexico 87505

Phone Number : 505 983-3199

Fax Number : 505 983-3476

Technology Maturity : Commercial use experience

Performance History : Tritium monitoring - LLNL, Barbara Mallon (510) 422-0913
Carbon Tetrachloride - Hanford (Westinghouse), Virginia Rohay (509) 376-5507
VOCs - Sandia, Jim Phelan (505) 845-9892
VOCs, tritium - Los Alamos, Steve McLin (505) 665-1721

Comments : System is presently only used in unsaturated zone; however, development is underway for a system to be used below the water table. For the greatest benefit, an uncased borehole should be used. Two people can deploy and operate the system. Once installed, borehole instrumentation takes less than 30 minutes. All equipment (air source, elect. generator, SEAMIST system) are easily transported (no heavy equipment).

Source of Information : TechCon

CONTAMINANTS:

- ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Injection/Delivery Systems***Technology Name:** Linear Contaminant Remediation System (LCRS)

Application: In-situ (vadose zone)
 In-situ (saturated zone)

Brief Description: This technology involves using the trenched horizontal well installation process that was developed by Horizontal Technologies, Inc., (HTI). For trenched air sparging applications, the lower horizontal well screen is utilized to introduce air into the base of the trench. An upper line is installed near the top of the trench and above the water table to serve as a vapor extraction line. The lower horizontal line can be installed to depths of 20 to 30 feet. Both the lower and upper lines are installed along with the placement of the artificial trench backfill material in a one step process in a nominal 14 inch wide trench.

Company Name/POC: Horizontal Technologies, Inc./Donald R. Justice, Greg Rawl**Address:** 2309 Hancock Bridge Parkway (33990)/P.O.Box 150820/Cape Coral, Florida 33915-0820**Phone Number:** 813 995-8777**Fax Number:** 941 995-846**Technology Maturity:** Commercial use experience

Performance History: Technology is full scale. Systems for delivery and extraction of contaminants using trenched horizontal wells have been installed on numerous sites in the U.S. and are currently being permitted for use by environmental consultants on over 100 sites. The first air sparging application is currently under design and should be in operation prior to the end of 1994.

Comments: Cannot be installed directly under buildings. The maximum installation depth below the water table is approximately 25 feet. However, greater depths can be reached by benching down of the installation equipment. The installation machine cannot cut hard rock strata without pre-trenching with a conventional excavator.

Source of Information: VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Injection/Delivery Systems*

Technology Name : Piezocone/Drill Rig Truck with Computerized Stratigraphic and Environmental Analysis

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : High speed high-capacity (20 ton+) piezoconic penetrometer linked to on-board computer for stratigraphic and environmental analysis. Rig also includes conventional rotary rig for rock/soil/concrete. Piezocone can identify soil layers as small as a few millimeters thick. Probes can be mounted with detectors for a variety of environmental parameters e.g., VOCs, radionuclides. High speed (4ft/min) enables numerous soil profiles to be obtained in a short time with much higher sensitivity compared with conventional drilling. Allows better (closer) spacing.

Company Name/POC: Ontario Hydro Technologies/C. Cragg/R. Tsang

Address : 800 Kipling Ave #KR252/Etobicoke Ontario, Canada M87 5S4

Phone Number : 416 207-6139

Fax Number : 905 855-4725

Technology Maturity : Commercial use experience

Performance History : Contact company for performance history data.

Comments : Requires field access for 10-ton truck, or unit can be dismounted to 5-ton flat-bed truck or barge for lakes/rivers/swamps.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Dust Control***Technology Name :** Electrically Charged Fog (Fog Gun)**Application :** On-site Ex-situ

Brief Description : Natural dust (generated by roads or moving sand piles) is normally electrically charged. The small particles, i.e., 1 micron in size, are usually negative; the larger particles, i.e., 7 microns, are positively charged. The same thing is observed with industrial dust from grinding, walking, sweeping, or abrasion, (cf. A.D. Zimon, Adhesion of Dust and Powder, 2nd ed., Consultant Bureau, New York NY, 1982). In some cases, impurities may affect the sign or value of the charge, but there is always some charge. This means that oppositely charged water fog is very effective in contacting the dust and causing it to drop out of the atmosphere. The amount of water required is small and the collection is very effective.

Company Name/POC: hydroGEOPHYSICS/Stuart Hoenig**Address :** 5865 S. Old Spanish Trail/Tucson, AZ 85474**Phone Number :** 520 887-3815**Fax Number :** 520 647-342**Technology Maturity :** Field demo complete

Performance History : Devices have been used in a laboratory and have been successfully demonstrated in one or more lead, copper, steel foundries, in ore milling, battery building companies, several sections of a steel mill including: ore recovery, coke ovens, rough and fine grinding areas. Use in a copper mine has covered the drilling, milling, casting areas and disposal of wastes. In a wood fabrication facility, operations were successful in the primary (rough fabrication) area and in the finishing area. In the paint shop, the charged spray was very successful in removing excess paint from the atmosphere. In a tire rebuilding shop, it was possible to suppress floating dust in several areas. Commercial sales are handled by Research-Cottrell Environmental Service and Technology, U.S. Highway 22 West, Branchburg, NJ 09976, phone (905) 685-4000. Contact Mr. J.D. Helfrich.

Comments : Performance data are available.

A single unit is 2.5 ft (0.75m) long and 8 inches (0.203) in diameter. It requires 110 volts at 3 amps, 1 CFM of compressed air at 80 psi and a supply of water, 1 gallon (3.79 L) per minute. No other support services are required. There is no electrical hazard if people get into the fog spray. The area must permit water spraying, but there is no hazard with flammable or explosive dusts. The water spray is designed to "reduce" the natural charge on the dust so the system becomes "safe" if the charged fog is used. There have been some tests on fire and it appears that the charged fog is more effective than the usual uncharged material. The system is easy to use. It can be hand held or mounted on a stand. For larger applications, more fog guns can be used, or larger fog guns can be built. There have been tests on mine trucks moving over dirt roads, and there was about 80% reduction of visible dust. Very little infrastructure is needed. Throwing the fog for long distances, over large ore piles, is a problem and special high speed blowers are needed.

Source of Information : TechCon

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Dust Control*

Technology Name : Electrostatically Charged Plastic

Application :	On-site	Ex-situ

Brief Description : In any cleaning operation there is a large quantity of dust raised into the air. This is hazardous to people and dust keeps settling onto clean areas. Unless cleaning tools are oiled, they do not collect and hold dust efficiently. This technology involves sheets of plastic (polypropylene) which are heated and electrically charged. The charge is permanent (3 years) and the material can be cleaned and reused. Almost any plastic can be charged; as you might expect, Teflon holds the highest charge (1000) volts per cm) but it is too expensive for most applications. The charged plastic causes no shock if touched; the flow of charge through the material is far too slow. It is important to note that the charged plastic does not require that the dust actually touch the surface. Particles can be drawn by induced charges - a 5 micron particle would be drawn in from a distance of 2 cm in a relatively calm atmosphere. The material is used to collect asbestos dust from clean-up sites. It has been used in semiconductor clean rooms where the dust may be atmospheric, paper based, human dust from hair and skin, and chemically based. All of these materials are collected and prepared for eventual removal or disposal with the collecting plastic.

Company Name/POC: Wall-Rite/Jack Fogel, CEO

Address : 5930 Midway Park/Albuquerque, New Mexico 87109

Phone Number : 800 795-1415

Fax Number : 505 344-7039

Technology Maturity : Commercial use experience

Performance History : The material is used extensively in offices for meetings - the material sticks on the wall and can be written upon, erased, and used again. Stick-on signs of all kinds are available. An electrostatically charged broom and dog brush have been demonstrated and are being redesigned for manufacturing. Applications to disk drives (for dust collection) have been demonstrated, semiconductor clean room use has been tested in the laboratory and in operating facilities.

Comments : The material is usually sold in sheets 0.003 inches thick. Plastics as heavy as 1/4" have been successfully charged. Fibers can be charged for filtering or as wiping cloths. Hollow fibers or solid materials can be charged and will be used in the broom/brush work. For dust collection, the material is normally hung up or pasted (electrostatically) to a wall. The material is normally most effective on dust particles from 0.1 microns (3.28 x 10 ft) to 50 microns. Above that size, dust does not remain in the air long enough to be a problem or to be collected. The smaller particles (0.1 to 10 microns) are most dangerous since they enter the human breathing system.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Robotics*

Technology Name : Robotic Manipulator and Control Systems

Application : On-site

Brief Description : Teleoperated and autonomous robotic systems provided include manipulators, control systems and sensors. ISE robotic products are mission driven. Therefore, ISE has the ability to tailor all robotic products to suit the specific applications of the customer. All of the robotic systems are designed and built using hardware and software modules. The hardware modules may be re-configured to create other mechanical systems for very specific applications.

Company Name/POC: International Submarine Engineering LTD./Owen Williams

Address : 1734 Broadway Street/Port Coquitlam, B.C. V3C 2M8 Canada

Phone Number : 604 942-5223

Fax Number : 604 942-757

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Customers for ISE autonomous robotic systems include the U.S. Air Force and the Canadian Space Agency. The USAF system is used to autonomously refuel aircraft. The CSA robots are part of the development of autonomous robot technology applicable to the Space Station "Freedom" Project. Customers for ISE's teleoperated systems include Westinghouse, AT&T, the U.S. Navy, GPU Nuclear, Shin Nippon, Southwest Research, and Oceaneering Space Systems.

Comments : Personnel require 1-2 week training course. All systems are designed and built to operate in specific environments. Systems are used by trained technicians. Systems are typically self contained.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Robotics*

Technology Name : Remotely Controlled and Video-Assisted Remotely Controlled Excavation

Application : On-site Ex-situ

Brief Description : Remote control system allows the operator to be removed from the job site and avoid exposure to harsh conditions and/or hazardous materials. System can be used with visual range RF-based remote control or with a video-assisted remote control that allows a greater range and operation without visual contact with the vehicle. Modulaire offers both the versatile, tracked vehicle with a robotic manipulator and the remote control technology. The system has been used very successfully to remove unexploded ordnance from an army artillery test firing range since 1994.

Company Name/POC: Modulaire Ltd./Mikko Sampo

Address : P.O. Box 10/14201 Turenki/Finland

Phone Number : 358 17 6878433

Fax Number : 358 17 6881510

Technology Maturity : Commercial use experience

Performance History : Sales began in 1994. A video-assisted unit has been used by the Finnish Defense Forces since September 1994 for removing unexploded ordnance from a test firing range. The system has functioned flawlessly and the customer has optioned to purchase an upgrade to a fully autonomous system later on. German MaK corporation has entered into an agreement with Modulaire for joint technology development and marketing efforts. The technology is being considered for clean-up operations in the former East Germany.

Comments : Minimal facilities are needed. The system can be controlled from outside or from almost any type of shelter. The remote control system is battery operated and a battery charging facility is needed, as is a supply of diesel fuel and oil for the vehicle. Increasing the range of the remote control system requires significantly increased power and may raise permitting issues. Video-assisted remote control requires some training and very delicate manipulator operations can be challenging. The internal combustion engine is not suitable for explosive atmospheres. The system is very easy to implement and maintain as it consists mainly of standard components. The main issue is proper operator training, as poorly trained operators are inefficient and can even damage the equipment. Infrastructure needs are minimal. Operator training is a key issue: a well-trained operator is both effective and safe.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Robotics*

Technology Name : Remote Excavator

Application : ☐ On-site ☒ Ex-situ

Brief Description : Remotely controlled Excavator is a radio or tether controlled heavy hydraulic excavator that allows all functions including end tooling and camera pan and tilt units. Advanced robotic features include coordinated motion control. Applications for excavation of hazardous waste eliminating the need for manned presence at excavation site.

Company Name/POC: RSI Research Ltd./Brad Moore

Address : Bldg. #3-203 Harbour Road/Victoria, BC, Canada V9A 3S2

Phone Number : 604 360-1025

Fax Number : 604 360-116

Technology Maturity : Commercial use experience

Performance History : U.S. Army, Yuma Proving Grounds, Yuma, AZ - ROND Remote Vehicle
 SPAR Aerospace/INEL, BWID '95 demonstration, Idaho Falls - Remote Excavator

Comments : None.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Other*

Technology Name : Sludge Dryer / Concentrate Dryer with Post-Feeding Capability

Application : On-site Ex-situ
Off-site

Brief Description : With this technology sludges and liquid waste can be treated. This drying technologies are producing a dry and dewatered waste product. The activity remains in the dry product. Further VR is possible with supercompaction. HPA builds drying systems since 1988. This technology is being used in Germany at more than 10 different nuclear power stations.

Company Name/POC: Hansa Projekt Anlagentechnik GmbH/Michael Szukala

Address : Tarpenring 4/22419 Hamburg, Germany

Phone Number : 49 40 527 02 62

Fax Number : 49 40 527 56 64

Technology Maturity : Commercial use experience

Performance History : HPA has built drying systems since 1988. 12 systems are currently operating in Germany for various applications. The customers are:

NPP Brunsbuttel
 NPP Krummel
 NPP Wurgassen
 NPP Grohnde
 NPP Philippsburg
 NPP Grafenrheinfeld
 NPP Greifswald and Rheinsberg

Comments : Process affords ease of use because of fully automated process, simple infrastructure, flexibility for various waste streams and proven and available technology. HPA dryers are built for the following applications:

Drying of DAW
 Drying of NPP sludges (sump)
 Drying of contaminated soil
 Drying and solidification of process sludge
 Drying and solidification of evaporator bottoms

Source of Information : International TechCon

 

[illegible]

 

Process Water

Extraction/Delivery/Materials Handling

Process Water

Extraction/Delivery/Materials Handling

CONTAMINANTS:

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Injection/Delivery Systems*

Technology Name : AMT Membrane In-Situ Bubbleless Oxygenation

Application :	In-situ (vadose zone)	Ex-situ
	In-situ (saturated zone)	

Brief Description : The In-Situ Bubbleless Oxygenator will utilize patented AMT membranes to transfer oxygen (or other gases) and cometabolites to groundwater within a well casing. Circulation of water will be provided by a pump in the well so as to distribute oxygen and nutrients to the contaminated aquifer for enhanced biological degradation of contaminants. These units will transfer gases with 100% gas to liquid efficiencies via membrane diffusion, i.e., with no bubbles.

Company Name/POC: Applied Membrane Technology, Inc./Stephen Conover

Address : 11558 Encore Circle/Minnetonka, MN 55343

Phone Number : 612 933 5121

Fax Number : 612 933-8839

Technology Maturity : Pilot plant testing

Performance History : Limited to pilot/bench scale information. The In-Situ Bubbleless Oxygenator is in the product-development stage with testing being organized. Certain membrane devices with some features in common have been successfully field tested by AMT for surface water treatment for over a year. Field tests conducted on membrane oxygenators for surface waters include the City of St. Paul's Water Intake Source, Lake Vadnais, and the discharge of Minneapolis/St. Paul's sewage treatment plant at Pig's Eye on the Mississippi. Contact: Stephen P. Conover, Sr. VP, Applied Membrane Technology, Inc., 11558 Encore Circle, Minnetonka, MN 55343, 612/933-5121. Testing of AMT's membranes for suitability in treatment applications involving direct contact with solvents, soils, and other contaminants has been conducted at the Hazardous Waste Research and Information Center, One E. Hazelwood Drive, Champaign, IL 61820. Contact Dr. Kishore Rajagopalan at 217/244-8905. Testing of AMT's membrane modules for solvent vapor stripping from vent gas emissions has been funded by the Center for Waste Reduction Technologies, under the direction of Dr. Kam Sirkar, Chair, Membrane Separations and Biotechnology, New Jersey Institute of Technology, 201/596-8447.

Comments : In-situ membrane oxygenators will be designed for easy insertion into existing wells. They require minimal infrastructure to assemble in place or for support services (electrical, gas, space) to fully implement. The modular construction of the units makes them flexible and readily adaptable to many situations. Treatment installations could vary both at the number and/or spacing to best suit the site characteristics. At this time, AMT's Membrane Cartridge technology has been used extensively in the medical technology industry and for aeration of surface waters. Development of In-Situ Bubbleless Oxygenators is proceeding and full-scale field demos are anticipated in the next 1-2 years. The major challenge facing actual use is coordinating collaborative field trials to document field performance.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Robotics*

Technology Name : Robotic Manipulator and Control Systems

Application : On-site

Brief Description : Teleoperated and autonomous robotic systems provided include manipulators, control systems and sensors. ISE robotic products are mission driven. Therefore, ISE has the ability to tailor all robotic products to suit the specific applications of the customer. All of the robotic systems are designed and built using hardware and software modules. The hardware modules may be re-configured to create other mechanical systems for very specific applications.

Company Name/POC: International Submarine Engineering LTD./Owen Williams

Address : 1734 Broadway Street/Port Coquitlam, B.C. V3C 2M8 Canada

Phone Number : 604 942-5223

Fax Number : 604 942-757

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Customers for ISE autonomous robotic systems include the U.S. Air Force and the Canadian Space Agency. The USAF system is used to autonomously refuel aircraft. The CSA robots are part of the development of autonomous robot technology applicable to the Space Station "Freedom" Project. Customers for ISE's teleoperated systems include Westinghouse, AT&T, the U.S. Navy, GPU Nuclear, Shin Nippon, Southwest Research, and Oceaneering Space Systems.

Comments : Personnel require 1-2 week training course. All systems are designed and built to operate in specific environments. Systems are used by trained technicians. Systems are typically self contained.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Other*

Technology Name : Autoflash Multi-Stage Evaporation

Application : On-site Ex-situ

Brief Description : Evaporation of highly contaminated water, for instance leachate from sanitary landfills.

Company Name/POC: Hofstetter Umwelttechnik AG/U.P. Hofstetter

Address : Anlagenbau/CH-3324 Hindelbank, Switzerland

Phone Number : 41 0 34 51 23 11

Fax Number : 41 0 34 51 25 08

Technology Maturity : Commercial use experience

Performance History : Several plants in operation throughout Europe.

Comments : Suspended solids and light volatile organics require pretreatment. Fully automatic operation, low requirement of supervision have 24-hour operation, very low maintenance and servicing. Need for protection against frost and vandalism.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Other*

Technology Name : Power Fluidic RFD Pump

Application : ☐ On-site ☐ Ex-situ

Brief Description : Maintenance free pump for transferring active liquors. Well proven technology with 400 installed to date. The early pumps have been running for 10 years plus - without the need for maintenance.

Company Name/POC: Power Fluidics/Paul Murray

Address : Bldg RD2,/Risley, Warrington/Cheshire, U.K. WA36AT

Phone Number : 44 1925252818

Fax Number : 1925252459

Technology Maturity : Commercial use experience

Performance History : Contact company for performance data.

Comments : None.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Other***Technology Name :** Pulse Drying/Evaporation**Application :** On-site Ex-situ

Brief Description : Evaporates water from industrial process and wastewater sludges from hazardous to radiological uranium wastewater, including agricultural wastes. Uses sound-pressure waves to atomize the raw feed and heat to evaporate the water using a pulse combustion pulsating burner as its sound and heat source. Direct fired, fossil-fueled burner. Dissolved and suspended solids from sub micron to 1/4" particles. Exit temperature of solids 125-145F. 1,250 BTU-input/lb H₂O removed to 16,000 BTUs. Similar to spray drying and flash drying. Advantages are that there are no moving parts in the drying process; no atomizing nozzles or splatter wheels, wide variety of raw material feed stocks, low temperature product, low operating cost, single-pass process, startup <5 minutes, and system is transportable.

Company Name/POC: Pulse Drying Systems, Inc./Samuel G. N. Duncan**Address :** 1075 N.W. Murray Road/Suite 119/Portland, Oregon 97229**Phone Number :** 503 641-9427**Fax Number :** 503 641-7266**Technology Maturity :** Commercial use experience**Performance History :** Contact company for performance history data.

Comments : Transportable system. Utilities include water, electricity and natural gas/propane/fuel oil. Need surge tank and dry material packaging support system with dryer/evaporator. Raw material feed stock limited to dissolved and suspended solids from sub micron to 1/4" particle size. From 1-40 percent solids. High moisture/low solids raw feed is best. No oil or volatiles in feed stock or viscous, sticky/plastic feed stocks. Production begins from 3-5 minutes from cold startup. Horizontal orientation of system enables it to be easily transported. Setup time <7 days. No water discharge, with only air permits required. Need surge tank and dry material packaging support system with dryer/evaporator. Providing the proper particle collection system along with the proper air cleaning system to handle VOCs and designing larger/more efficient pulse burners to be able to handle more throughput requirements.

Source of Information : International TechCon

 

[illegible]

Ground Water

Extraction/Delivery/Materials Handling

Ground Water

Extraction/Delivery/Materials Handling

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Directional Wells*

Technology Name : Horizontal Drilling

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Drilex Systems, Inc. has developed a horizontal drilling system for use as a remediation tool. The principal involves drilling a borehole by directional or horizontal drilling into contaminated areas that are otherwise difficult or impossible to reach due to surface obstructions; or to drill extended lengths of borehole into contaminated areas to expose more area to a given treatment technology.

Company Name/POC: Drilex Systems, Inc./Vernon Robin

Address : 15151 Sommermeyer/P.O. Box 801114/Houston, Texas 77280-1114

Phone Number : 713 937-8888

Fax Number : 713 849-2390

Technology Maturity : Commercial use experience

Performance History : Initial pilot project was undertaken in February 1990 at a site in Michigan. Two horizontal boreholes were drilled - one into the contaminant source to pump and treat, and the other into the down stream plume to stop the migration. Drilling rig is available for full scale operations. Drilex has over 10 years' experience in directional and horizontal drilling.

Comments : The rig is mounted on four truck trailers and is a fully transportable, non-permit, self-powered setup that can be moved with ease. The only outside source needed is for water to mix drilling fluids. Wells can be installed at depths from 12 feet to 250 feet. The horizontal section can be up to 2500 feet long. There are no limitations on specific contaminants. However, the type of contaminant does limit the types the hardware that can be used in the well.

Source of Information : VISITT 3.0

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Directional Wells***Technology Name :** Curved Horizontal Wells with Ductile Porous Polyethylene

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : It is patented procedure to install curved horizontal wells with specially developed porous screens and drilling services (mud, navigation, precision). It is used for soil vapor extraction, groundwater extraction, bioremediation, monitoring, etc.

Company Name/POC: FlowTex GUT GmbH/Dr. Ingo Sass

Address : Gesellschaft für Großbohr- und Umwelttechnik/Chausseestraße 1/D-06317 Amsdorf, Post
Roblingen, Germany

Phone Number : 34601 40 164**Fax Number :** 34601 40 15**Technology Maturity :** Commercial use experience

Performance History : 1989 : first field test performed. 1990 : first porous pipes introduced. 1991 - 1993 : technical operations. Since 1993 : commercial use (55 wells in operation up to now in Germany alone). Portsmouth site horizontal well recirculation system with ORNL.

Comments : Maximum screen diameter: 12 inch, max. length 2000 meters, maximum depth 300 meters. Six different qualities of porous pipes; different mud designs; drill systems from 8 to 400 metric tons (pulling force) available; very high precision drilling; porous screens much more efficient; higher clogging and colmation resistivity; use of shelter casing procedure for well completion and filter cake destruction; hydrophobic screens.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Directional Wells***Technology Name :** Horizontal Guided Drilling

Application :
 In-situ (vadose zone)
 In-situ (saturated zone)

Brief Description : Horizontal guided drilling is a technology used for groundwater plume control. Hydrostatic pressures in aquifers under polluted sites are controlled by installing specially designed production pipes; polluted groundwater can be recovered for treatment; or airsparging/venting used for in situ treatment.

Company Name/POC: Rasmussen & Shiotz Anlaeg A/S**Address :** Industriholmen 82/2650 Hvidovre/Denmark**Phone Number :** 3677 0899**Fax Number :** 3677 2122**Technology Maturity :** Commercial use experience

Performance History : Originally the technology was used to drill under roads and highways (for installation of cables, sewers, water supplies etc.). Precise design of position of wells is prerequisite as well as detailed geological description of the ground in which the wells are to be drilled.

Comments : While drilling and installing production pipe, only the drilling rig is needed as well as ordinary construction equipment, including freshwater supply and power supply. The technology is difficult to use in very rocky soils. The hydraulics of the groundwater formation in relation to the position of the pollution have to be suitable for the use of the technology. Easy and flexible to use for a well trained staff. The technology is available everywhere. Need precise geological/hydrogeological description of site.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Injection/Delivery Systems***Technology Name :** Cone Penetrometer

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : The Lightweight static cone penetrometer was specially designed to perform geotechnical investigations in areas or locations which are not accessible to other equipment. Aspects such as weight, ease of operation and simplicity have played an important role during the design phase. Several applications can be realized with the basic system such as mechanical and electrical cone tests or soil sampling. In order to compensate for the reaction forces while testing, four solid ground anchors give sufficient grip, even at greater depths.

Company Name/POC: A.P. van den Berg B.V./ Engbert Welling**Address :** 8440 AB Heerenveen/Ijzerweg 4/The Netherlands.**Phone Number:** 31 5130 31355**Fax Number :** 31 5130 3121**Technology Maturity :** Commercial use experience**Performance History :** Contact company for performance data.

Comments: Two models are available - the Hyson 50 kN and Hyson 100kN with pushing capacity of 5.5 US tons and 11 US tons respectively.

Source of Information : International TechCon

CONTAMINANTS :	☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
	☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
	☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Injection/Delivery Systems*

Technology Name : AMT Membrane In-Situ Bubbleless Oxygenation

Application : In-situ (vadose zone) Ex-situ
In-situ (saturated zone)

Brief Description : The In-Situ Bubbleless Oxygenator will utilize patented AMT membranes to transfer oxygen (or other gases) and cometabolites to groundwater within a well casing. Circulation of water will be provided by a pump in the well so as to distribute oxygen and nutrients to the contaminated aquifer for enhanced biological degradation of contaminants. These units will transfer gases with 100% gas to liquid efficiencies via membrane diffusion, i.e., with no bubbles.

Company Name/POC: Applied Membrane Technology, Inc./Stephen Conover

Address : 11558 Encore Circle/Minnetonka, MN 55343

Phone Number : 612 933 5121 **Fax Number :** 612 933-8839

Technology Maturity : Pilot plant testing

Performance History : Limited to pilot/bench scale information. The In-Situ Bubbleless Oxygenator is in the product-development stage with testing being organized. Certain membrane devices with some features in common have been successfully field tested by AMT for surface water treatment for over a year. Field tests conducted on membrane oxygenators for surface waters include the City of St. Paul's Water Intake Source, Lake Vadnais, and the discharge of Minneapolis/St. Paul's sewage treatment plant at Pig's Eye on the Mississippi. Contact: Stephen P. Conover, Sr. VP, Applied Membrane Technology, Inc., 11558 Encore Circle, Minnetonka, MN 55343, 612/933-5121. Testing of AMT's membranes for suitability in treatment applications involving direct contact with solvents, soils, and other contaminants has been conducted at the Hazardous Waste Research and Information Center, One E. Hazelwood Drive, Champaign, IL 61820. Contact Dr. Kishore Rajagopalan at 217/244-8905. Testing of AMT's membrane modules for solvent vapor stripping from vent gas emissions has been funded by the Center for Waste Reduction Technologies, under the direction of Dr. Kam Sirkar, Chair, Membrane Separations and Biotechnology, New Jersey Institute of Technology, 201/596-8447.

Comments : In-situ membrane oxygenators will be designed for easy insertion into existing wells. They require minimal infrastructure to assemble in place or for support services (electrical, gas, space) to fully implement. The modular construction of the units makes them flexible and readily adaptable to many situations. Treatment installations could vary both at the number and/or spacing to best suit the site characteristics. At this time, AMT's Membrane Cartridge technology has been used extensively in the medical technology industry and for aeration of surface waters. Development of In-Situ Bubbleless Oxygenators is proceeding and full-scale field demos are anticipated in the next 1-2 years. The major challenge facing actual use is coordinating collaborative field trials to document field performance.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Injection/Delivery Systems*

Technology Name : Cone Penetrometer Platform

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Technology combines cone penetrometer and surface geophysics to permit a real-time, three-dimensional site characterization approach on soil sites.

Company Name/POC: Applied Research Associates, Inc./Terry Steinborn

Address : 4300 San Mateo, NE/Suite A-200/Albuquerque, New Mexico 87110

Phone Number : 505 883-3636

Fax Number : 505 883-367

Technology Maturity : Commercial use experience

Performance History : Performance Data are Available.

Demonstrations at Savannah River and Hanford. Components of technology are in daily use. Full on-site characterization from start to remediation awaiting an appropriate project. Demonstrations at Hanford and Savannah River involved hazardous, mixed wastes, and low-level nuclear waste.

Comments : The technology is completely ready to be applied on accessible soil sites having contaminated groundwater or buried contaminant materials at depths up to 300 ft. This is a very comprehensive and adaptable system which can be used to solve specific site problems or can provide a broad, rapid site characterization which permits site characterization tactical planning and data acquisition planning in real time (the observation approach). Little characterization-related contaminant is brought to the surface. Cost and schedule savings may be very large in appropriate cases. Site characterization, installation of monitoring wells and instruments and inception of remediation can be integrated through this technology. An integrated three-dimensional database and data archive provides support for site hydrogeology analysis, hydrologic modeling, remedial planning, site activity documentation and generation of presentation and report graphics.

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Injection/Delivery Systems*

Technology Name : SEAMIST

Application : In-situ (vadose zone)

Brief Description : SEAMIST is a borehole lining and instrumentation system which uses an inverting impermeable tubular membrane to deploy sensors into the borehole. Its demonstrated uses are unsaturated zone vapor and liquid sampling, and borehole lining.

Company Name/POC: Eastman Cherrington Environmental/Carl Keller

Address : 1640 Old Pecos Trail/Suite H/Santa Fe, New Mexico 87505

Phone Number : 505 983-3199

Fax Number : 505.983-3476

Technology Maturity : Commercial use experience

Performance History : Tritium monitoring - LLNL, Barbara Mallon (510) 422-0913
Carbon Tetrachloride - Hanford (Westinghouse), Virginia Rohay (509) 376-5507
VOCs - Sandia, Jim Phelan (505) 845-9892
VOCs, tritium - Los Alamos, Steve McLin (505) 665-1721

Comments : System is presently only used in unsaturated zone; however, development is underway for a system to be used below the water table. For the greatest benefit, an uncased borehole should be used. Two people can deploy and operate the system. Once installed, borehole instrumentation takes less than 30 minutes. All equipment (air source, elect. generator, SEAMIST system) are easily transported (no heavy equipment).

Source of Information : TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : Injection/Delivery Systems**Technology Name :** Linear Contaminant Remediation System (LCRS)

Application : In-situ (vadose zone)
 In-situ (saturated zone)

Brief Description : This technology involves using the trenched horizontal well installation process that was developed by Horizontal Technologies, Inc., (HTI). For trenched air sparging applications, the lower horizontal well screen is utilized to introduce air into the base of the trench. An upper line is installed near the top of the trench and above the water table to serve as a vapor extraction line. The lower horizontal line can be installed to depths of 20 to 30 feet. Both the lower and upper lines are installed along with the placement of the artificial trench backfill material in a one step process in a nominal 14 inch wide trench.

Company Name/POC: Horizontal Technologies, Inc./Donald R. Justice, Greg Rawl**Address :** 2309 Hancock Bridge Parkway (33990)/P.O.Box 150820/Cape Coral, Florida 33915-0820**Phone Number :** 813 995-8777**Fax Number :** 941 995-846**Technology Maturity :** Commercial use experience

Performance History : Technology is full scale. Systems for delivery and extraction of contaminants using trenched horizontal wells have been installed on numerous sites in the U.S. and are currently being permitted for use by environmental consultants on over 100 sites. The first air sparging application is currently under design and should be in operation prior to the end of 1994.

Comments : Cannot be installed directly under buildings. The maximum installation depth below the water table is approximately 25 feet. However, greater depths can be reached by benching down of the installation equipment. The installation machine cannot cut hard rock strata without pre-trenching with a conventional excavator.

Source of Information : VISITT 3.0

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Robotics*

Technology Name : Robotic Manipulator and Control Systems

Application : On-site

Brief Description : Teleoperated and autonomous robotic systems provided include manipulators, control systems and sensors. ISE robotic products are mission driven. Therefore, ISE has the ability to tailor all robotic products to suit the specific applications of the customer. All of the robotic systems are designed and built using hardware and software modules. The hardware modules may be re-configured to create other mechanical systems for very specific applications.

Company Name/POC: International Submarine Engineering LTD./Owen Williams

Address : 1734 Broadway Street/Port Coquitlam, B.C. V3C 2M8 Canada

Phone Number : 604 942-5223

Fax Number : 604 942-757

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Customers for ISE autonomous robotic systems include the U.S. Air Force and the Canadian Space Agency. The USAF system is used to autonomously refuel aircraft. The CSA robots are part of the development of autonomous robot technology applicable to the Space Station "Freedom" Project. Customers for ISE's teleoperated systems include Westinghouse, AT&T, the U.S. Navy, GPU Nuclear, Shin Nippon, Southwest Research, and Oceaneering Space Systems.

Comments : Personnel require 1-2 week training course. All systems are designed and built to operate in specific environments. Systems are used by trained technicians. Systems are typically self contained.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Injection/Delivery Systems***Technology Name :** Piezocone/Drill Rig Truck with Computerized Stratigraphic and Environmental Analysis

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : High speed high-capacity (20 ton+) piezoconic penetrometer linked to on-board computer for stratigraphic and environmental analysis. Rig also includes conventional rotary rig for rock/soil/concrete. Piezocone can identify soil layers as small as a few millimeters thick. Probes can be mounted with detectors for a variety of environmental parameters e.g., VOCs, radionuclides. High speed (4ft/min) enables numerous soil profiles to be obtained in a short time with much higher sensitivity compared with conventional drilling. Allows better (closer) spacing.

Company Name/POC: Ontario Hydro Technologies/C. Cragg/R. Tsang**Address :** 800 Kipling Ave #KR252/Etobicoke Ontario, Canada M87 5S4**Phone Number :** 416 207-6139**Fax Number :** 905 855-4725**Technology Maturity :** Commercial use experience**Performance History :** Contact company for performance history data.

Comments : Requires field access for 10-ton truck, or unit can be dismounted to 5-ton flat-bed truck or barge for lakes/rivers/swamps.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Other*

Technology Name : Autoflash Multi-Stage Evaporation

Application : On-site Ex-situ

Brief Description : Evaporation of highly contaminated water, for instance leachate from sanitary landfills.

Company Name/POC: Hofstetter Umwelttechnik AG/U.P. Hofstetter

Address : Anlagenbau/CH-3324 Hindelbank, Switzerland

Phone Number : 41 0 34 51 23 11

Fax Number : 41 0 34 51 25 08

Technology Maturity : Commercial use experience

Performance History : Several plants in operation throughout Europe.

Comments : Suspended solids and light volatile organics require pretreatment. Fully automatic operation, low requirement of supervision have 24-hour operation, very low maintenance and servicing. Need for protection against frost and vandalism.

Source of Information : International TechCon

 

[illegible]

 

[illegible]

Surface Water

Extraction/Delivery/Materials Handling

Surface Water

Extraction/Delivery/Materials Handling

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Injection/Delivery Systems*

Technology Name : AMT Membrane In-Situ Bubbleless Oxygenation

Application : In-situ (vadose zone) Ex-situ
In-situ (saturated zone)

Brief Description : The In-Situ Bubbleless Oxygenator will utilize patented AMT membranes to transfer oxygen (or other gases) and cometabolites to groundwater within a well casing. Circulation of water will be provided by a pump in the well so as to distribute oxygen and nutrients to the contaminated aquifer for enhanced biological degradation of contaminants. These units will transfer gases with 100% gas to liquid efficiencies via membrane diffusion, i.e., with no bubbles.

Company Name/POC: Applied Membrane Technology, Inc./Stephen Conover

Address : 11558 Encore Circle/Minnetonka, MN 55343

Phone Number : 612 933 5121

Fax Number : 612 933-8839

Technology Maturity : Pilot plant testing

Performance History : Limited to pilot/bench scale information. The In-Situ Bubbleless Oxygenator is in the product-development stage with testing being organized. Certain membrane devices with some features in common have been successfully field tested by AMT for surface water treatment for over a year. Field tests conducted on membrane oxygenators for surface waters include the City of St. Paul's Water Intake Source, Lake Vadnais, and the discharge of Minneapolis/St. Paul's sewage treatment plant at Pig's Eye on the Mississippi. Contact: Stephen P. Conover, Sr. VP, Applied Membrane Technology, Inc., 11558 Encore Circle, Minnetonka, MN 55343, 612/933-5121. Testing of AMT's membranes for suitability in treatment applications involving direct contact with solvents, soils, and other contaminants has been conducted at the Hazardous Waste Research and Information Center, One E. Hazelwood Drive, Champaign, IL 61820. Contact Dr. Kishore Rajagopalan at 217/244-8905. Testing of AMT's membrane modules for solvent vapor stripping from vent gas emissions has been funded by the Center for Waste Reduction Technologies, under the direction of Dr. Kam Sirkar, Chair, Membrane Separations and Biotechnology, New Jersey Institute of Technology, 201/596-8447.

Comments : In-situ membrane oxygenators will be designed for easy insertion into existing wells. They require minimal infrastructure to assemble in place or for support services (electrical, gas, space) to fully implement. The modular construction of the units makes them flexible and readily adaptable to many situations. Treatment installations could vary both at the number and/or spacing to best suit the site characteristics. At this time, AMT's Membrane Cartridge technology has been used extensively in the medical technology industry and for aeration of surface waters. Development of In-Situ Bubbleless Oxygenators is proceeding and full-scale field demos are anticipated in the next 1-2 years. The major challenge facing actual use is coordinating collaborative field trials to document field performance.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Robotics***Technology Name :** Robotic Manipulator and Control Systems**Application :** On-site

Brief Description : Teleoperated and autonomous robotic systems provided include manipulators, control systems and sensors. ISE robotic products are mission driven. Therefore, ISE has the ability to tailor all robotic products to suit the specific applications of the customer. All of the robotic systems are designed and built using hardware and software modules. The hardware modules may be re-configured to create other mechanical systems for very specific applications.

Company Name/POC: International Submarine Engineering LTD./Owen Williams**Address :** 1734 Broadway Street/Port Coquitlam, B.C. V3C 2M8 Canada**Phone Number :** 604 942-5223**Fax Number :** 604 942-757**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.

Customers for ISE autonomous robotic systems include the U.S. Air Force and the Canadian Space Agency. The USAF system is used to autonomously refuel aircraft. The CSA robots are part of the development of autonomous robot technology applicable to the Space Station "Freedom" Project. Customers for ISE's teleoperated systems include Westinghouse, AT&T, the U.S. Navy, GPU Nuclear, Shin Nippon, Southwest Research, and Oceaneering Space Systems.

Comments : Personnel require 1-2 week training course. All systems are designed and built to operate in specific environments. Systems are used by trained technicians. Systems are typically self contained.

Source of Information : International TechCon

Process Wastes/Sludge

Extraction/Delivery/Materials Handling

Process Wastes/Sludge

Extraction/Delivery/Materials Handling

CONTAMINANTS :

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

■ Petroleum Hydrocarbons

Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

■ **Halogenated VOC**

■ N/A

TECHNOLOGY TYPE :

Excavation, Retrieval, and Off-Site Disposal

Technology Name : Retrieval of Stored Wastes

Application :

On-site

Ex-situ

Brief Description :

Retrieves a wide variety of high dose rate solid and slurry from radioactive wastes that have been stored in vaults and tanks that are difficult to access. Technology has been developed, installed and operated to access and remotely retrieve wastes. Plant designs are based on an appropriate combination of mixers, pumps, and ejectors, grabs and deployment systems.

Company Name/POC: Nuclear Electric plc/Dr. R. Clayton

Address : Littlebroom Manorway/Dartford Kent DA1 5PY, UK

Phone Number : 44 0 1322 2700

Fax Number : 44 1322 2706

Technology Maturity : Commercial use experience

Performance History : 3 plants installed and operated successfully for retrieving slurry form wastes.
1 plant installed and operated successfully for retrieving solid form wastes.
4 future plants being designed.
Plants operated on a batch basis to match controlling downstream waste production.

Comments :

None.

Source of Information : International TechCon

PROCESS WASTES/SLUDGE

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Size reduction*

Technology Name : Extec Screens and Crushers

Application : On-site Ex-situ
Off-site

Brief Description : This equipment improves preparation and presentation of materials to be treated.

Company Name/POC: Extec Screens and Crushers/P. Douglas

Address : Heathcote Road, Swadlincote/Derbyshire DE 11 9DU, U.K.

Phone Number : 44 1283 212121

Fax Number : 44 1283 21734

Technology Maturity : Commercial use experience

Performance History : Contact company for performance data.

Comments : None.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides☐ Heavy Metals☐ PCB☐ Explosives/Propellants☐ Petroleum Hydrocarbons☐ Radionuclides☐ SVOC☐ Other Contaminant☐ Nonhalogenated VOC☐ Halogenated VOC☐ N/A**TECHNOLOGY TYPE :** *Size reduction***Technology Name :** Microfluidizer (TM)**Application :**

On-site

Ex-situ

Brief Description :

Microfluidizer equipment employs high energy mixing, involving shear impact and cavitation in a patented interaction chamber. Size reduction and deagglomeration to submicron structures are routinely achieved, continuously and predictably. Devices are air-driven (or by explosion-proof motor driven systems at user's option). Enormous surface area is created under extremely turbulent conditions by collision of high velocity streams at high pressure in a controlled, confined small space.

Company Name/POC: Microfluidics Corp./Irwin Gruverman**Address :** 30 Ossipee Rd./ Newton, Massachusetts 02164-9101**Phone Number :** 617 969-5452**Fax Number :** 617 965-1213**Technology Maturity :**

Pilot plant testing

Performance History : Not available.**Comments :** None.**Source of Information :** VISITT 3.0

PROCESS WASTES/SLUDGE

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Dewatering

Technology Name : Mini-Miser (TM) Dewatering System

Application : On-site Ex-situ

Brief Description : The Mini-Miser Dewatering System mechanically extracts liquids from sludges, sediments, and solids. The system incorporates a patented press design that previously has been applied for the extraction of fruit and vegetable juices in the food processing industry. This design allows for the dewatering of materials with varying particle sizes and viscosities, including non-pumpable solids and sludges as well as material containing grit, gravel, vegetation or debris. The unit can operate as a secondary dewatering unit or as an alternative to filter presses, sludge drying beds, and thermal dryers and is particularly suited for materials with high solids content (i.e., sediments).

Company Name/POC: Recra Environmental, Inc./James F. LaDue

Address : 10 Hazelwood Drive/Amherst, New York 14228-2298

Phone Number : 716 691-2600

Fax Number : 716 691-261

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Dry cakes in excess of 60 percent solids with a 75 percent reduction in volume have been produced. The full-scale system is available in manual or automated, semi-continuous or batch feed systems designs with processing capacities up to 30 tons per hour. The system has shown successful results in pressing low solids content sludges (2 - 5 percent). In 1990, development and testing began on waste related applications and the first unit was installed on a commercial basis for a lagoon sludge remediation project in 1992.

Comments :

Since this equipment was originally used for juice extraction from fruit and vegetable pulp, it is designed primarily to process sludges and materials with a relatively high solids content (>15 percent). The equipment incorporates hydraulic cylinders to exert, uniformly distributed high pressure to mechanically extract free liquid from the wastes resulting in greater reduction of volume and weight without chemicals or polymers.

Source of Information : VISITT 3.0

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Dust Control***Technology Name :** Electrostatically Charged Plastic**Application :** On-site Ex-situ

Brief Description : In any cleaning operation there is a large quantity of dust raised into the air. This is hazardous to people and dust keeps settling onto clean areas. Unless cleaning tools are oiled, they do not collect and hold dust efficiently. This technology involves sheets of plastic (polypropylene) which are heated and electrically charged. The charge is permanent (3 years) and the material can be cleaned and reused. Almost any plastic can be charged; as you might expect, Teflon holds the highest charge (1000) volts per cm) but it is too expensive for most applications. The charged plastic causes no shock if touched; the flow of charge through the material is far too slow. It is important to note that the charged plastic does not require that the dust actually touch the surface. Particles can be drawn by induced charges - a 5 micron particle would be drawn in from a distance of 2 cm in a relatively calm atmosphere. The material is used to collect asbestos dust from clean-up sites. It has been used in semiconductor clean rooms where the dust may be atmospheric, paper based, human dust from hair and skin, and chemically based. All of these materials are collected and prepared for eventual removal or disposal with the collecting plastic.

Company Name/POC: Wall-Rite/Jack Fogel, CEO**Address :** 5930 Midway Park/Albuquerque, New Mexico 87109**Phone Number :** 800 795-1415**Fax Number :** 505 344-7039**Technology Maturity :** Commercial use experience

Performance History : The material is used extensively in offices for meetings - the material sticks on the wall and can be written upon, erased, and used again. Stick-on signs of all kinds are available. An electrostatically charged broom and dog brush have been demonstrated and are being redesigned for manufacturing. Applications to disk drives (for dust collection) have been demonstrated, semiconductor clean room use has been tested in the laboratory and in operating facilities.

Comments : The material is usually sold in sheets 0.003 inches thick. Plastics as heavy as 1/4" have been successfully charged. Fibers can be charged for filtering or as wiping cloths. Hollow fibers or solid materials can be charged and will be used in the broom/brush work. For dust collection, the material is normally hung up or pasted (electrostatically) to a wall. The material is normally most effective on dust particles from 0.1 microns (3.28 x 10 ft) to 50 microns. Above that size, dust does not remain in the air long enough to be a problem or to be collected. The smaller particles (0.1 to 10 microns) are most dangerous since they enter the human breathing system.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : Robotics

Technology Name : Robotic Manipulator and Control Systems

Application : On-site

Brief Description : Teleoperated and autonomous robotic systems provided include manipulators, control systems and sensors. ISE robotic products are mission driven. Therefore, ISE has the ability to tailor all robotic products to suit the specific applications of the customer. All of the robotic systems are designed and built using hardware and software modules. The hardware modules may be re-configured to create other mechanical systems for very specific applications.

Company Name/POC: International Submarine Engineering LTD./Owen Williams

Address : 1734 Broadway Street/Port Coquitlam, B.C. V3C 2M8 Canada

Phone Number : 604 942-5223

Fax Number : 604 942-757

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Customers for ISE autonomous robotic systems include the U.S. Air Force and the Canadian Space Agency. The USAF system is used to autonomously refuel aircraft. The CSA robots are part of the development of autonomous robot technology applicable to the Space Station "Freedom" Project. Customers for ISE's teleoperated systems include Westinghouse, AT&T, the U.S. Navy, GPU Nuclear, Shin Nippon, Southwest Research, and Oceanneering Space Systems.

Comments : Personnel require 1-2 week training course. All systems are designed and built to operate in specific environments. Systems are used by trained technicians. Systems are typically self contained.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Robotics***Technology Name :** Multi-Limb, Long-Reach, Heavy Duty Hydraulic Manipulator**Application :** On-site Ex-situ**Brief Description :** Multi-limb (15 dof) long reach heavy duty hydraulic manipulator equipment is a remote deployment system for a wide range of enabling technologies to provide total capability.**Company Name/POC:** Nuclear Electric plc/Dr. R. Clayton**Address :** Littlebroom Manorway/Dartford Kent DA1 5PY, UK**Phone Number :** 44 0 1322 2700**Fax Number :** 44 1322 2706**Technology Maturity :** Commercial use experience**Performance History :** Prototype developed in mid 80's, 9 units in service. High performance and high reliability for use in reactor during statutory shut-down.

Comments : Limitations include maximum (1) payload 200 lb.; (2) temperature 80 degrees celcius; and (3) radiation dose 1 MRAD. Heavy duty manipulators and in some cases mobile and climbing vehicles provide the means of deployment of a wide range of enabling technologies, which includes drilling, bolting, stud welding, welding, laser welding and cutting, in radioactive and hostile environments. This also facilitates both non intrusive and intrusive inspection programs employing equipment and methods such as advanced TV systems, laser scanning cameras, infra-red surveys, ultrasonics, ultrasonic spectroscopy, laser induced breakdown spectroscopy, trepanning and sampling to support the long term safe operation of reactor plant.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : Other

Technology Name : Sludge Dryer / Concentrate Dryer with Post-Feeding Capability

Application : ☐ On-site ☐ Ex-situ
☐ Off-site

Brief Description : With this technology sludges and liquid waste can be treated. This drying technologies are producing a dry and dewatered waste product. The activity remains in the dry product. Further VR is possible with supercompaction. HPA builds drying systems since 1988. This technology is being used in Germany at more than 10 different nuclear power stations.

Company Name/POC: Hansa Projekt Anlagentechnik GmbH/Michael Szukala

Address : Tarpenning 4/22419 Hamburg, Germany

Phone Number : 49 40 527 02 62

Fax Number : 49 40 527 56 6

Technology Maturity : Commercial use experience

Performance History : HPA has built drying systems since 1988. 12 systems are currently operating in Germany for various applications. The customers are:

NPP Brunsbüttel
 NPP Krummel
 NPP Würgassen
 NPP Grohnde
 NPP Philippsburg
 NPP Grafenrheinfeld
 NPP Greifswald and Rheinsberg

Comments : Process affords ease of use because of fully automated process, simple infrastructure, flexibility for various waste streams and proven and available technology. HPA dryers are built for the following applications:
 Drying of DAW
 Drying of NPP sludges (sump)
 Drying of contaminated soil
 Drying and solidification of process sludge
 Drying and solidification of evaporator bottoms

Source of Information : International TechCon

CONTAMINANTS :

Pesticides/Herbicides

Heavy Metals

 PCB

Explosives/Propellants

■ Petroleum Hydrocarbons

■ Radionuclides

SVOC

Other Contaminant

Nonhalogenated VOC

■ Halogenated VOC

N/A

TECHNOLOGY TYPE: *Other*

Technology Name : Autoflash Multi-Stage Evaporation

Application :	On-site	Ex-situ

Brief Description : Evaporation of highly contaminated water, for instance leachate from sanitary landfills.

Company Name/POC: Hofstetter Umwelttechnik AG/U.P. Hofstetter'

Address : Anlagenbau/CH-3324 Hindelbank, Switzerland

Phone Number : 41 0 34 51 23 11

Fax Number : 41 0 34 51 25 08

Technology Maturity : Commercial use experience

Performance History : Several plants in operation throughout Europe.

Comments : Suspended solids and light volatile organics require pretreatment. Fully automatic operation, low requirement of supervision have 24-hour operation, very low maintenance and servicing. Need for protection against frost and vandalism.

Source of Information : International TechCon

PROCESS WASTES/SLUDGE

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Other*

Technology Name : Power Fluidic RFD Pump

Application : On-site Ex-situ

Brief Description : Maintenance free pump for transferring active liquors. Well proven technology with 400 installed to date. The early pumps have been running for 10 years plus - without the need for maintenance.

Company Name/POC: Power Fluidics/Paul Murray

Address : Bldg RD2,/Risley, Warrington/Cheshire, U.K. WA36AT

Phone Number : 44 1925252818

Fax Number : 1925252459

Technology Maturity : Commercial use experience

Performance History : Contact company for performance data.

Comments : None.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : Other

Technology Name : Pulse Drying/Evaporation

Application : On-site Ex-situ

Brief Description : Evaporates water from industrial process and wastewater sludges from hazardous to radiological uranium wastewater, including agricultural wastes. Uses sound-pressure waves to atomize the raw feed and heat to evaporate the water using a pulse combustion pulsating burner as its sound and heat source. Direct fired, fossil-fueled burner. Dissolved and suspended solids from sub micron to 1/4" particles. Exit temperature of solids 125-145F. 1,250 BTU-input/lb H₂O removed to 16,000 BTUs. Similar to spray drying and flash drying. Advantages are that there are no moving parts in the drying process; no atomizing nozzles or splatter wheels, wide variety of raw material feed stocks, low temperature product, low operating cost, single-pass process, startup <5 minutes, and system is transportable.

Company Name/POC: Pulse Drying Systems, Inc./Samuel G. N. Duncan

Address : 1075 N.W. Murray Road/Suite 119/Portland, Oregon 97229

Phone Number : 503 641-9427

Fax Number : 503 641-7266

Technology Maturity : Commercial use experience

Performance History : Contact company for performance history data.

Comments : Transportable system. Utilities include water, electricity and natural gas/propane/fuel oil. Need surge tank and dry material packaging support system with dryer/evaporator. Raw material feed stock limited to dissolved and suspended solids from sub micron to 1/4" particle size. From 1-40 percent solids. High moisture/low solids raw feed is best. No oil or volatiles in feed stock or viscous, sticky/plastic feed stocks. Production begins from 3-5 minutes from cold startup. Horizontal orientation of system enables it to be easily transported. Setup time <7 days. No water discharge, with only air permits required. Need surge tank and dry material packaging support system with dryer/evaporator. Providing the proper particle collection system along with the proper air cleaning system to handle VOCs and designing larger/more efficient pulse burners to be able to handle more throughput requirements.

Source of Information : International TechCon

PROCESS WASTES/SLUDGE

CONTAMINANTS: ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE: *Other***Technology Name:** Centrifuge Separator**Application:** On-site Ex-situ

Brief Description: Used on oily sludges, the separation process consists of up to four steps: chemical pretreatment; heat at a high gravitational force; three-phase separator centrifuge; and a horizontal bowl decanter centrifuge. By recycling the decanter concentrate back to the separator and feeding separator sediment to the decanter, it is possible to achieve significant volume reduction of the solid wastes while recovering reusable oil and clean water.

Company Name/POC: Walsh Environmental/George Taniwaki**Address:** 800 Jefferson County Parkway/Golden, Colorado 80401**Phone Number:** 303 670-2875**Fax Number:** 303 443-036**Technology Maturity:** Commercial use experience

Performance History: The process has been demonstrated at a throughput of 14,000 lbs/hr using tank bottoms sludge as feed. Other waste streams which have been used as feed for the process have been demonstrated through field operations. These tests have included wastes from dissolved air flotation operations as well as tank bottoms sludge and slop oils.

Comments: Contaminant identified as: Oily Sludges

Common to all centrifugal force-based processes, the wastes combined must have a minimum specific gravity difference to effect the separation. Typically, this difference should be 0.02 g/ml or greater. Almost any refinery waste stream which contains solids would be separable from the oil and water contained within. The process is generally limited to wastestreams with fine-sized solids with limited abrasive characteristics. Oversized solids may be removed by gravity settling during the pretreatment.

Source of Information: VISITT 3.0

Sediments in Surface Water

Extraction/Delivery/Materials Handling

Sediments in Surface Water

Extraction/Delivery/Materials Handling

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Dewatering*

Technology Name : Mini-Miser (TM) Dewatering System

Application : On-site Ex-situ

Brief Description : The Mini-Miser Dewatering System mechanically extracts liquids from sludges, sediments, and solids. The system incorporates a patented press design that previously has been applied for the extraction of fruit and vegetable juices in the food processing industry. This design allows for the dewatering of materials with varying particle sizes and viscosities, including non-pumpable solids and sludges as well as material containing grit, gravel, vegetation or debris. The unit can operate as a secondary dewatering unit or as an alternative to filter presses, sludge drying beds, and thermal dryers and is particularly suited for materials with high solids content (i.e., sediments).

Company Name/POC: Recra Environmental, Inc./James F. LaDue

Address : 10 Hazelwood Drive/Amherst, New York 14228-2298

Phone Number : 716 691-2600

Fax Number : 716 691-2617

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Dry cakes in excess of 60 percent solids with a 75 percent reduction in volume have been produced. The full-scale system is available in manual or automated, semi-continuous or batch feed systems designs with processing capacities up to 30 tons per hour. The system has shown successful results in pressing low solids content sludges (2 - 5 percent). In 1990, development and testing began on waste related applications and the first unit was installed on a commercial basis for a lagoon sludge remediation project in 1992.

Comments : Since this equipment was originally used for juice extraction from fruit and vegetable pulp, it is designed primarily to process sludges and materials with a relatively high solids content (>15 percent). The equipment incorporates hydraulic cylinders to exert, uniformly distributed high pressure to mechanically extract free liquid from the wastes resulting in greater reduction of volume and weight without chemicals or polymers.

Source of Information : VISITT 3.0

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : Injection/Delivery Systems

Technology Name : Cone Penetrometer

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : The Lightweight static cone penetrometer was specially designed to perform geotechnical investigations in areas or locations which are not accessible to other equipment. Aspects such as weight, ease of operation and simplicity have played an important role during the design phase. Several applications can be realized with the basic system such as mechanical and electrical cone tests or soil sampling. In order to compensate for the reaction forces while testing, four solid ground anchors give sufficient grip, even at greater depths.

Company Name/POC: A.P. van den Berg B.V./ Engbert Welling

Address : 8440 AB Heerenveen/Ijzerweg 4/The Netherlands.

Phone Number : 31 5130 31355

Fax Number : 31 5130 3121

Technology Maturity : Commercial use experience

Performance History : Contact company for performance data.

Comments : Two models are available - the Hyson 50 kN and Hyson 100kN with pushing capacity of 5.5 US tons and 11 US tons respectively.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Injection/Delivery Systems*

Technology Name : Cone Penetrometer Platform

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Technology combines cone penetrometer and surface geophysics to permit a real-time, three-dimensional site characterization approach on soil sites.

Company Name/POC: Applied Research Associates, Inc./Terry Steinborn

Address : 4300 San Mateo, NE/Suite A-200/Albuquerque, New Mexico 87110

Phone Number : 505 883-3636

Fax Number : 505 883-3673

Technology Maturity : Commercial use experience

Performance History : Performance Data are Available.

Comments :

Demonstrations at Savannah River and Hanford. Components of technology are in daily use. Full on-site characterization from start to remediation awaiting an appropriate project. Demonstrations at Hanford and Savannah River involved hazardous, mixed wastes, and low-level nuclear waste.

The technology is completely ready to be applied on accessible soil sites having contaminated groundwater or buried contaminant materials at depths up to 300 ft. This is a very comprehensive and adaptable system which can be used to solve specific site problems or can provide a broad, rapid site characterization which permits site characterization tactical planning and data acquisition planning in real time (the observation approach). Little characterization-related contaminant is brought to the surface. Cost and schedule savings may be very large in appropriate cases. Site characterization, installation of monitoring wells and instruments and inception of remediation can be integrated through this technology. An integrated three-dimensional database and data archive provides support for site hydrogeology analysis, hydrologic modeling, remedial planning, site activity documentation and generation of presentation and report graphics.

Source of Information : TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Injection/Delivery Systems*

Technology Name : Piezocone/Drill Rig Truck with Computerized Stratigraphic and Environmental Analysis

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : High speed high-capacity (20 ton+) piezoconic penetrometer linked to on-board computer for stratigraphic and environmental analysis. Rig also includes conventional rotary rig for rock/soil/concrete. Piezocone can identify soil layers as small as a few millimeters thick. Probes can be mounted with detectors for a variety of environmental parameters e.g., VOCs, radionuclides. High speed (4ft/min) enables numerous soil profiles to be obtained in a short time with much higher sensitivity compared with conventional drilling. Allows better (closer) spacing.

Company Name/POC: Ontario Hydro Technologies/C. Cragg/R. Tsang

Address : 800 Kipling Ave #KR252/Etobicoke Ontario, Canada M87 5S4

Phone Number : 416 207-6139

Fax Number : 905 855-472

Technology Maturity : Commercial use experience

Performance History : Contact company for performance history data.

Comments : Requires field access for 10-ton truck, or unit can be dismounted to 5-ton flat-bed truck or barge for lakes/rivers/swamps.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Robotics*

Technology Name : Robotic Manipulator and Control Systems

Application : On-site

Brief Description : Teleoperated and autonomous robotic systems provided include manipulators, control systems and sensors. ISE robotic products are mission driven. Therefore, ISE has the ability to tailor all robotic products to suit the specific applications of the customer. All of the robotic systems are designed and built using hardware and software modules. The hardware modules may be re-configured to create other mechanical systems for very specific applications.

Company Name/POC: International Submarine Engineering LTD./Owen Williams

Address : 1734 Broadway Street/Port Coquitlam, B.C. V3C 2M8 Canada

Phone Number : 604 942-5223

Fax Number : 604 942-7577

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Customers for ISE autonomous robotic systems include the U.S. Air Force and the Canadian Space Agency. The USAF system is used to autonomously refuel aircraft. The CSA robots are part of the development of autonomous robot technology applicable to the Space Station "Freedom" Project. Customers for ISE's teleoperated systems include Westinghouse, AT&T, the U.S. Navy, GPU Nuclear, Shin Nippon, Southwest Research, and Oceaneering Space Systems.

Comments : Personnel require 1-2 week training course. All systems are designed and built to operate in specific environments. Systems are used by trained technicians. Systems are typically self contained.

Source of Information : International TechCon

SEDIMENTS IN SURFACE WATER

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Other*

Technology Name : Sludge Dryer / Concentrate Dryer with Post-Feeding Capability

Application : On-site Ex-situ
Off-site

Brief Description : With this technology sludges and liquid waste can be treated. This drying technologies are producing a dry and dewatered waste product. The activity remains in the dry product. Further VR is possible with supercompaction. HPA builds drying systems since 1988. This technology is being used in Germany at more than 10 different nuclear power stations.

Company Name/POC: Hansa Projekt Anlagentechnik GmbH/Michael Szukala

Address : Tarpenring 4/22419 Hamburg, Germany

Phone Number : 49 40 527 02 62

Fax Number : 49 40 527 56 6

Technology Maturity : Commercial use experience

Performance History : HPA has built drying systems since 1988. 12 systems are currently operating in Germany for various applications. The customers are:

- NPP Brunsbuttel
- NPP Krummel
- NPP Würgassen
- NPP Grohnde
- NPP Philippsburg
- NPP Grafenrheinfeld
- NPP Greifswald and Rheinsberg

Comments : Process affords ease of use because of fully automated process, simple infrastructure, flexibility for various waste streams and proven and available technology. HPA dryers are built for the following applications:

- Drying of DAW
- Drying of NPP sludges (sump)
- Drying of contaminated soil
- Drying and solidification of process sludge
- Drying and solidification of evaporator bottoms

Source of Information : International TechCon

Construction Materials/Debris

Extraction/Delivery/Materials Handling

Construction Materials/Debris

Extraction/Delivery/Materials Handling

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Size reduction*

Technology Name : Extec Screens and Crushers

Application :

	On-site	Ex-situ
	Off-site	

Brief Description : This equipment improves preparation and presentation of materials to be treated.

Company Name/POC: Extec Screens and Crushers/P. Douglas

Address : Heathcote Road, Swadlincote/Derbyshire DE 11 9DU, U.K.

Phone Number : 44 1283 212121

Fax Number : 44 1283 217342

Technology Maturity : Commercial use experience

Performance History : Contact company for performance data.

Comments : None.

Source of Information : International TechCon

**CONSTRUCTION
MATERIALS/DEBRIS**

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Size reduction*

Technology Name : AFAB Method (registered)

Application : ☐ On-site ☐ Ex-situ
☐ Off-site

Brief Description : Crushing of industrial waste to achieve higher density. Performance is between 50 - 100 percent better than existing methods.

Company Name/POC: Fonova AB/Mats Edvardsson

Address : Box 1450/S-90124 UMEA/Sweden

Phone Number : 46 90 137180

Fax Number : 46 90 13780

Technology Maturity : Commercial use experience

Performance History : Testing during 92-93
Commercial use 93-95
Very good results for this application

Comments : Highly adaptable to most landfill sites.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Size reduction*

Technology Name : 2000mt High Pressure Compactor

Application :

	On-site	Ex-situ
	Off-site	

Brief Description : Volume reduction of contaminated waste. Compaction in drums with in-drum compactors and compaction of 52 or 55 gallon drums with 2000 t high pressure compactors. This technology is used since 1983 and is a proven technology based on its excellent performance.

Company Name/POC: Hansa Projekt Anlagentechnik GmbH/Michael Szukala

Address : Tarpenring 4/22419 Hamburg, Germany

Phone Number : 49 40 527 02 62

Fax Number : 49 40 527 56 64

Technology Maturity : Commercial use experience

Performance History : HPA has built compactors since 1982. 10 systems are currently operating throughout the world for various applications. The customers are :

EdF Bugey, France	NPP Brunsbuttel, Germany
Trawsfynydd, U.K.	UK AEA Winfrith, U.K.
Nucleco Casicca, Italy	Quadrex, Oak Ridge, TN, USA
Allied Techn. Hanford, USA	NSP Redwing, MN, USA
EG&G Rocky Flats, CO, USA	Kepeco, Kangnam, Seoul, Korea

Comments : Radiation level and waste media which reacts hydraulically can be limiting factors. System affords ease of use because of fully automated process, simple infrastructure, flexibility for various waste streams and proven and available technology.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Size reduction*

Technology Name : Concrete Decontamination and Volume Reduction

Application : On-site Ex-situ
Off-site

Brief Description : Separation of contaminated and non-contaminated parts of concrete structures and materials. For concrete materials, the technique results in volume reduction of 3-4 times. The installation was successfully operated in Germany. Only the contaminated parts of concrete have to be treated as radwaste. The clean parts (gravel) can be reused in the concrete industry. The alternative is that all the concrete must be stored as radwaste.

Company Name/POC: KEMA Nederland B.V./H.A.W. Cornelissen

Address : P.O.Box 9035/NL-6800 ET ARNHEM, The Netherlands

Phone Number : 31 26 35 66 104

Fax Number : 31 26 35 15 83

Technology Maturity : Field demo complete

Performance History : The technology and installation was developed during an eight year European project. The installation was approved by the German TuV and then operated in Kahl for treatment of concrete.

Comments : Important is that dense gravel is used in the concrete so that the contamination is only present in the porous cementstone. It is a straightforward technology. Important is dust-control which implies the use of an appropriate filtering system. KEMA has developed, designed, and constructed a pilot plant scale test installation for separation of aggregate from contaminated concrete. The separation is based on a thermal treatment followed by milling and sieving. In normal quality concretes, the volume of the porous cementstone is approximately 30 percent, while the remaining part consists of dense aggregates such as quartz and limestone. Tests have shown that contamination primarily penetrates in the cementstone. Separation of the porous and dense components of concrete will therefore result in substantial volume reduction of radioactive waste. Separation of concrete into its components-gravel, sand and cementstone- is based on the reduction of bond between the cement matrix and the aggregates. The bond can be reduced by temperature induced mechanical stresses. In the first step, concrete parts are crushed in order to extend the surface accessible for the subsequent treatments. By means of heating up, the bond between aggregate and cement matrix is reduced and in the next step separation is realized by mechanical forces in a turning mill. Then a selection has to be made between contaminated and clean material. It was decided from preceding tests, to sieve the material over 1 mm sieves. The material greater than or equal to 1mm turned out to contain the powdered cementstone and consequently the contamination. Depending on the concrete composition, volume reduction of at least a factor 2 can be reached of material that has to be treated and stored as radioactive waste.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Size reduction*

Technology Name : Ice Sawing

Application : On-site

Brief Description : Freezing of water-filled heat exchangers before segmenting with a band saw. Advantages: fixing of internals (e.g., tube bundle); no aerosol release; reduction of area dose rate; no additional cooling of the sawblade.

Company Name/POC: Kernkraftwerke Gundremmingen/Norbert Eickelpasch

Address : Betriebsgesellschaft mbH/Postfach 3 00/D-89355/Gundremmingen, Germany

Phone Number : 011 49 8224 78 2170

Fax Number : 011 49 8224 78 2900

Technology Maturity : Commercial use experience

Performance History : Cutting of a shut-down cooler in 1991; cutting of three steam generators 1992-1995.

Comments : None.

Source of Information : International TechCon

**CONSTRUCTION
MATERIALS/DEBRIS****CONTAMINANTS :**☐ Pesticides/Herbicides☐ Heavy Metals☐ PCB☐ Explosives/Propellants☐ Petroleum Hydrocarbons☐ Radionuclides☐ SVOC☐ Other Contaminant☐ Nonhalogenated VOC☐ Halogenated VOC☐ N/A**TECHNOLOGY TYPE :** *Size reduction***Technology Name :** Plasma Arc Cutting Underwater**Application :**

On-site

Ex-situ

Brief Description : Underwater plasma arc cutting of activated RPV internals successfully applied at the RPV steam dryer of KRB A; development of different plasma torches; development of a tool carrier for underwater segmenting.**Company Name/POC:** Kernkraftwerke Gundremmingen/Norbert Eickelpasch**Address :** Betriebsgesellschaft mbH/Postfach 3 00/D-89355/Gundremmingen, Germany**Phone Number :** 011 49 8224 78 2170**Fax Number :** 011 49 8224 78 290**Technology Maturity :** Commercial use experience**Performance History :** KRB A is a boiling water reactor operated from 1966 to 1977. The dismantling started in 1983. The described technologies were developed and successfully applied in the frame of the dismantling of this plant.**Comments :** Industrially available technique - New developments: special plasma torches; qualified up to 20 m water depth; up to 150 m distance between power source and plasma torch. Works with material thickness up to 100 mm (60 mm) in a waterdepth of 1 m (20 m).**Source of Information :** International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Size reduction*

Technology Name : Electric High Power Pulse-Technology (HPPT)

Application : On-site Ex-situ

Brief Description : This technology uses a high power pulse to crack solid materials (concrete, etc.) without harming the base material (tank, piping).

Company Name/POC: telerob GmbH/Dr. Bernd Birkicht

Address : Vogelsangstrasse 8/D-73760/Ostfildern, Germany

Phone Number : 011 49 711 348 0189

Fax Number : 011 49 711 348 0156

Technology Maturity : Pilot plant testing

Performance History : Pilot testing equipment is available. Similar applications (cast cleaning) are used commercially. Decontamination of steam generator executed at University of Tomsu (Russia)

Comments : Contact company for performance data.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Robotics

Technology Name : Robotic Manipulator and Control Systems

Application : On-site

Brief Description : Teleoperated and autonomous robotic systems provided include manipulators, control systems and sensors. ISE robotic products are mission driven. Therefore, ISE has the ability to tailor all robotic products to suit the specific applications of the customer. All of the robotic systems are designed and built using hardware and software modules. The hardware modules may be re-configured to create other mechanical systems for very specific applications.

Company Name/POC: International Submarine Engineering LTD./Owen Williams

Address : 1734 Broadway Street/Port Coquitlam, B.C. V3C 2M8 Canada

Phone Number : 604 942-5223

Fax Number : 604 942-757

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Customers for ISE autonomous robotic systems include the U.S. Air Force and the Canadian Space Agency. The USAF system is used to autonomously refuel aircraft. The CSA robots are part of the development of autonomous robot technology applicable to the Space Station "Freedom" Project. Customers for ISE's teleoperated systems include Westinghouse, AT&T, the U.S. Navy, GPU Nuclear, Shin Nippon, Southwest Research, and Oceaneering Space Systems.

Comments : Personnel require 1-2 week training course. All systems are designed and built to operate in specific environments. Systems are used by trained technicians. Systems are typically self contained.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Robotics*

Technology Name : Use of Remotely Operated Vehicles

Application : On-site Ex-situ

Brief Description : Integration of expertise in ROV's with long experience in nuclear industry. Use of adapted and available ROV's for clearing nuclear debris in both radiation and contamination environments. High success rate/low cost.

Company Name/POC: Nuclear Decommissioning LTD./Mike Napper

Address : 9 Queen Sq./Bristol, England BS1 4HR

Phone Number : 011 44 1179 29 3691

Fax Number : 011 44 1179 29 3692

Technology Maturity : Commercial use experience

Performance History : Previously used on BNFL Sellafield site. Currently being used on Windscale site (AEA).

Comments : Can result in additional waste as ROV's are difficult to decontaminate. Trained operators are essential, with training being relatively easy.

Source of Information : International TechCon

CONTAMINANTS :☐ Pesticides/Herbicides☐ Heavy Metals☐ PCB☐ Explosives/Propellants☐ Petroleum Hydrocarbons☐ Radionuclides☐ SVOC☐ Other Contaminant☐ Nonhalogenated VOC☐ Halogenated VOC☒ N/A**TECHNOLOGY TYPE :** *Robotics***Technology Name :** Radio Controlled Fork Lift - Trucks**Application :**

On-site

Ex-situ

Brief Description : Radio controlled Fork Lift Trucks - Remotely operated heavy fork lifts for hazardous material handling. RF links for video, telemetry, and redundant emergency stop. Control of all fork lift functions and barrel handling tools. This technology makes possible and practical overpacking and clean-up of barrels of hazardous waste and other, palletized objects.

Company Name/POC: RSI Research Ltd./Brad Moore**Address :** Bldg. #3-203 Harbour Road/Victoria, BC, Canada V9A 3S2**Phone Number :** 604 360-1025**Fax Number :** 604 360-1116**Technology Maturity :** Commercial use experience**Performance History :** SPAR Aerospace/FERMCO, Cincinnati - 2 Forklift Trucks supplied, with an option on a third.**Comments :** None.**Source of Information :** International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Robotics*

Technology Name : Remote Robotics

Application : On-site

Brief Description : These robotic devices utilize electrically operated master-slave-manipulators which are umbilical controlled. ROV's are umbilical controlled or radio controlled.

Company Name/POC: telerob GmbH/Dr. Bernd Birkicht

Address : Vogelsangstrasse 8/D-73760/Ostfildern, Germany

Phone Number : 011 49 711 348 0189

Fax Number : 011 49 711 348 0156

Technology Maturity : Commercial use experience

Performance History : Used in mockup for decommissioning of fuel reprocessing facility.

Comments : Easy to use, flexible, and rugged. Modular design, easy to maintain.

Source of Information : International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : Robotics**Technology Name :** Innovative Approach to Robotics Design**Application :** On-site Ex-situ**Brief Description :** Innovative approach to adapting existing technology for design and manufacture of robotics for survey and sampling in hazardous environmental/radioactive conditions.**Company Name/POC:** W.S. Atkins Consultants Ltd./Dr. R. B. Dean/Mr. R. Dexter-Smith**Address :** Woodcote Grove/Ashley Road/Epsom, Surrey, KT18 5BW, UK**Phone Number :** 1372 726140**Fax Number :** 01372 74005**Technology Maturity :** Commercial use experience**Performance History :** Design and development for use in surveys of existing plant at the windscale piles and trawsfynydd Magnox reactor.**Comments :** The particular "technology" being described has in fact a proven track record in tackling complex survey and sampling tasks. Have adapted existing systems (where possible) and brought them together to form a specialist robotic system suited to the specific project objective. This has been done for UKAEA, BNFL and nuclear electric in a highly cost effective manner.**Source of Information :** International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Other***Technology Name :** Abrasive Water Jet Cutting Technology (A.S.J.T)**Application :** On-site Ex-situ**Brief Description :** Water jet cutting. Precise cutting open of ammunitions with no heat or sparking; can use all types of water and cheap abrasives. Recycling of water and abrasive is possible. Can be used in remote operations, away from personnel or hazards.**Company Name/POC:** Alba Industrie Umweltschutz Service GmbH/Dr. K. Faber**Address :** Rehrhoferweg 160/D29625 Munster, Germany**Phone Number :** 0 5192 963 212**Fax Number :** 0 5192 963 311**Technology Maturity :** Commercial use experience**Performance History :** Working for two years in Russia and Germany.**Comments :** None.**Source of Information :** International TechCon

THE STATE OF TEXAS,
COUNTY OF DALLAS.

Know all men by these presents,

THAT J. M. SMITH, of the County of Dallas, State of Texas, for and in consideration of the sum of \$100.00, to J. M. SMITH in hand paid by J. M. SMITH, the receipt of which is hereby acknowledged, have granted, sold and conveyed, and by these presents do grant, sell and convey unto the said J. M. SMITH, all that certain

Tract of Land, situate in the County of Dallas, State of Texas,

containing more or less than the following described:

TO HAVE AND TO HOLD unto the said J. M. SMITH, his heirs and assigns forever.

Containers/Equipment

Extraction/Delivery/Materials Handling

Containers/Equipment

Extraction/Delivery/Materials Handling

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Excavation, Retrieval, and Off-Site Disposal*

Technology Name : Transport and Handling of Radioactive Waste

Application : On-site Ex-situ
Off-site

Brief Description : The company provides equipment for transport and handling of various sizes of containers on the surface and underground, including shaft hoisting. The equipment can handle container sizes up to 85 tons. This technology replaces the presently used storage of containers in storage vaults on the surface. Its objective is final storage of radioactive waste underground.

Company Name/POC: Siemag Transplan GmbH/Klaus Simmich

Address : P.O. Box 1451/Obere Industriestrasse 8/57238 Netphen, Germany

Phone Number : 0049 2738 21321

Fax Number : 0049 2738 21502

Technology Maturity : Field demo complete

Performance History : Performance data are available.

All equipment has been successfully tested in endurance tests and can be verified by the following organizations: DBE, GSF, KFK, BFS, and TUV.

Comments : Safe and automated handling, compact equipment for restricted available space underground.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Size reduction***Technology Name :** Extec Screens and Crushers**Application :** ☐ On-site ☐ Ex-situ
☐ Off-site**Brief Description :** This equipment improves preparation and presentation of materials to be treated.**Company Name/POC:** Extec Screens and Crushers/P. Douglas**Address :** Heathcote Road, Swadlincote/Derbyshire DE 11 9DU, U.K.**Phone Number :** 44 1283 212121**Fax Number :** 44 1283 21734**Technology Maturity :** Commercial use experience**Performance History :** Contact company for performance data.**Comments :** None.**Source of Information :** International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Size reduction*

Technology Name : AFAB Method (registered)

Application : On-site Ex-situ
Off-site

Brief Description : Crushing of industrial waste to achieve higher density. Performance is between 50 - 100 percent better than existing methods.

Company Name/POC: Fonova AB/Mats Edvardsson

Address : Box 1450/S-90124 UMEA/Sweden

Phone Number : 46 90 137180

Fax Number : 46 90 137800

Technology Maturity : Commercial use experience

Performance History : Testing during 92-93
Commercial use 93-95
Very good results for this application

Comments : Highly adaptable to most landfill sites.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Size reduction***Technology Name :** 2000mt High Pressure Compactor

Application : On-site Ex-situ
Off-site

Brief Description : Volume reduction of contaminated waste. Compaction in drums with in-drum compactors and compaction of 52 or 55 gallon drums with 2000 t high pressure compactors. This technology is used since 1983 and is a proven technology based on its excellent performance.

Company Name/POC: Hansa Projekt Anlagentechnik GmbH/Michael Szukala**Address :** Tarpenring 4/22419 Hamburg, Germany**Phone Number :** 49 40 527 02 62**Fax Number :** 49 40 527 56 6**Technology Maturity :** Commercial use experience

Performance History : HPA has built compactors since 1982. 10 systems are currently operating throughout the world for various applications. The customers are :

EdF Bugey, France	NPP Brunsbuttel, Germany
Trawsfynydd, U.K.	UK AEA Winfrith, U.K.
Nucleco Casicca, Italy	Quadrex, Oak Ridge, TN, USA
Allied Techn. Hanford, USA	NSP Redwing, MN, USA
EG&G Rocky Flats, CO, USA	Kepco, Kangnam, Seoul, Korea

Comments : Radiation level and waste media which reacts hydraulically can be limiting factors. System affords ease of use because of fully automated process, simple infrastructure, flexibility for various waste streams and proven and available technology.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Size reduction***Technology Name :** Ice Sawing**Application :** On-site**Brief Description :** Freezing of water-filled heat exchangers before segmenting with a band saw. Advantages: fixing of internals (e.g., tube bundle); no aerosol release; reduction of area dose rate; no additional cooling of the sawblade.**Company Name/POC:** Kernkraftwerke Gundremmingen/Norbert Eickelpasch**Address :** Betriebsgesellschaft mbH/Postfach 3 00/D-89355/Gundremmingen**Phone Number :** 011 49 8224 78 2170**Fax Number :** 011 49 8224 78 2900**Technology Maturity :** Commercial use experience**Performance History :** Inactive qualification in 1989; cutting of a shut-down cooler in 1991; cutting of three steam generators 1992-1995.**Comments :** None.**Source of Information :** International TechCon

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Size reduction*

Technology Name : Plasma Arc Cutting Underwater

Application : On-site Ex-situ

Brief Description : Underwater plasma arc cutting of activated RPV internals successfully applied at the RPV steam dryer of KRB A; development of different plasma torches; development of a tool carrier for underwater segmenting.

Company Name/POC: Kernkraftwerke Gundremmingen/Norbert Eickelpasch

Address : Betriebsgesellschaft mbH/Postfach 3 00/D-89355/Gundremmingen

Phone Number : 011 49 8224 78 2170

Fax Number : 011 49 8224 78 290

Technology Maturity: Commercial use experience

Performance History : KRB A is a boiling water reactor operated from 1966 to 1977. The dismantling started in 1983. The described technologies were developed and successfully applied in the frame of the dismantling of this plant.

Comments : Industrial available technique - New developments: special plasma torches; qualified up to 20 m water depth; up to 150 m distance between power source and plasma torch. Works with material thickness up to 100 mm (60 mm) in a waterdepth of 1 m (20 m).

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Size reduction*

Technology Name : Electric High Power Pulse-Technology (HPPT)

Application : On-site Ex-situ

Brief Description : This technology uses a high power pulse to crack solid materials (concrete, etc.) without harming the base material (tank, piping).

Company Name/POC: telerob GmbH/Dr. Bernd Birkicht

Address : Vogelsangstrasse 8/D-73760/Ostfildern, Germany

Phone Number : 011 49 711 348 0189

Fax Number : 011 49 711 348 0156

Technology Maturity : Pilot plant testing

Performance History : Pilot testing equipment is available. Similar applications (cast cleaning) are used commercially. Decontamination of steam generator executed at University of Tomsu (Russia)

Comments : Contact company for performance data.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Robotics***Technology Name :** Robotic Manipulator and Control Systems**Application :** On-site

Brief Description : Teleoperated and autonomous robotic systems provided include manipulators, control systems and sensors. ISE robotic products are mission driven. Therefore, ISE has the ability to tailor all robotic products to suit the specific applications of the customer. All of the robotic systems are designed and built using hardware and software modules. The hardware modules may be re-configured to create other mechanical systems for very specific applications.

Company Name/POC: International Submarine Engineering LTD./Owen Williams**Address :** 1734 Broadway Street/Port Coquitlam, B.C. V3C 2M8 Canada**Phone Number :** 604 942-5223**Fax Number :** 604 942-757**Technology Maturity :** Commercial use experience**Performance History :** Performance data are available.

Customers for ISE autonomous robotic systems include the U.S. Air Force and the Canadian Space Agency. The USAF system is used to autonomously refuel aircraft. The CSA robots are part of the development of autonomous robot technology applicable to the Space Station "Freedom" Project. Customers for ISE's teleoperated systems include Westinghouse, AT&T, the U.S. Navy, GPU Nuclear, Shin Nippon, Southwest Research, and Oceaneering Space Systems.

Comments : Personnel require 1-2 week training course. All systems are designed and built to operate in specific environments. Systems are used by trained technicians. Systems are typically self contained.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Robotics*

Technology Name : Tentacle Robotic Arm - Extensible (Tentacle)

Application : On-site Ex-situ

Brief Description : Tentacle robot is an innovative manipulator which can extend, contract and bend in two (or more) regions. The tentacle uses a special pneumatic bellows with motor-driven tendon cables to control position. The tentacle has a very large work volume and is able to reach around objects and into positions which conventional robots cannot attain. Its advantages include: highest strength-to-weight ratio of any manipulator, very large work volume, variable compliance control, contracts into small volume for storage.

Company Name/POC: Kinetic Sciences Inc./Guy Immega

Address : 3250 E. Mall/Vancouver, B.C. V6T1W5

Phone Number : 604 822-5782

Fax Number : 604 822-6188

Technology Maturity : Bench scale testing, only

Performance History : A prototype KSI Tentacle has been delivered to the Tennessee Valley Authority, for use as a tower climbing unit. A second Tentacle will be delivered to the TVA for use as a transmission tower painting manipulator. A third two-stage Tentacle was to be constructed for display June-Sept 1993 at Science World (major science museum) in Vancouver, B.C.

Comments : The tentacle robot can be teleoperated with proprietary joy sticks. Current Tentacle bladder technology uses plastic materials which cannot withstand extreme temperatures. The KSI Tentacle robotic manipulator can be carried either by another system or on a mobile robot. The tentacle can deploy sensors (video, chemical, etc.) or can be used to grasp and retrieve a wide variety of objects. Due to its very high strength-to-weight and its ability to move into difficult-to-reach areas, the tentacle is an effective manipulator for extreme environments, such as inside tanks. All that is required to operate the tentacle are control signals, compressed air (100 PSI) and 90 VDC motor voltages. When deployed downward (like an elephant's trunk), a 50 lb. tentacle will be able to lift up to 1000 pounds. Further development will provide improved control systems with the ability to serve end effector position with the KSI "Eagle Eye" machine vision system.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Robotics***Technology Name :** Use of Remotely Operated Vehicles**Application :** On-site Ex-situ**Brief Description :** Integration of expertise in ROV's with long experience in nuclear industry. Use of adapted and available ROV's for clearing nuclear debris in both radiation and contamination environments. High success rate/low cost.**Company Name/POC:** Nuclear Decommissioning LTD./Mike Napper**Address :** 9 Queen Sq./Bristol, England BS1 4HR**Phone Number :** 011 44 1179 29 3691**Fax Number :** 011 44 1179 29 369**Technology Maturity :** Commercial use experience**Performance History :** Previously used on BNFL Sellafield site. Currently being used on Windscale site (AEA).**Comments :** Can result in additional waste as ROV's are difficult to decontaminate. Trained operators are essential, with training being relatively easy.**Source of Information :** International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Robotics*

Technology Name : Radio Controlled Fork Lift - Trucks

Application : On-site Ex-situ

Brief Description : Radio controlled Fork Lift Trucks - Remotely operated heavy fork lifts for hazardous material handling. RF links for video, telemetry, and redundant emergency stop. Control of all fork lift functions and barrel handling tools. This technology makes possible and practical overpacking and clean-up of barrels of hazardous waste and other, palletted objects.

Company Name/POC: RSI Research Ltd./Brad Moore

Address : Bldg. #3-203 Harbour Road/Victoria, BC, Canada V9A 3S2

Phone Number : 604 360-1025

Fax Number : 604 360-1161

Technology Maturity : Commercial use experience

Performance History : SPAR Aerospace/FERMCO, Cincinnati - 2 Forklift Trucks supplied, with an option on a third.

Comments : None.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : Robotics

Technology Name : Resolved Motion Control of Hydraulic Manipulators

Application : ☐ On-site ☐ Ex-situ

Brief Description : Hydraulic Manipulators with Resolved Motion Digital Control: This technology provides remote manipulation with precision control. Hydraulic manipulation to 1,500 lbs. lift controlled with a digital control system that resolves complex movements using RSI algorithms. The control is ergonomically superior to spatially correspondent control.

Company Name/POC: RSI Research Ltd./Brad Moore

Address : Bldg. #3-203 Harbour Road/Victoria, BC, Canada V9A 3S2

Phone Number : 604 360-1025

Fax Number : 604 360-116

Technology Maturity : Commercial use experience

Performance History : Sonsub Oceaneering, DCEIM, IOS. Over 50 RSI manipulators in service.

Comments : Resolved control of manipulator translates the operators movements into precision control of end-effector.

Source of Information : International TechCon

CONTAMINANTS :☒ Pesticides/Herbicides☒ Heavy Metals☒ PCB☒ Explosives/Propellants☒ Petroleum Hydrocarbons☒ Radionuclides☒ SVOC☒ Other Contaminant☒ Nonhalogenated VOC☒ Halogenated VOC☒ N/A**TECHNOLOGY TYPE :** *Robotics***Technology Name :** Remote Robotics**Application :** On-site**Brief Description :** These robotic devices utilize electrically operated master-slave-manipulators which are umbilical controlled. ROV's are umbilical controlled or radio controlled.**Company Name/POC:** telerob GmbH/Dr. Bernd Birkicht**Address :** Vogelsangstrasse 8/D-73760/Ostfildern, Germany**Phone Number :** 011 49 711 348 0189**Fax Number :** 011 49 711 348 0156**Technology Maturity :** Commercial use experience**Performance History :** Used in mockup for decommissioning of fuel reprocessing facility.**Comments :** Easy to use, flexible, and rugged. Modular design, easy to maintain.**Source of Information :** International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : Robotics

Technology Name : Innovative Approach to Robotics Design

Application : On-site Ex-situ

Brief Description : Innovative approach to adapting existing technology for design and manufacture of robotics for survey and sampling in hazardous environmental/radioactive conditions.

Company Name/POC: W.S. Atkins Consultants Ltd./Dr. R. B. Dean/Mr. R. Dexter-Smith

Address : Woodcote Grove/Ashley Road/Epsom, Surrey, KT18 5BW, UK

Phone Number : 1372 726140

Fax Number : 01372 74005

Technology Maturity : Commercial use experience

Performance History : Design and development for use in surveys of existing plant at the windscale piles and trawsfynydd Magnox reactor.

Comments : The particular "technology" being described has in fact a proven track record in tackling complex survey and sampling tasks. Have adapted existing systems (where possible) and brought them together to form a specialist robotic system suited to the specific project objective. This has been done for UKAEA, BNFL and nuclear electric in a highly cost effective manner.

Source of Information : International TechCon

CONTAMINANTS :☐ Pesticides/Herbicides☐ Heavy Metals☐ PCB☐ Explosives/Propellants☐ Petroleum Hydrocarbons☐ Radionuclides☐ SVOC☐ Other Contaminant☐ Nonhalogenated VOC☐ Halogenated VOC☐ N/A**TECHNOLOGY TYPE :** *Other***Technology Name :** Abrasive Water Jet Cutting Technology (A.S.J.T)**Application :** On-site Ex-situ**Brief Description :** Water jet cutting. Precise cutting open of ammunitions with no heat or sparking; can use all types of water and cheap abrasives. Recycling of water and abrasive is possible. Can be used in remote operations, away from personnel or hazards.**Company Name/POC:** Alba Industrie Umweltschutz Service GmbH/Dr. K. Faber**Address :** Rehrhoferweg 160/D29625 Munster, Germany**Phone Number :** 0 5192 963 212**Fax Number :** 0 5192 963 311**Technology Maturity :** Commercial use experience**Performance History :** Working for two years in Russia and Germany.**Comments :** None.**Source of Information :** International TechCon

CONFIDENTIAL - SECURITY INFORMATION

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AUTHORITY: 1.3.1.2

CONFIDENTIAL - SECURITY INFORMATION

Vapor Phase

Extraction/Delivery/Materials Handling

Vapor Phase

Extraction/Delivery/Materials Handling

CONTAMINANTS :☐ Pesticides/Herbicides☐ Heavy Metals☐ PCB☐ Explosives/Propellants☐ Petroleum Hydrocarbons☐ Radionuclides☐ SVOC☐ Other Contaminant☐ Nonhalogenated VOC☐ Halogenated VOC☐ N/A**TECHNOLOGY TYPE :** *Dust Control***Technology Name :** Electrically Charged Fog (Fog Gun)**Application :** On-site Ex-situ

Brief Description : Natural dust (generated by roads or moving sand piles) is normally electrically charged. The small particles, i.e., 1 micron in size, are usually negative; the larger particles, i.e., 7 microns, are positively charged. The same thing is observed with industrial dust from grinding, walking, sweeping, or abrasion, (cf. A.D. Zimon, Adhesion of Dust and Powder, 2nd ed., Consultant Bureau, New York NY, 1982). In some cases, impurities may affect the sign or value of the charge, but there is always some charge. This means that oppositely charged water fog is very effective in contacting the dust and causing it to drop out of the atmosphere. The amount of water required is small and the collection is very effective.

Company Name/POC: hydroGEOPHYSICS/Stuart Hoenig**Address :** 5865 S. Old Spanish Trail/Tucson, AZ 85474**Phone Number :** 520 887-3815**Fax Number :** 520 647-3428**Technology Maturity :** Field demo complete

Performance History : Devices have been used in a laboratory and have been successfully demonstrated in one or more lead, copper, steel foundries, in ore milling, battery building companies, several sections of a steel mill including: ore recovery, coke ovens, rough and fine grinding areas. Use in a copper mine has covered the drilling, milling, casting areas and disposal of wastes. In a wood fabrication facility, operations were successful in the primary (rough fabrication) area and in the finishing area. In the paint shop, the charged spray was very successful in removing excess paint from the atmosphere. In a tire rebuilding shop, it was possible to suppress floating dust in several areas. Commercial sales are handled by Research-Cottrell Environmental Service and Technology, U.S. Highway 22 West, Branchburg, NJ 09976, phone (905) 685-4000. Contact Mr. J.D. Helfrich.

Comments : Performance data are available.

A single unit is 2.5 ft (0.75m) long and 8 inches (0.203) in diameter. It requires 110 volts at 3 amps, 1 CFM of compressed air at 80 psi and a supply of water, 1 gallon (3.79 L) per minute. No other support services are required. There is no electrical hazard if people get into the fog spray. The area must permit water spraying, but there is no hazard with flammable or explosive dusts. The water spray is designed to "reduce" the natural charge on the dust so the system becomes "safe" if the charged fog is used. There have been some tests on fire and it appears that the charged fog is more effective than the usual uncharged material. The system is easy to use. It can be hand held or mounted on a stand. For larger applications, more fog guns can be used, or larger fog guns can be built. There have been tests on mine trucks moving over dirt roads, and there was about 80% reduction of visible dust. Very little infrastructure is needed. Throwing the fog for long distances, over large ore piles, is a problem and special high speed blowers are needed.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Robotics*

Technology Name : Robotic Manipulator and Control Systems

Application : On-site

Brief Description : Teleoperated and autonomous robotic systems provided include manipulators, control systems and sensors. ISE robotic products are mission driven. Therefore, ISE has the ability to tailor all robotic products to suit the specific applications of the customer. All of the robotic systems are designed and built using hardware and software modules. The hardware modules may be re-configured to create other mechanical systems for very specific applications.

Company Name/POC: International Submarine Engineering LTD./Owen Williams
Address : 1734 Broadway Street/Port Coquitlam, B.C. V3C 2M8 Canada

Phone Number : 604 942-5223 **Fax Number :** 604 942-757

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Customers for ISE autonomous robotic systems include the U.S. Air Force and the Canadian Space Agency. The USAF system is used to autonomously refuel aircraft. The CSA robots are part of the development of autonomous robot technology applicable to the Space Station "Freedom" Project. Customers for ISE's teleoperated systems include Westinghouse, AT&T, the U.S. Navy, GPU-Nuclear, Shin Nippon, Southwest Research, and Oceaneering Space Systems.

Comments : Personnel require 1-2 week training course. All systems are designed and built to operate in specific environments. Systems are used by trained technicians. Systems are typically self contained.

Source of Information : International TechCon

Free Product

Extraction/Delivery/Materials Handling

Free Product

Extraction/Delivery/Materials Handling

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Free Product Recovery*

Technology Name : Chemically-Enhanced Solubilization for Aquifer Remediation (CESAR)

Application : In-situ (vadose zone)

Brief Description : The CESAR process uses surfactants to remove dense and light non-aqueous phase liquids from groundwater through chemically enhanced solubilization. Groundwater is pumped to the surface through extraction wells, adding surfactants, then returns the water via injection wells, significantly increasing the solubility of the DNAPLs in the groundwater, thus decreasing significantly the number of pore volumes of groundwater that must be withdrawn from the aquifer to decontaminate it of residual and pooled DNAPLs. By increasing the aqueous solubility of DNAPLs by as much as 100-fold through the injection of surfactants, CESAR greatly decreases the time and cost associated with aquifer remediation.

Company Name/POC: INTERA, Inc./ Kent Lantz

Address : 6850 Austin Center Boulevard, Suite 300/ Austin, Texas 78731

Phone Number : 512 346-2000

Fax Number : 512 346-9436

Technology Maturity : Pilot plant testing

Performance History : INTERA is currently working on two projects involving the CESAR technology. Both projects are still in the early stages and no definitive results have been obtained. INTERA is conducting a single-well solubilization test at DOE's gaseous diffusion plant in Paducah, KY to determine the location and chemical characterization of DNAPLs in the subsurface. In addition, INTERA is implementing an inter-well solubilization test at a chemical production facility in Louisiana. This test is a precursor to full-scale implementation of CESAR to remediate DNAPLs beneath the site.

Comments : CESAR has the following limitations: 1. There must be DNAPL present 2. Sufficiently high hydraulic conductivity (10-5 m/sec) 3. An underlying aquitard to prevent vertical migration 4. A clay content <5%/wt. Because CESAR is a significant enhancement of pump-and-treat technology, it has the potential to be used at any site that is currently using pump-and-treat technology and the potential to be used at any site that is currently using pump-and-treat to address DNAPL contamination. In addition, many pump-and-treat systems can be retrofitted to include the injection and withdrawal of surfactants. The primary challenge facing the CESAR process is the issue of contaminant mobilization. The reduction of interfacial tension is one of the fundamental properties of surfactants. The reduction in the DNAPL-water phase interfacial tension reduces the capillary forces on the DNAPL and promotes DNAPL solubilization as well as DNAPL mobility. However, through the careful selection of surfactants, reduction in interfacial tension can be minimized to the point that vertical mobilization does not occur.

Source of Information : TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : Dust Control**Technology Name :** Power Fluidic Gas Contactor**Application :** On-site Ex-situ

Brief Description : Gas contactor can be used to replace dedusters or conventional gas scrubbers. The units are smaller than conventional units generally 1/7th the size. They contain no internal packing and so generate little secondary waste. They have found extensive uses in the fire chemical industry. The units perform just as well as conventional units.

Company Name/POC: Power Fluidics/Paul Murray**Address :** Bldg RD2, Risley, Warrington/Cheshire, U.K. WA36AT**Phone Number :** 44 1925252818**Fax Number :** 1925252459**Technology Maturity :** Commercial use experience**Performance History :** Contact company for performance data.**Comments :** Maximum gas flow 20,000 m3/hr. Reaction kinetics of gas liquid important.**Source of Information :** International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Robotics*

Technology Name : Robotic Manipulator and Control Systems

Application : On-site

Brief Description : Teleoperated and autonomous robotic systems provided include manipulators, control systems and sensors. ISE robotic products are mission driven. Therefore, ISE has the ability to tailor all robotic products to suit the specific applications of the customer. All of the robotic systems are designed and built using hardware and software modules. The hardware modules may be re-configured to create other mechanical systems for very specific applications.

Company Name/POC: International Submarine Engineering LTD./Owen Williams

Address : 1734 Broadway Street/Port Coquitlam, B.C. V3C 2M8 Canada

Phone Number : 604 942-5223

Fax Number : 604 942-7577

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Customers for ISE autonomous robotic systems include the U.S. Air Force and the Canadian Space Agency. The USAF system is used to autonomously refuel aircraft. The CSA robots are part of the development of autonomous robot technology applicable to the Space Station "Freedom" Project. Customers for ISE's teleoperated systems include Westinghouse, AT&T, the U.S. Navy, GPU Nuclear, Shin Nippon, Southwest Research, and Oceaneering Space Systems.

Comments : Personnel require 1-2 week training course. All systems are designed and built to operate in specific environments. Systems are used by trained technicians. Systems are typically self contained.

Source of Information : International TechCon

 

Landfills

Extraction/Delivery/Materials Handling

Landfills

Extraction/Delivery/Materials Handling

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

TECHNOLOGY TYPE : *Directional Wells*

Technology Name : Horizontal Drilling

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Drilex Systems, Inc. has developed a horizontal drilling system for use as a remediation tool. The principal involves drilling a borehole by directional or horizontal drilling into contaminated areas that are otherwise difficult or impossible to reach due to surface obstructions; or to drill extended lengths of borehole into contaminated areas to expose more area to a given treatment technology.

Company Name/POC: Drilex Systems, Inc./Vernon Robin

Address : 15151 Sommermeyer/P.O. Box 801114/Houston, Texas 77280-1114

Phone Number : 713 937-8888

Fax Number : 713 849-2390

Technology Maturity : Commercial use experience

Performance History : Initial pilot project was undertaken in February 1990 at a site in Michigan. Two horizontal boreholes were drilled - one into the contaminant source to pump and treat, and the other into the down stream plume to stop the migration. Drilling rig is available for full scale operations. Drilex has over 10 years experience in directional and horizontal drilling.

Comments : The rig is mounted on four truck trailers and is a fully transportable, non-permit, self-powered setup that can be moved with ease. The only outside source needed is for water to mix drilling fluids. Wells can be installed at depths from 12 feet to 250 feet. The horizontal section can be up to 2500 feet long. There are no limitations on specific contaminants. However, the type of contaminant does limit the types the hardware that can be used in the well.

Source of Information : VISITT 3.0

CONTAMINANTS :

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Directional Wells*

Technology Name : Curved Horizontal Wells with Ductile Porous Polyethylene

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : It is patented procedure to install curved horizontal wells with specially developed porous screens and drilling services (mud, navigation, precision). It is used for soil vapor extraction, groundwater extration, bioremediation, monitoring, etc.

Company Name/POC: FlowTex GUT GmbH/Dr. Ingo Sass

Address : Gesellschaft fur GroBbohr- und Umwelttechnik/ChausseestraBe 1/D-06317 Amsdorf, Post
Roblingen, Germany

Phone Number : 34601 40 164

Fax Number : 34601 40 15

Technology Maturity : Commercial use experience

Performance History : 1989 : first field test performed. 1990 : first porous pipes introduced. 1991 - 1993 : technical operations. Since 1993 : commercial use (55 wells in operation up to now in Germany alone). Portsmouth site horizontal well recirculation system with ORNL.

Comments : Maximum screen diameter: 12 inch, max. length 2000 meters, maximum depth 300 meters. Six different qualities of porous pipes; different mud designs; drill systems from 8 to 400 metric tons (pulling force) available; very high precision drilling; porous screens much more efficient; higher clogging and colmation resistivity; use of shelter casing procedure for well completion and filter cake destruction; hydrophobic screens.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Size reduction*

Technology Name : AFAB Method (registered)

Application : On-site Ex-situ
Off-site

Brief Description : Crushing of industrial waste to achieve higher density. Performance is between 50 - 100 percent better than existing methods.

Company Name/POC: Fonova AB/Mats Edvardsson

Address : Box 1450/S-90124 UMEA/Sweden

Phone Number : 46 90 137180

Fax Number : 46 90 137800

Technology Maturity : Commercial use experience

Performance History : Testing during 92-93
Commercial use 93-95
Very good results for this application

Comments : Highly adaptable to most landfill sites.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Robotics*

Technology Name : Robotic Manipulator and Control Systems

Application : On-site

Brief Description : Teleoperated and autonomous robotic systems provided include manipulators, control systems and sensors. ISE robotic products are mission driven. Therefore, ISE has the ability to tailor all robotic products to suit the specific applications of the customer. All of the robotic systems are designed and built using hardware and software modules. The hardware modules may be re-configured to create other mechanical systems for very specific applications.

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Address : 1734 Broadway Street/Port Coquitlam, B.C. V3C 2M8 Canada

Phone Number : 604 942-5223

Fax Number : 604 942-757

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Customers for ISE autonomous robotic systems include the U.S. Air Force and the Canadian Space Agency. The USAF system is used to autonomously refuel aircraft. The CSA robots are part of the development of autonomous robot technology applicable to the Space Station "Freedom" Project. Customers for ISE's teleoperated systems include Westinghouse, AT&T, the U.S. Navy, GPU Nuclear, Shin Nippon, Southwest Research, and Oceaneering Space Systems.

Comments : Personnel require 1-2 week training course. All systems are designed and built to operate in specific environments. Systems are used by trained technicians. Systems are typically self contained.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Robotics*

Technology Name : Remote Excavator

Application : On-site Ex-situ

Brief Description : Remotely controlled Excavator is a radio or tether controlled heavy hydraulic excavator that allows all functions including end tooling and camera pan and tilt units. Advanced robotic features include coordinated motion control. Applications for excavation of hazardous waste eliminating the need for manned presence at excavation site.

Company Name/POC: RSI Research Ltd./Brad Moore

Address : Bldg. #3-203 Harbour Road/Victoria, BC, Canada V9A 3S2

Phone Number : 604 360-1025

Fax Number : 604 360-1161

Technology Maturity : Commercial use experience

Performance History : U.S. Army, Yuma Proving Grounds, Yuma, AZ - ROND Remote Vehicle
SPAR Aerospace/INEL, BWID '95 demonstration, Idaho Falls - Remote Excavator

Comments : None.

Source of Information : International TechCon

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Other*

Technology Name : Remotely Controlled and Video-Assisted Remotely Controlled Excavation

Application : On-site Ex-situ

Brief Description : Remote control system allows the operator to be removed from the job site and avoid exposure to harsh conditions and/or hazardous materials. System can be used with visual range RF-based remote control or with a video-assisted remote control that allows a greater range and operation without visual contact with the vehicle. Modulaire offers both the versatile, tracked vehicle with a robotic manipulator and the remote control technology. The system has been used very successfully to remove unexploded ordnance from an army artillery test firing range since 1994.

Company Name/POC: Modulaire Ltd./Mikko Sampo

Address : P.O. Box 10/14201 Turenki/Finland

Phone Number : 358 17 6878433

Fax Number : 358 17 688151

Technology Maturity : Commercial use experience

Performance History : Sales began in 1994. A video-assisted unit has been used by the Finnish Defense Forces since September 1994 for removing unexploded ordnance from a test firing range. The system has functioned flawlessly and the customer has optioned to purchase an upgrade to a fully autonomous system later on. German MaK corporation has entered into an agreement with Modulaire for joint technology development and marketing efforts. The technology is being considered for clean-up operations in the former East Germany.

Comments : Minimal facilities are needed. The system can be controlled from outside or from almost any type of shelter. The remote control system is battery operated and a battery charging facility is needed, as is a supply of diesel fuel and oil for the vehicle. Increasing the range of the remote control system requires significantly increased power and may raise permitting issues. Video-assisted remote control requires some training and very delicate manipulator operations can be challenging. The internal combustion engine is not suitable for explosive atmospheres. The system is very easy to implement and maintain as it consists mainly of standard components. The main issue is proper operator training, as poorly trained operators are inefficient and can even damage the equipment. Infrastructure needs are minimal. Operator training is a key issue: a well-trained operator is both effective and safe.

Source of Information : International TechCon

Surface Impoundment

Extraction/Delivery/Materials Handling

Surface Impoundment

Extraction/Delivery/Materials Handling

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Directional Wells*

Technology Name : Horizontal Drilling

Application : In-situ (vadose zone)
In-situ (saturated zone)

Brief Description : Drilex Systems, Inc. has developed a horizontal drilling system for use as a remediation tool. The principal involves drilling a borehole by directional or horizontal drilling into contaminated areas that are otherwise difficult or impossible to reach due to surface obstructions; or to drill extended lengths of borehole into contaminated areas to expose more area to a given treatment technology.

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Address : 15151 Sommermeyer/P.O. Box 801114/Houston, Texas 77280-1114

Phone Number : 713 937-8888

Fax Number : 713 849-2390

Technology Maturity : Commercial use experience

Performance History : Initial pilot project was undertaken in February 1990 at a site in Michigan. Two horizontal boreholes were drilled - one into the contaminant source to pump and treat, and the other into the down stream plume to stop the migration. Drilling rig is available for full scale operations. Drilex has over 10 years experience in directional and horizontal drilling.

Comments : The rig is mounted on four truck trailers and is a fully transportable, non-permit, self-powered setup that can be moved with ease. The only outside source needed is for water to mix drilling fluids. Wells can be installed at depths from 12 feet to 250 feet. The horizontal section can be up to 2500 feet long. There are no limitations on specific contaminants. However, the type of contaminant does limit the types the hardware that can be used in the well.

Source of Information : VISITT 3.0

CONTAMINANTS : ☒ Pesticides/Herbicides ☒ Heavy Metals ☒ PCB ☒ Explosives/Propellants
☒ Petroleum Hydrocarbons ☒ Radionuclides ☒ SVOC ☒ Other Contaminant
☒ Nonhalogenated VOC ☒ Halogenated VOC ☒ N/A

TECHNOLOGY TYPE : *Robotics*

Technology Name : Robotic Manipulator and Control Systems

Application : On-site

Brief Description : Teleoperated and autonomous robotic systems provided include manipulators, control systems and sensors. ISE robotic products are mission driven. Therefore, ISE has the ability to tailor all robotic products to suit the specific applications of the customer. All of the robotic systems are designed and built using hardware and software modules. The hardware modules may be re-configured to create other mechanical systems for very specific applications.

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Phone Number : 604 942-5223

Fax Number : 604 942-757

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Customers for ISE autonomous robotic systems include the U.S. Air Force and the Canadian Space Agency. The USAF system is used to autonomously refuel aircraft. The CSA robots are part of the development of autonomous robot technology applicable to the Space Station "Freedom" Project. Customers for ISE's teleoperated systems include Westinghouse, AT&T, the U.S. Navy, GPU Nuclear, Shin Nippon, Southwest Research, and Oceaneering Space Systems.

Comments : Personnel require 1-2 week training course. All systems are designed and built to operate in specific environments. Systems are used by trained technicians. Systems are typically self contained.

Source of Information : International TechCon

Drums/Tanks/Piping

Extraction/Delivery/Materials Handling

Drums/Tanks/Piping

Extraction/Delivery/Materials Handling

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Excavation, Retrieval, and Off-Site Disposal*

Technology Name : Retrieval of Stored Wastes

Application : On-site Ex-situ

Brief Description : Retrieves a wide variety of high dose rate solid and slurry from radioactive wastes that have been stored in vaults and tanks that are difficult to access. Technology has been developed, installed and operated to access and remotely retrieve wastes. Plant designs are based on an appropriate combination of mixers, pumps, and ejectors, grabs and deployment systems.

Company Name/POC: Nuclear Electric plc/Dr. R. Clayton

Address : Littlebroom Manorway/Dartford Kent DA1 5PY, UK

Phone Number : 44 0 1322 2700

Fax Number : 44 1322 2706

Technology Maturity : Commercial use experience

Performance History : 3 plants installed and operated successfully for retrieving slurry form wastes.
 1 plant installed and operated successfully for retrieving solid form wastes.
 4 future plants being designed.
 Plants operated on a batch basis to match controlling downstream waste processing rate.

Comments : None.

Source of Information : International TechCon

CONTAMINANTS :

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Size reduction*

Technology Name : 2000mt High Pressure Compactor

Application :

☐ On-site	☐ Ex-situ
☐ Off-site	

Brief Description : Volume reduction of contaminated waste. Compaction in drums with in-drum compactors and compaction of 52 or 55 gallon drums with 2000 t high pressure compactors. This technology is used since 1983 and is a proven technology based on its excellent performance.

Company Name/POC: Hansa Projekt Anlagentechnik GmbH/Michael Szukala

Address : Tarpenring 4/22419 Hamburg, Germany

Phone Number : 49 40 527 02 62

Fax Number : 49 40 527 56 6

Technology Maturity : Commercial use experience

Performance History : HPA has built compactors since 1982. 10 systems are currently operating throughout the world for various applications. The customers are :

EdF Bugey, France	NPP Brunsbuttel, Germany
Trawsfynydd, U.K.	UK AEA Winfrith, U.K.
Nucleco Casicca, Italy	Quadrex, Oak Ridge, TN, USA
Allied Techn. Hanford, USA	NSP Redwing, MN, USA
EG&G Rocky Flats, CO, USA	Kepeco, Kangnam, Seoul, Korea

Comments : Radiation level and waste media which reacts hydraulically can be limiting factors. System affords ease of use because of fully automated process, simple infrastructure, flexibility for various waste streams and proven and available technology.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
☐ Petroleum Hydrocarbons ☐ Radionuclides ☐ SVOC ☐ Other Contaminant
☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Robotics*

Technology Name : Robotic Manipulator and Control Systems

Application : On-site

Brief Description : Teleoperated and autonomous robotic systems provided include manipulators, control systems and sensors. ISE robotic products are mission driven. Therefore, ISE has the ability to tailor all robotic products to suit the specific applications of the customer. All of the robotic systems are designed and built using hardware and software modules. The hardware modules may be re-configured to create other mechanical systems for very specific applications.

Company Name/POC: International Submarine Engineering LTD./Owen Williams

Address : 1734 Broadway Street/Port Coquitlam, B.C. V3C 2M8 Canada

Phone Number : 604 942-5223

Fax Number : 604 942-7577

Technology Maturity : Commercial use experience

Performance History : Performance data are available.

Customers for ISE autonomous robotic systems include the U.S. Air Force and the Canadian Space Agency. The USAF system is used to autonomously refuel aircraft. The CSA robots are part of the development of autonomous robot technology applicable to the Space Station "Freedom" Project. Customers for ISE's teleoperated systems include Westinghouse, AT&T, the U.S. Navy, GPU Nuclear, Shin Nippon, Southwest Research, and Oceaneering Space Systems.

Comments : Personnel require 1-2 week training course. All systems are designed and built to operate in specific environments. Systems are used by trained technicians. Systems are typically self contained.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
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TECHNOLOGY TYPE : *Robotics*

Technology Name : Tentacle Robotic Arm - Extensible (Tentacle)

Application : On-site Ex-situ

Brief Description : Tentacle robot is an innovative manipulator which can extend, contract and bend in two (or more) regions. The tentacle uses a special pneumatic bellows with motor-driven tendon cables to control position. The tentacle has a very large work volume and is able to reach around objects and into positions which conventional robots cannot attain. Its advantages include: highest strength-to-weight ratio of any manipulator, very large work volume, variable compliance control, contracts into small volume for storage.

Company Name/POC: Kinetic Sciences Inc./Guy Immega

Address : 3250 E. Mall/Vancouver, B.C. V6T1W5

Phone Number : 604 822-5782

Fax Number : 604 822-618

Technology Maturity : Bench scale testing, only

Performance History : A prototype KSI Tentacle has been delivered to the Tennessee Valley Authority, for use as a tower climbing unit. A second Tentacle will be delivered to the TVA for use as a transmission tower painting manipulator. A third two-stage Tentacle was to be constructed for display June-Sept 1993 at Science World (major science museum) in Vancouver, B.C.

Comments : The tentacle robot can be teleoperated with proprietary joy sticks. Current Tentacle bladder technology uses plastic materials which cannot withstand extreme temperatures. The KSI Tentacle robotic manipulator can be carried either by another system or on a mobile robot. The tentacle can deploy sensors (video, chemical, etc.) or can be used to grasp and retrieve a wide variety of objects. Due to its very high strength-to-weight and its ability to move into difficult-to-reach areas, the tentacle is an effective manipulator for extreme environments, such as inside tanks. All that is required to operate the tentacle are control signals, compressed air (100 PSI) and 90 VDC motor voltages. When deployed downward (like an elephant's trunk), a 50 lb. tentacle will be able to lift up to 1000 pounds. Further development will provide improved control systems with the ability to serve end effector position with the KSI "Eagle Eye" machine vision system.

Source of Information : International TechCon

CONTAMINANTS : ☐ Pesticides/Herbicides ☐ Heavy Metals ☐ PCB ☐ Explosives/Propellants
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☐ Nonhalogenated VOC ☐ Halogenated VOC ☐ N/A

TECHNOLOGY TYPE : *Robotics*

Technology Name : Multi-Limb, Long-Reach, Heavy Duty Hydraulic Manipulator

Application : On-site Ex-situ

Brief Description : Multi-limb (15 dof) long reach heavy duty hydraulic manipulator equipment is a remote deployment system for a wide range of enabling technologies to provide total capability.

Company Name/POC: Nuclear Electric plc/Dr. R. Clayton

Address : Littlebroom Manorway/Dartford Kent DA1 5PY, UK

Phone Number : 44 0 1322 2700

Fax Number : 44 1322 2706

Technology Maturity : Commercial use experience

Performance History : Prototype developed in mid 80's, 9 units in service. High performance and high reliability for use in reactor during statutory shut-down.

Comments : Limitations include maximum (1) payload 200 lb.; (2) temperature 80 degrees celcius; and (3) radiation dose 1 MRAD. Heavy duty manipulators and in some cases mobile and climbing vehicles provide the means of deployment of a wide range of enabling technologies, which includes drilling, bolting, stud welding, welding, laser welding and cutting, in radioactive and hostile environments. This also facilitates both non intrusive and intrusive inspection programs employing equipment and methods such as advanced TV systems, laser scanning cameras, infra-red surveys, ultrasonics, ultrasonic spectroscopy, laser induced breakdown spectroscopy, trepanning and sampling to support the long term safe operation of reactor plant.

Source of Information : International TechCon

CONTAMINANTS :

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☒ Nonhalogenated VOC	☒ Halogenated VOC	☒ N/A	

TECHNOLOGY TYPE : *Robotics*

Technology Name : Resolved Motion Control of Hydraulic Manipulators

Application : On-site Ex-situ

Brief Description : Hydraulic Manipulators with Resolved Motion Digital Control: This technology provides remote manipulation with precision control. Hydraulic manipulation to 1,500 lbs. lift controlled with a digital control system that resolves complex movements using RSI algorithms. The control is ergonomically superior to spatially correspondent control.

Company Name/POC: RSI Research Ltd./Brad Moore

Address : Bldg. #3-203 Harbour Road/Victoria, BC, Canada V9A 3S2

Phone Number : 604 360-1025

Fax Number : 604 360-116

Technology Maturity : Commercial use experience

Performance History : Sonsub Oceaneering, DCEIM, IOS. Over 50 RSI manipulators in service.

Comments : Resolved control of manipulator translates the operators movements into precision control of end-effector.

Source of Information : International TechCon

CONTAMINANTS :				
☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants	
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☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A		

TECHNOLOGY TYPE : *Robotics*

Technology Name : Innovative Approach to Robotics Design

Application :	On-site	Ex-situ

Brief Description : Innovative approach to adapting existing technology for design and manufacture of robotics for survey and sampling in hazardous environmental/radioactive conditions.

Company Name/POC: W.S. Atkins Consultants Ltd./Dr. R. B. Dean/Mr. R. Dexter-Smith

Address : Woodcote Grove/Ashley Road/Epsom, Surrey, KT18 5BW, UK

Phone Number : 1372 726140

Fax Number : 01372 740055

Technology Maturity : Commercial use experience

Performance History : Design and development for use in surveys of existing plant at the windscale piles and trawsfynydd Magnox reactor.

Comments : The particular "technology" being described has in fact a proven track record in tackling complex survey and sampling tasks. Have adapted existing systems (where possible) and brought them together to form a specialist robotic system suited to the specific project objective. This has been done for UKAEA, BNFL and nuclear electric in a highly cost effective manner.

Source of Information : International TechCon