**Environmental Cleanup Privatization
Products and Services
Directory**

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

January 1997

**Prepared for
U.S. Department of Energy
Office of Environmental Restoration
Office of Program Integration**

**Prepared by
MACTEC-ERS
U.S. Department of Energy
Albuquerque Operations Office
Grand Junction Office**

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29

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Contents

	<u>Page</u>
About This Directory	v
Media Icon Key	vii
Treatment	T1-T518
Company Name Index	T i
Process Type Index	T v
Characterization	C1-C219
Company Name Index	C i
Process Type Index	C iii
Extraction/Delivery/Materials Handling	E1-E101
Company Name Index	E i
Process Type Index	E iii

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About This Environmental Cleanup Privatization Products and Services Directory

The U.S. Department of Energy has undertaken an ambitious "Ten Year Plan" for the Weapons Complex, an initiative to complete cleanup at most nuclear sites within a decade. *This Second Edition of the Directory is designed to facilitate privatization which is key to the success of the Plan.*

The Directory is patterned after the telephone Yellow Pages. Like the Yellow Pages, it provides the user with points of contact for inquiring further into the capabilities of the listed companies. This edition retains the original format of three major sections under the broad headings: Treatment, Characterization, and Extraction/Delivery/Materials Handling. Within each section, companies are listed alphabetically. Also, "company name" and "process type" indices are provided at the beginning of each section to allow the user quick access to listings of particular interest.

Material for the Directory was obtained from the U.S. Environmental Protection Agency's VISITT database, the U.S. Department of Energy's TechCon program, and through direct contact with each listed company. This edition has been expanded to include more than 500 domestic and international commercial firms currently operating in the environmental cleanup market. Both the number of listings and the breadth of products and services included will be increased in future editions, as information about the rapidly growing cleanup industry becomes available.

Information contained in the Directory is also available via the Internet from the Grand Junction Office homepage, [http:// www.doejpo.com](http://www.doejpo.com), under Environmental Information Sources. The Internet version of the Directory includes a search engine that allows the user to peruse the Directory according to problem description, company name, or product/service.

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Media Icon Key¹

Surface Impoundment

Construction Materials/Debris

Soil

Surface Water

Free Product

Process Water

Process Wastes/Sludge

Landfills

Sediments in Surface Water

Ground Water

Vapor Phase

Drums/Tanks/Piping

Containers/Equipment

¹Media icons are listed at the top of each entry to assist the reader in quickly identifying the applicable media.

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Treatment

1. The first step in the treatment of a patient with a mental health condition is to establish a rapport with the patient. This involves building a trusting relationship between the patient and the healthcare provider. This can be achieved through active listening, empathy, and understanding the patient's perspective.

2. Once a rapport has been established, the next step is to conduct a thorough assessment of the patient's condition. This includes gathering information about the patient's symptoms, history, and current functioning. This assessment helps the healthcare provider to identify the underlying causes of the patient's condition and to develop a tailored treatment plan.

3. The third step in the treatment process is to develop a treatment plan. This plan should be based on the patient's assessment and should take into account the patient's preferences, strengths, and needs. The treatment plan should outline the goals of treatment, the interventions to be used, and the timeline for achieving these goals.

4. The fourth step is to implement the treatment plan. This involves providing the patient with the interventions outlined in the treatment plan. These interventions may include medication, psychotherapy, and other forms of support. The healthcare provider should monitor the patient's response to treatment and make adjustments as needed.

5. The final step in the treatment process is to evaluate the patient's progress. This involves assessing the patient's symptoms, functioning, and overall well-being. This evaluation helps the healthcare provider to determine whether the treatment plan is effective and to make any necessary adjustments.

Company Name Index

A

A.S. Bioteknisk Jordrens, 2, 3
 ABB Air Preheater, 4, 5, 6, 7
 ABCOV, Inc., 8
 ABRA Fluid AG, 9
 Adirondack Environmental Assoc., Inc.
 (AEA)/Champlain Labs, 10
 ADTECHS, Inc. (a wholly owned subsidiary of
 JGC Corp.), 11, 12, 13, 14, 15, 16
 AEA Technology, 17, 19
 AEC, 20
 AECL Research, 21, 22
 Aerojet, 23
 Aerospatiale, 24
 Airex Corporation, 25
 Alba Industrie Umweltschutz Service GmbH, 26,
 27
 Alpheus Cleaning Technologies Corp., 28
 Alternative Remedial Technologies, Inc., 29
 Alvarez Brothers, Inc., 30
 Andco Environmental Processes, Inc., 31, 32
 Applied Membrane Technology, Inc., 33
 ARAMSCO, 35
 Arctech, Inc., 36, 37
 Art International, Inc., 38
 A-Z WASTE TEK Ltd., 1

B

Bachy Enterprise, 39
 Barnebey and Sutcliffe Corporation, 40, 41
 BECO Engineering Co., 42
 Billings & Associates, Inc., 43
 Bio Solutions, Inc., 44
 Bio-Electrics, Inc., 45
 BioGEE International, Inc., 49, 50, 51
 Bio-Genesis Technologies, Inc., 46, 47, 48
 Biomin, Inc., 52
 Bionergies Laboratories, Biosurf, 53, 55, 57
 Bioremediation Technology Services, 59
 Bioscience, Inc., 60, 61, 62, 63, 64, 65, 66, 67
 Biotall LTD., 68
 BioTrol, Inc., 69
 Bodem, Sanering B.V., 70
 Bodem Sanering Nederland BV, 71
 Bogart Environmental Services, Inc., 72
 Bohn Biofilter Corp., 73
 Brice Environmental Services Corporation
 (BESCORP), 74
 British Columbia Research Corporation, 75, 76
 British Nuclear Fuels plc, 77, 78, 80, 81
 Brown & Root Environmental (previously known
 as Halliburton), 82

C

Carl Bro Energy & Environment, 83
 Carlo Environmental Technologies, Inc., 84
 CDS Research Ltd., 85
 Chemetrics, Inc., 91
 ChemPete, Inc., 92
 CHEM-SECURITY (Alberta) Ltd., 86, 87, 88,
 89, 90
 Clyde Engineering Services, 93, 94, 95
 COGNIS, Inc., 96, 98, 99, 100
 Compact Membrane Systems, Inc., 101
 Container Products Corporation, 102, 103
 ConTeck Environmental Services, Inc., 104
 CORPEX Technologies Inc., 105, 106
 CURE International, 107
 Cytec Industries, 108

D

Dames & Moore, Inc., 109, 110, 111, 112, 113,
 114, 115, 116, 117, 118, 119, 120, 121
 Daub & Associates, 122
 Davis Environmental, 123
 Davis Industrial Waste Systems, 124, 125, 126,
 127
 Davy International, 128
 Dehydro-Tech Corp., 129
 Delft Geotechnics, 130
 Delta Cooling Towers, Inc., 131
 Department of Chemical and Environmental
 Engineering, 132
 Desalination Systems, Inc., 133
 Divesco Technologies, 134
 DuPont, 135
 Dynaphore, Inc., 136

E

EA Technology Ltd., 138
 EA Technology Ltd./Technocell Group, 137
 Earth Remediation Services, Inc., 139, 140, 141,
 142, 143, 144
 Earthfax Engineering, Inc., 145
 ECO Purification Systems USA, Inc., 146
 Ecology Technologies International, Inc., 152,
 153, 154, 155
 ECO-TEC, Inc./Ecology Technology, Inc., 147,
 148, 149, 150, 151
 EET, Inc., 156
 EG&G Environmental, Inc., 158
 Electro-Petroleum, Inc., 159
 Electro-Pyrolysis, Inc., 160
 ELI Eco Logic International Inc., 161
 ENPAC Corporation, 163

Company Name Index (continued)

E (cont.)

ENSR Consulting and Engineering, 164, 165, 166

Entec Europe, 167

Entropic Systems, Inc., 168

Envirex, Inc., 170

Envirogen, Inc., 172, 173

EnviroMetal Technologies, Inc., 174

Environmental Alternatives, Inc., 176

Environmental Compliance Products, 177

Environmental Dimensions, Inc. (EDI), 178

Environmental Fuel Systems, Inc., 179

Environmental Resource Center, 181

Environmental Tech. of N. America, Inc., 182

Environmental Technologies International, 183

Enviro-Soil Remediation, Inc., 171

EnviroWall, 184

EODT Services, Inc., 185, 186, 187, 188

EPG Companies Inc., 189, 190

EPS Environmental, Inc., 191

ERM Group, The, 192

Etus, Inc., 193, 194

Exploration Products, 195

F

Filter Flow Technology, Inc., 196, 198

First Environment, Inc., 200

FLO TREND Systems, Inc., 201

Flow International Environmental Application Division, 202

Fluid Tech, Inc., 203, 204

Fluor Daniel GTI, 205

Foss Environmental Services, 207

Four Seasons Environmental Inc., 208

G

G.E.M., Inc., 209, 210

GDT Corporation, 211

General Atomics, 212

General Carbon Corporation, 213

General Electric, Corp. R&D, 214

Geo-Microbial Technologies, Inc., 215, 216

Geosafe Corporation, 217

Geotech Environmental, 219

Global Environmental Engineering, 220, 221

Global Equipment Marketing, Inc., 222, 223

Global Technologies (Anguil Environmental Systems, Inc. Div), 224, 225, 226

Goodway Technologies Corporation, 227

Grace Dearborn, Inc., 228, 229

Great Lakes Environmental, Inc., 230

Groundwater & Environmental Services, Inc. (GES), 232, 233, 234

Groundwater Technology, Inc., 235, 236, 238, 240

GRS, 242, 243, 244

GTS Duretek, Inc., 245

GZA Geoenvironmental, Inc., 247

H

H. Krantz-TKT, 248

H2O, Inc./c/o ADTECHS, Inc./a wholly owned subsidiary of JGC, 249

H2O Science, Inc., 250

Hansa Projekt Anlagentechnik GmbH, 251

HazTech News, 252

Hedeselskabet, 253

Heyl and Patterson Inc., 254

High Voltage Environmental Applications, Inc., 255

HRUBETZ Environmental Services, Inc., 257

I

Ice Blast West Inc., 258

IEG - Industrie Eng., 259

IEG Technologies Corp., 260

Integrated Chemistries, 261, 262, 263

International Reserve Equipment Corporation, 264

ISOTRON Corporation, 265, 266, 267

IT Corporation, 268, 269, 270, 271, 272, 273, 275, 276, 277, 278, 279

ITEX Environmental Services, Inc., 280

J

J. R. Simplot Company, 281

Jerman Company, 283

K

KAM Biotechnology Ltd., 284

KAP s.r.o., 285

Keller Environmental Inc., 287, 288

KEMA Nederland B.V., 289, 290, 291, 292

Kemron Environmental Services, Inc., 293

Kernkraftwerke Gundremmingen, 294

Kraissl Company Inc., 295

Kruger A.S., 296

KSE, Inc., 297

L

Landa Water Cleaning Systems, 298

Layne-Christensen Company, 299

Lockheed Environmental Technologies Divisions, 301, 302

Lopata Technical Service Corp., 303, 304

Company Name Index (continued)

M

M. L. Energia, Inc., 305, 307
 Magnox Electric, 308
 Maple Environmental Services Ltd., 309
 Matrix Photocatalytic, Inc. (formerly NuTech), 310
 Maxymillian Technologies, Inc., 311
 MBI International, 312
 Membrane Technology & Research, Inc., 314
 Mercury Recovery Services, Inc., 315
 MES/ACT Environmental, Inc., 317, 318
 Metcalf and Eddy, Inc., 319, 320
 Millgard Environmental Corporation, 321
 Misonix Inc., 322
 Molten-Metal Technology, Inc., 323
 MSE Technology Applications, Inc., 325
 MWR, Inc., Division of Envirogen, Inc., 327, 328, 329
 Mycotech Corp., 330

N

National Seal Company, 331
 Newcon A/S, 332
 Noell Aball- u. Energietechnik GmbH, 333
 Non-Destructive Cleaning, Inc., 334
 Norwegian Geotechnical Institute, 335

O

O'Brien & Gere Technical Services, Inc., 336
 OEELL Ltd/ESU Ltd, 337
 Ontario Hydro Technologies, 339
 Osprey Biotechnics, 340

P

Paques, Inc., 341
 Parsons Engineering-Science, Inc., 342
 PEGO Systems, Inc., 343
 PENTEK, Inc., 344, 345
 Pet-Con Soil Remediation, Inc., 346
 Petrol Rem, Inc., 347
 Pittsburgh Activated Carbon Services, Inc., 348, 349, 350
 Pittsburgh Mineral & Environmental Tech, 351
 Plastronics Inc., 352
 Polygon Industries, Inc., 353
 Portec, Inc., 355
 Power Fluidics, 356
 Praxair, Inc., 357
 Pressure Systems Inc., 358
 Process Technologies, Inc., 360
 Promeco B.V., 362

Q

Quaternary Investigations, Inc. (QI), 363, 364

R

R. Mazur, 365
 Radian Corporation, 366, 367
 Radian International, 368, 369
 Radiation Science Inc., 370
 Radiological Services, Inc., 372
 Ranator AB, 373
 Recycling Sciences International Inc., 374
 Regenes Bioremediation Products, 375
 Remediation Service International (RSI), 377, 378, 379, 380, 381, 382, 383, 384, 385
 Resource Conservation Company, 386
 Resource Management and Recovery, 387
 Richard Buchen GmpH, 388
 Riso National Laboratory, 389
 RKK, Ltd., 390, 392, 394
 RMT, Inc., 396, 398
 Robertson Barrier Systems Corporation, 400
 Rockwell International, 402
 Roy F. Weston, Inc., 404

S

S.S. Papadopoulos & Associates, Inc., 405
 SBP Technologies, Inc., 406, 407, 408
 SC&A, 409
 SCC Technology, Inc., 411
 Seaman Corporation, 412
 Selentec, 413, 414, 415, 417
 Selion Technologies, Inc., 418, 419, 420
 Sensible Environmental Solutions (SES), 421
 Separation and Recovery Systems, Inc., 422, 424
 Serengeti Products Company, 426, 427
 Severson Environmental Service, 428
 Shields Environmental Corporation, 429
 SIEMPELKAMP GIESSEREI GmbH & CO., 430
 Sive Services, 431
 Slaggrprodukter, 432
 Smith Environmental Technologies Corp., 433, 434
 Soil Solutions Inc., 435
 Soiltech ATP Systems, Inc., 437
 Solarchem Environmental Systems, 439
 Solucorp Industries, 440
 Someus & Partners Unlimited, 441
 SONOSEP BioTech Inc., 442
 SPI/ASTEC, 443
 SRE, Inc., 444
 STC Omega, Inc., 445, 446
 Stord, Inc., 447, 448
 Studsvik RadWaste AB, 449, 450, 451, 452
 Surface Combustion, 453, 454, 455, 456, 457, 458

Company Name Index (continued)

T

Tauw Milieu, 459
Technology Scientific Ltd, 460
Technotreat Corporation, 462
Tekno Associates Inc., 463
Terra Vac, 464, 466, 468, 470, 472
Tetronics Limited, 473
Texarome, Inc., 474
Texilla Environmental, Inc., 475
ThermoChem, Inc., 476, 477, 478
Trisep Corporation, 479
TVIES, Inc., 480

U

U.S. Filter-Recovery Services, 481
Ultrox-Zimpro, 482
Umweltschutz Nord GmbH & Co., 483, 484,
485, 486
URT Umwelttechnik GmbH, 487

V

Va-Tran Systems, Inc., 488
Vert LTD., 490
Viking Industries, 491
VKI Water Quality Institute, 492, 493

W

W.E.S. Environmental Division, 494, 495
Walsh & Associates, 496
Waste Minimization and Containment Corp., 497
Waste Technologies Industries (WTI), 498
WASTECHEM Ltd, 500
Water Protection International, 501, 503, 505
Water Technology Int. Corp./Wastewater
Technology Centre, 507, 508, 509
Water Technology International Corporation,
510, 511
Waterjet Technology, Inc., 512
Westar Resources, Inc., 513
Western Research Institute, 514
Westinghouse Communications, 515
Westinghouse Remediation Services, Inc., 516
Wheelabrator Technologies, Inc., 517
Wheelabrator Water Technologies, Inc.,
Memteck Division, 518

Z

Zapit Technology, Inc., 519

Process Type Index

- Air Sparging, 83, 111, 142, 211, 233, 236, 260, 275, 329, 363, 380, 466
- Air Stripping, 123, 131, 356
- Bioaugmentation, 340
- Biodegradation (In Situ), 20, 46, 50, 53, 62, 66, 91, 92, 96, 109, 118, 148, 155, 158, 165, 173, 215, 228, 268, 287, 293, 312, 317, 335, 337, 357, 375, 377, 408, 508
- Biofiltration, 73, 94, 459, 484
- Bioreactors, 48, 57, 63, 110, 125, 154, 170, 172, 187, 216, 309, 318, 332, 444, 483, 493, 495
- Bioremediation, 108, 347
- Bioventing, 61, 115, 120, 144, 149, 164, 220, 240, 250, 269, 327, 342, 364, 365, 381, 468, 492
- Chemical Extraction, 38, 129, 183, 242, 271, 301, 320, 350, 386
- Chemical Oxidation, 89, 127, 210, 305, 478
- Chemical Reduction, 11, 15, 26, 37, 90, 124, 161, 194, 209, 249, 272, 279, 307, 370, 462, 476
- Chemical Surface Cleaning, 81, 106, 156, 168, 207, 261, 262, 263, 267, 292, 294, 345, 388, 415, 452
- Co-Metabolic Processes, 113, 221, 496
- Composting, 36, 150, 486
- Containment, 85, 163, 177, 184, 195, 204, 247, 299, 331, 352, 392, 394, 400, 412, 429, 485, 501, 503, 511
- Dual Phase Extraction, 117, 141, 200, 234, 259, 277, 385
- Electrical Separation, 3, 19, 31, 78, 107, 137, 159, 500
- Electron Beam, 255, 519
- Filtration, 13, 21, 42, 126, 135, 139, 196, 198, 212, 213, 219, 227, 230, 248, 264, 295, 298, 308, 348, 419, 518
- High Temperature Thermal Desorption, 4, 254, 257, 311, 351, 422, 437, 441, 447
- Hot Water or Steam Flushing/Stripping, 366, 369, 382, 431, 435, 514
- In Situ Vitrification, 217
- Incineration, 5, 87, 224, 449, 454, 457, 498
- Ion Exchange, 12, 16, 132, 136, 387, 418, 420, 481, 487
- Liquid Phase Carbon Adsorption, 40
- Low Temperature Thermal Desorption, 6, 84, 88, 104, 171, 315, 346, 374, 404, 424, 443, 448, 474, 515
- Mechanical Surface Cleaning, 23, 28, 35, 80, 102, 103, 176, 202, 223, 251, 258, 289, 291, 334, 336, 344, 353, 372, 389, 488, 497, 512
- Membrane Separation, 33, 101, 133, 304, 314, 479
- Other, 9, 10, 22, 45, 52, 76, 122, 128, 130, 146, 178, 179, 181, 188, 191, 192, 222, 226, 252, 253, 266, 283, 322, 325, 339, 355, 368, 390, 402, 405, 413, 414, 421, 432, 442, 451, 477, 505
- Oxidation, 25, 190, 225, 235, 265, 297, 303, 384, 455, 458
- Oxygen Enhancement with Air Sparging, 82, 112, 379
- Passive Treatment Walls, 174, 244
- Precipitation, 32, 296, 513
- Pyrolysis, 7, 450, 456
- Recycle, 323, 349, 430, 434, 453, 491
- Slurry Phase Biological Treatment, 44, 51, 55, 60, 72, 100, 114, 151, 152, 185, 273, 281, 284, 341, 407, 463, 507, 509
- Soil Flushing, 186, 243
- Soil Vapor Extraction (Ex Situ), 285
- Soil Vapor Extraction (In Situ), 121, 143, 208, 232, 276, 328, 378, 464, 470
- Soil Washing, 17, 27, 29, 69, 70, 71, 74, 77, 98, 105, 134, 201, 214, 302, 319, 362, 373, 409, 417, 433, 460, 480, 516
- Solid Phase Biological Treatment, 2, 30, 47, 49, 59, 67, 99, 116, 147, 153, 166, 167, 182, 193, 229, 238, 270, 406, 426, 427
- Solidification/Stabilization (Ex Situ), 1, 14, 64, 75, 86, 290, 358, 398, 428, 440, 446, 475, 510, 517
- Solidification/Stabilization (In Situ), 8, 39, 65, 203, 205, 280, 288, 321, 367, 396, 411, 445
- Ultraviolet Oxidation, 278, 310, 360, 439, 482
- Vacuum Vapor Extraction, 43, 119, 140, 189, 343, 383, 472, 494
- Vapor-Phase Carbon Adsorption, 41
- Vitrification (Ex Situ), 24, 138, 160, 245, 473, 490
- White Rot Fungus, 68, 93, 95, 145, 330, 333

THE UNITED STATES OF AMERICA
DEPARTMENT OF JUSTICE
FEDERAL BUREAU OF INVESTIGATION
WASHINGTON, D. C. 20535

MEMORANDUM FOR THE DIRECTOR

FROM: SAC, NEW YORK (100-100000)

SUBJECT: [REDACTED]

RE: [REDACTED]

DATE: 10/10/68

CLASSIFICATION: [REDACTED]

1. [REDACTED]

2. [REDACTED]

3. [REDACTED]

4. [REDACTED]

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15. [REDACTED]

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17. [REDACTED]

18. [REDACTED]

19. [REDACTED]

20. [REDACTED]

21. [REDACTED]

22. [REDACTED]

23. [REDACTED]

ALL INFORMATION CONTAINED
HEREIN IS UNCLASSIFIED
DATE 10/10/68 BY [REDACTED]

EXEMPT FROM AUTOMATIC
DECLASSIFICATION

DATE 10/10/68 BY [REDACTED]

REASON: [REDACTED]

1. [REDACTED]

2. [REDACTED]

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Company Name/POC	A-Z WASTE TEK Ltd./David J. Brown 32A Pooch Rd Upton Poole Dorset England BH16 5JB	
E-Mail Address		
Product/Service	Customized Grout Applications for Waste Management	Phone Number 01144 1202 624985
Process Type	Solidification/Stabilization (Ex Situ)	Fax Number 01144 1202 625177

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service 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

Treatment

Company Name/POC	A.S. Biotechnisk Jordrens/Soren Schiotz 10. Maglehojvej DK 4400 Kalundborg, Denmark	
E-Mail Address		
Product/Service	Biological Soil Remediation	Phone Number 45 5350 4668
Process Type	Solid Phase Biological Treatment	Fax Number 45 5350 4490

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On site

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

Product/Service 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: Vendor

Company Name/POC	A.S. Bioteknisk Jordrens/Soren Schiotz 10. Maglehojvej DK 4400 Kalundborg, Denmark	
E-Mail Address		
Product/Service	Electrodialytical Heavy Metals Remediation	Phone Number 45 5350 4668
Process Type	Electrical Separation	Fax Number 45 5350 4490

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

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

Product/Service Maturity: Bench scale testing only

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: Vendor

Company Name/POC - ABB Air Preheater/Mark Monawski
650 Warnerville Road
Lisle, Illinois 60532

E-Mail Address

Product/Service High Temperature Thermal Desorption

Phone Number 708 971-2500

Process Type High Temperature Thermal Desorption

Fax Number 708 971-1076

Contaminants

☒ Pesticides/Herbicides
☒ Petroleum Hydrocarbons
☒ Nonhalogenated VOC

☒ Heavy Metals
☒ Radionuclides
☒ Halogenated VOC

☒ PCB
☒ SVOC
☐ N/A

☒ Explosives/Propellants
☐ Other Contaminant

Media

☐ Surface Impoundment
☒ Construction Materials/Debris
☐ Sediments in Water
☒ Process Wastes and Sludge

☒ Soil
☒ Landfills
☐ Vapor Phase

☐ Process Water
☐ Drums/Tanks/Piping
☐ Free Product

☐ Surface Water
☐ Containers/Equipment
☐ Ground Water

Application: Off site On site

Brief Description: Possess a wide variety of thermal treatment technologies.

Product/Service Maturity: Commercial use experience

Performance History: Contact vendor for performance data.

Comments: None.

Source of Information: Vendor

Company Name/POC	ABB Air Preheater/Mark Monawski 650 Warnerville Road Lisle, Illinois 60532		
E-Mail Address			
Product/Service	Incineration	Phone Number	708 971-2500
Process Type	Incineration	Fax Number	708 971-1076

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Off site On site

Brief Description: Possess a wide variety of thermal treatment technologies.

Product/Service Maturity: Commercial use experience

Performance History: Contact vendor for performance data.

Comments: None.

Source of Information: Vendor

Company Name/POC ABB Air Preheater/Mark Monawski
650 Warnerville Road
Lisle, Illinois 60532

E-Mail Address

Product/Service Low Temperature Thermal Desorption

Phone Number 708 971-2500

Process Type Low Temperature Thermal Desorption

Fax Number 708 971-1076

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Off site On site

Brief Description: Possess a wide variety of thermal treatment technologies.

Product/Service Maturity: Commercial use experience

Performance History: Contact vendor for performance data.

Comments: None.

Source of Information: Vendor

Company Name/POC	ABB Air Preheater/Mark Monawski 650 Warnenville Road Lisle, Illinois 60532		
E-Mail Address			
Product/Service	Pyrolysis	Phone Number	708 971-2500
Process Type	Pyrolysis	Fax Number	708 971-1076

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Off site On site

Brief Description: Possess a wide variety of thermal treatment technologies.

Product/Service Maturity: Commercial use experience

Performance History: Contact vendor for performance data.

Comments: None.

Source of Information: Vendor

Company Name/POC	ABCOV, Inc./ Tony Nocito 214 Sullivan Street New York, New York 10012	
E-Mail Address		
Product/Service	The ABCOV Method of asbestos abatement and conversion to a non-toxic material	Phone Number 212 505-5558
Process Type	Solidification/Stabilization (In Situ)	Fax Number 212 505-5666

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: The ABCOV Method is a patented, simple and economical, chemical and mixing approach for all types of 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.

Product/Service Maturity: Commercial use experience

Performance History: Ralph LaLonde (315 339-2820); ConEdison, Glen Newell (212 542-2367); Radian Corp. (EPRI), Dave Daniels (512 454-4797); Aberdeen Proving Ground, John Hayden (410-278-8499); Defense Logistics Agency, Kevin Reilly (702) 767-6522).

Comments: The ABCOV Method converts all types of asbestos to a non-toxic 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. ABCOV, Inc. provides licenses and chemicals and coordinates training in the use of the ABCOV Method.

Source of Information: Vendor

Company Name/POC	ABRA Fluid AG/Markus Frei Industrie Nollen Birkenstr. 109 CH-9443 Widnau, Switzerland		
E-Mail Address			
Product/Service	Wet-Oxidation Process Using Special Autoclave Equipment	Phone Number	41 71 722 78 72
Process Type	Other	Fax Number	41 71 722 78 75

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service Maturity: Commercial use experience

Performance History: Contact company for performance history.

Comments: None.

Source of Information: Vendor

Company Name/POC Adirondack Environmental Associates, Inc./Champlain Laboratories/Guy B. Fenwick
9 Kastner Road
Plattsburgh, New York 12901

E-Mail Address**Product/Service**

Environmental Contractor and Consultant

Phone Number 518 563-5726**Process Type**

Other

Fax Number 518 562-0789**Contaminants**

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Phase I, II (active and passive soil gas surveys)-Environmental site assessments, subsurface groundwater studies, remedial investigations, feasibility studies. Design, installation, operation and maintenance of remediations systems: soil vapor extraction, sparging, in situ and ex situ biocells, including air strippers, separators, liquid and air carbon filters (55 gal - 2,000 lb).

Product/Service Maturity: Commercial use experience

Performance History: Parishville, Hopkington School: New York installed 11/95 soil vapor extraction system feeding thru 4,000 lb vapor carbon filter with pump and treat to shallow tray stripper.
Cronin sunoco: SVE and sparge system w/ex situ biocell.

Comments: The remedial methods that AEA is experienced with and capable of performing after Site Review (with Phase II Active and Passive Soil Gas Surveys) and Risk Assessment are: pump and treat, air stripping, ex situ land farming and passive remediation, soil vapor extraction, bioremediation (in situ and ex situ) composting, air sparging, on site high temperature thermal incineration treatment, vapor and liquid phase activated carbon filtration, beneficial reuse disposal of contaminated soil through asphalt batching.

The equipment to be used for a particular method will be determined after review of the site. Specific company and employee remediation experience can be provided upon request.

Source of Information: Vendor

Company Name/POC	ADTECHS, Inc. (a wholly owned subsidiary of JGC Corp.)/Phil Baldwin 2411 Dulles Corner Park Suite 520 Herndon, Virginia 22071		
E-Mail Address			
Product/Service	E-Process	Phone Number	703 713-9000
Process Type	Chemical Reduction	Fax Number	703 713-9101

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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

Company Name/POC ADTECHS, Inc. (a wholly owned subsidiary of JGC Corp.)/Phil Baldwin
2411 Dulles Corner Park
Suite 520
Herndon, Virginia 22071

E-Mail Address

Product/Service Uranium Selective Chelate Resin **Phone Number** 703 713-9000
Process Type Ion Exchange **Fax Number** 703 713-9101

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: This ion exchange resin, which is highly selective for removing uranium, is used to treat liquid waste streams.

Product/Service 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

Company Name/POC	ADTECHS, Inc. (a wholly owned subsidiary of JGC Corp.)/Phil Baldwin 2411 Dulles Corner Park Suite 520 Herndon, Virginia 22071		
E-Mail Address			
Product/Service	High Efficiency Filter	Phone Number	703 713-9000
Process Type	Filtration	Fax Number	703 713-9101

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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 um. 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

Company Name/POC	ADTECHS, Inc. (a wholly owned subsidiary of JGC Corp.)/Phil Baldwin 2411 Dulles Corner Park Suite 520 Herndon, Virginia 22071		
E-Mail Address			
Product/Service	Polymerization of Heavy Metal Ions	Phone Number	703 713-9000
Process Type	Solidification/Stabilization (Ex Situ)	Fax Number	703 713-9101

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service 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

Company Name/POC	ADTECHS, Inc. (a wholly owned subsidiary of JGC Corp.)/Phil Baldwin 2411 Dulles Corner Park Suite 520 Herndon, Virginia 22071		
E-Mail Address			
Product/Service	Atmospheric Pressure Wet Oxidation	Phone Number	703 713-9000
Process Type	Chemical Reduction	Fax Number	703 713-9101

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service Maturity: Commercial use experience

Performance History: Process has been used at a U.S. Nuclear Power Plant to process organic decontamination liquids.

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

Company Name/POC	ADTECHS, Inc. (a wholly owned subsidiary of JGC Corp.)/Phil Baldwin	
	2411 Dulles-Corner Park	
	Suite 520	
	Herndon, Virginia 22071	
E-Mail Address		
Product/Service	Radionuclide Separation Process (RASEP)	Phone Number 703 713-9000
Process Type	Ion Exchange	Fax Number 703 713-9101

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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.

Source of Information: TechCon

Company Name/POC	AEA Technology/Dr. Mark Neville Building 429 Harwell Laboratory Near Didcot Oxon, OX11 0RA, UK		
E-Mail Address	mark.neville@AEAT.Co.UK		
Product/Service	Physical Separation (Soil Washing)	Phone Number	44 1235 432252
Process Type	Soil Washing	Fax Number	44 1235 432278

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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 harbor 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

Treatment

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: Vendor

Company Name/POC	AEA Technology/Dr. Mark Neville Building 429 Harwell Laboratory Near Didcot Oxon, OX11 0RA, UK		
E-Mail Address	mark.neville@AEAT.Co.UK		
Product/Service	Direct Membrane Cleaning (DMC)	Phone Number	44 1235 432252
Process Type	Electrical Separation	Fax Number	44 1235 432278

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

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.

Product/Service Maturity: Field demo complete

Performance History: Performance data are available.

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.

Comments: 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.

"Other contaminants" identified as: solid/liquid separation(s). Applications include sludge dewatering and solid/liquid separation(s).

Source of Information: Vendor

Company Name/POC AEC/Jan Hyttel, Managing Director
GI Kongevej 131
DK-1850 Frederiksberg C
Denmark

E-Mail Address**Product/Service**

Biogard method

Phone Number 45 31247122**Process Type**

Biodegradation (In Situ)

Fax Number 45 31247222**Contaminants**

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service 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

Company Name/POC	AECL Research/C. A. McDowall Whiteshell Laboratories Pinawa, Manitoba, R0 E1L0, Canada	
E-Mail Address		
Product/Service	Uranium removal from groundwater	Phone Number 204 753-2311
Process Type	Filtration	Fax Number 204 753-2922

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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 harbor 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.

Product/Service 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

Company Name/POC	AECL Research/C. A. McDowall Whiteshell Laboratories Pinawa, Manitoba, R0 E1L0, Canada		
E-Mail Address			
Product/Service	Catalytic Separation	Phone Number	204 753-2311
Process Type	Other	Fax Number	204 753-2922

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service 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

Company Name/POC	Aerojet/Steve Pocock Old Highway 11 East Jonesborough, Tennessee 37659		
E-Mail Address			
Product/Service	Advanced Recyclable Media System	Phone Number	423 753 1200
Process Type	Mechanical Surface Cleaning	Fax Number	423 753-8645

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service Maturity: Commercial use experience

Performance History: Performance Data are available.

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.

Comments: 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

Company Name/POC Aerospatiale/Herve Saul
P.O. BP2
78133 Les Mureaux
Cedex, France

E-Mail Address

Product/Service Plasma Torch
Process Type Vitrification (Ex Situ)

Phone Number 33 1 34 92 39 00

Fax Number 33 1 34 92 11 92

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service 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

Company Name/POC	Airex Corporation/Joseph R. Terry 803 W. Angus Avenue Orange, California 92668		
E-Mail Address			
Product/Service	Retox	Phone Number	714 997-2349
Process Type	Oxidation	Fax Number	714 997-8744

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Regenerative thermal oxidizer - 95% thermal eff., >95% VOC destruction.
Applications: any vapors containing VOC's, also SVE units with vacuum blower and knockout pot.

Product/Service Maturity: Commercial use experience

Performance History: Over 300 units in operation nationwide.

Comments: None.

Source of Information: Vendor

Company Name/POC	Alba Industrie Umweltschutz Service GmbH/Dr. K. Faber Rehrhoferweg 160 D29625 Munster Germany	
E-Mail Address		
Product/Service	Thermo Catalytic Cracking	Phone Number 051 92 96 3212
Process Type	Chemical Reduction	Fax Number 051 92 96 3311

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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

Company Name/POC	Alba Industrie Umweltschutz Service GmbH/Dr. K. Faber Rehrhoferweg 160 D29625 Munster Germany	
E-Mail Address		
Product/Service	Chemical and Physical Treatment of Soil and Groundwater (CPT)	Phone Number 051.92.96.3212
Process Type	Soil Washing	Fax Number 051.92.96.3311

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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

Company Name/POC Alpheus Cleaning Technologies Corp./Scott Stratford
9119 Milliken Avenue
Rancho Cucamonga, CA 91720

E-Mail Address**Product/Service** CO2 Cleanblast/CO2 Miniblast**Phone Number** 909 481 6444**Process Type** Mechanical Surface Cleaning**Fax Number** 909 980-3885**Contaminants**

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

Media

☒ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Company Name/POC	Alternative Remedial Technologies, Inc./Michael Mann 14497 N. Dale Mabry Hwy., Suite 140, Tampa, Florid		
E-Mail Address			
Product/Service	Soil Washing	Phone Number	813 264 3571
Process Type	Soil Washing	Fax Number	813 962-0867

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service 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 no more than 40% clay or silt. 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: Vendor

Company Name/POC	Alvarez Brothers, Inc./Bob Alvarez 2004 S. Laurent P.O. Box 2975 Victoria, Texas 77901		
E-Mail Address			
Product/Service	Bioremediation	Phone Number	512 576-0404
Process Type	Solid Phase Biological Treatment	Fax Number	512 576-2163

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site

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.

Product/Service 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: Vendor

Company Name/POC	Andco Environmental Processes, Inc./Jack Reich 595 Commerce Drive Amherst, New York 14228		
E-Mail Address	andco@localnet.com		
Product/Service	Electrochemical Treatment of Inorganics	Phone Number	716 691-2100
Process Type	Electrical Separation	Fax Number	716 691-2880

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

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.

Product/Service Maturity: Commercial use experience

Performance History: The Gleason Works/Rochester, NY/Dino Giordano/716-473-1000
Xerox Corporation/Webster, NY/Jim Jakubonis/716-422-1090
Lockheed-Martin Corporation/Tucson, AZ/Steve Sexton/602-573-8628
Lockheed-Martin Corporation/Charleston, SC/Sonny Moore/803-747-6331
Chrysler Corporation/Huntsville, AL/Steve Smith/205-464-2132
General Motors/St. Therese, Quebec/John DeCarie/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: Vendor

Company Name/POC	Andco Environmental Processes, Inc./Jack Reich 595 Commerce Drive Amherst, New York 14228		
E-Mail Address	andco@localnet.com	Phone Number	716 691-2100
Product/Service	Electrochemical Treatment	Fax Number	716 691-2880
Process Type	Precipitation		

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: 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 form.

Product/Service Maturity: Commercial use experience

Performance History: Andco has engineered and supplied systems since the early 1970s. The technology has successfully been applied to the removal of heavy metals from cooling tower blowdown, printed circuit board manufacturing, metal finishing, and automotive part suppliers among others. The technology has also been applied to groundwater and surface water cleanups at sites containing both heavy metals alone and heavy metals with organic contaminants. Flowrates typically range from 2 to 2,000 gpm.

Comments: 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: Vendor

Company Name/POC	Applied Membrane Technology, Inc./Stephen Conover 11558 Encore Circle Minnetonka, MN 55343		
E-Mail Address			
Product/Service	AMT Membrane Cartridge System	Phone Number	612 933 5121
Process Type	Membrane Separation	Fax Number	612 933-8839

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service 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: Vendor

Company Name/POC	ARAMSCO/Mark Perry c/o Aramsco 906 Grace St. Elgin, Illinois 60120		
E-Mail Address			
Product/Service	Portable Shot Blast Cleaning System (BLASTRAC)	Phone Number	800 767 9981
Process Type	Mechanical Surface Cleaning	Fax Number	708 741-1218

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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

Treatment

Company Name/POC Arctech, Inc./Dr. Daman Walia
14100 Park Meadow Drive
Chantilly, Virginia 22021

E-Mail Address

Product/Service

Bioremediation

Phone Number 703 222-0280

Process Type

Composting

Fax Number 703 222-0299

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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

Company Name/POC	Arctech, Inc./Dr. Daman Walia 14100 Park Meadow Drive Chantilly, Virginia 22021		
E-Mail Address			
Product/Service	Light Activated Reduction of Chemicals (LARC)	Phone Number	703 222-0280
Process Type	Chemical Reduction	Fax Number	703 222-0299

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☒ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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

Treatment

Company Name/POC Art International, Inc./Werner Steiner, Genya Mallach
100 Ford Road
Denville, New Jersey 07834

E-Mail Address

Product/Service Low Energy Extraction Process (LEEP)

Phone Number 201 627-7601

Process Type Chemical Extraction

Fax Number 201 627-6524

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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

Company Name/POC	Bachy/Michel Gandaïs Les Colonnades - 4 rue H. Sainte-Claire Deville 92563 Rueil Malmaison Cedex, France	
E-Mail Address		
Product/Service	Deep Soil Mixing (COLMIX)	Phone Number 33 1 47 14 26 00
Process Type	Solidification/Stabilization (In Situ)	Fax Number 33 1 47 14 26 26

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service 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: Vendor

Company Name/POC	Barnebey and Sutcliffe Corporation/Customer Service P.O. Box 2526 Columbus, Ohio 43216-2526		
E-Mail Address	activated_carbon@msn.com		
Product/Service	Activated Carbon Technologies	Phone Number	614 258-9501
Process Type	Liquid Phase Carbon Adsorption	Fax Number	614 258-3464

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Off site On site

Brief Description: Supplier of activated carbon products produced from coconut shell, coal, and wood. Manufacturers of carbon adsorption equipment and systems for environmental control and remediation, corrosive gas removal, and indoor air quality. Carbon reactivation and laboratory analysis services available.

Product/Service Maturity: Commercial use experience

Performance History: Over 75 years experience in the manufacturing and use of activated carbon.

Comments: None.

Source of Information: Vendor

Company Name/POC	Barnebey and Sutcliffe Corporation/Customer Service P.O. Box 2526 Columbus, Ohio 43216-2526		
E-Mail Address	activated_carbon@msn.com		Phone Number 614 258-9501
Product/Service	Activated Carbon Technologies	Fax Number 614 258-3464	
Process Type	Vapor-Phase Carbon Adsorption		

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Off site On site

Brief Description: Supplier of activated carbon products produced from coconut shell, coal, and wood. Manufacturers of carbon adsorption equipment and systems for environmental control and remediation, corrosive gas removal, and indoor air quality. Carbon reactivation and laboratory analysis services available.

Product/Service Maturity: Commercial use experience

Performance History: Over 75 years experience in the manufacturing and use of activated carbon.

Comments: None.

Source of Information: Vendor

Company Name/POC	BECO Engineering Co./B.J. Lerner 800 Third Street P.O. Box 443 Oakmont, Pennsylvania 15139		
E-Mail Address			
Product/Service	Alka/Sorb Process	Phone Number	412 828-6080
Process Type	Filtration	Fax Number	412 828-6144

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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

Company Name/POC	Billings & Associates, Inc./Rick M. Billings 6808 Academy Parkway East-NE Suite A4 Albuquerque, New Mexico 87109		
E-Mail Address	RickBillings@aristotle.com		
Product/Service	SVVS (R)	Phone Number	505 345-1116
Process Type	Vacuum Vapor Extraction	Fax Number	505 345-1756

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Combined technology, using sparging and vacuum, protected by three US Patents Nos. (5221,159; 5,227,518; 5,472,294).

Product/Service Maturity: Commercial use experience Field demo complete

Performance History: Initial US Patent. Currently on over 75 UST sites, several have reached maximum clean levels in groundwater in less than three years. Actual site data and system performance on most company sites is located at <http://www.aristotle.com>.

Comments: Technology has been tested and reported by the EPA Site Program and "exceeded vendor claims." Integrated technology that cleans soil, groundwater, and free-phase product. Can be operated remotely (at present 4 sites).

Source of Information: Vendor

Company Name/POC	Bio Solutions, Inc./George J. Kehrberger, Ph.D., P.E. P.O. Box 207 Riverdale, New Jersey 07457	
E-Mail Address		
Product/Service	Soil Slurry - Sequencing Batch Reactor	Phone Number 201 616-1158
Process Type	Slurry Phase Biological Treatment	Fax Number 201 616-1930

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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

Company Name/POC	Bio-Electrics, Inc./E. Sarapuu 1301 Woodswether Kansas City, Missouri 64105		
E-Mail Address			
Product/Service	In-Situ Electro-Enhanced Remediation/Electrofrac	Phone Number	816 474-4895
Process Type	Other	Fax Number	816 842-1245

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: In situ electro-thermal treatment uses volatilization, pyrolysis and fusion to treat the soil. This technology replaces excavation of soil.

Product/Service 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

Company Name/POC	Bio-Genesis Technologies, Inc./Victor Coukoulis 7343 E. Camelback Road Suite D Scottsdale, Arizona 85251		
E-Mail Address	rbmorr19@idt.liberty.com		
Product/Service	GT-1000 Series of Product	Phone Number	602 990-0709
Process Type	Biodegradation (In Situ)	Fax Number	602 990-7745

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: Biotechnology uses natural organisms to cause or promote the breakdown of contaminants, sludge, odor-causing agents, grease and other unwanted components in a variety of processes. In essence, the harmful organic compounds are digested or metabolized using the enzyme actions of living microbes.

Product/Service Maturity: Commercial use experience Field demo complete

Performance History: BIO-G.T. is proud of its client roster. Their marketing strategy is to work closely with distributors and licensed representatives worldwide who have experience and have an established customer base. Some of BIO-G.T.s clients are:

Arizona State University, Bio-GT, Central States, Continental Baking, Environmental Technologies Inc., City of Flagstaff WWTP, City of Tucson, Environmental Waste Solutions, Inc., Honeywell, Long Beach Memorial Hospital, Marriott Corporation, McDonalds Corporation, Mobil Oil Corporation, Pepsi Cola Bottling Co., PEMEX-Mexico, Pizza Hut Corporation, Ralston Purina, and Waste Management, Inc.

Comments: None.

Source of Information: Vendor

Company Name/POC	Bio-Genesis Technologies, Inc./Victor Coukoulis 7343 E. Camelback Road Suite D Scottsdale, Arizona 85251		
E-Mail Address	rbmorr19@idt.liberty.com		
Product/Service	GT-1000 Series of Product	Phone Number	602 990-0709
Process Type	Solid Phase Biological Treatment	Fax Number	602 990-7745

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: Bio-G.T. uses only naturally occurring microbes -- none are genetically altered. Bio-G.T. uses a process of selection and adaptation to find the right microbe to target a specific compound and give it added strength to digest it.

Product/Service Maturity: Commercial use experience Field demo complete

Performance History: BIO-G.T. is proud of its client roster. Their marketing strategy is to work closely with distributors and licensed representatives worldwide who have experience and have an established customer base. Some of BIO-G.T.s clients are:

Arizona State University, Bio-GT, Central States, Continental Baking, Environmental Technologies Inc., City of Flagstaff WWTP, City of Tuscon, Environmental Waste Solutions, Inc., Honeywell, Long Beach Memorial Hospital, Marriott Corporation, McDonalds Corporation, Mobil Oil Corporation, Pepsi Cola Bottling Co., PEMEX-Mexico, Pizza Hut Corporation, Ralston Purina, and Waste Management, Inc.

Comments: None.

Source of Information: Vendor

Company Name/POC	Bio-Genesis Technologies, Inc./Victor Coukoulis 7343 E. Camelback Road Suite D Scottsdale, Arizona 85251		
E-Mail Address	rbmorr19@idt.liberty.com		
Product/Service	GT-1000 Series of Product	Phone Number	602 990-0709
Process Type	Bioreactors	Fax Number	602 990-7745

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: Bio-G.T. uses a proprietary process to culture and manufacture our products that results in a more concentrated microbe population. Culture counts in all of Bio-G.T.'s liquid products always exceed 10(8) per milliliter.

Product/Service Maturity: Commercial use experience Field demo complete

Performance History: BIO-G.T. is proud of its client roster. Their marketing strategy is to work closely with distributors and licensed representatives worldwide who have experience and have an established customer base. Some of BIO-G.T.'s clients are:
Arizona State University, Bio-GT, Central States, Continental Baking, Environmental Technologies Inc., City of Flagstaff WWTP, City of Tucson, Environmental Waste Solutions, Inc., Honeywell, Long Beach Memorial Hospital, Marriott Corporation, McDonalds Corporation, Mobil Oil Corporation, Pepsi Cola Bottling Co., PEMEX-Mexico, Pizza Hut Corporation, Ralston Purina, and Waste Management, Inc.

Comments: None.

Source of Information: Vendor

Company Name/POC	BioGEE International, Inc./Trey Barber Two Park Ten Place 16300 Katy Freeway Suite 100 Houston, Texas 77094-1609		
E-Mail Address			
Product/Service	Bioaugmentation - Solid Phase	Phone Number	800 299-3111
Process Type	Solid Phase Biological Treatment	Fax Number	713 578-1114

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC	BioGEE International, Inc./Trey Barber Two Park Ten Place 16300 Katy Freeway Suite 100 Houston, Texas 77094-1609	
E-Mail Address		
Product/Service	Bioaugmentation	Phone Number 800 299-3111
Process Type	Biodegradation (In Situ)	Fax Number 713 578-1114

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Product/Service 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: Vendor

Company Name/POC	BioGEE International, Inc./Trey Barber Two Park Ten Place 16300 Katy Freeway Suite 100 Houston, Texas 77094-1609	
E-Mail Address		
Product/Service	Drill Cuttings Bioremediation	Phone Number 800 299-3111
Process Type	Slurry Phase Biological Treatment	Fax Number 713 578-1114

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC Biomin, Inc./George Alther
P.O. Box 20028
Ferndale, Michigan 48220

E-Mail Address

Product/Service Prepolishing with Organoclay

Phone Number 810 544-2552

Process Type Other

Fax Number 810 544-3733

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service Maturity: Commercial use experience

Performance History: Hill AFB, Utah - 90,000 lb every 2-3 years (Jeff Watkins 801 777 4924).
Andrews AFB, Battelle

Comments: VOCs are not removed effectively with clay. Use organoclay in the same manner as activated carbon.

"Other contaminants" identified as PNA and PNAH.

Source of Information: Vendor

Company Name/POC	Bionergies Laboratories, Biosurf/M. Jacques FAUDIN 59-100, rue des 4 termes B.P. 1009 Z.I. des Paluds 13781 AUBAGNE Cedex, France	
E-Mail Address		
Product/Service	Bionergies, Biosmose, Biosurf	Phone Number 33 42 84 30 07
Process Type	Biodegradation (In Situ)	Fax Number 33 42 84 23 33

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: Bioremediation of organic pollution in soils (in surface, in depth), water, (lagoons, basins, lakes), effluents (domestic, collective, urban, industrial) by using:

- 1) Exogenous specific bacterial consortium in order to control a full, complete and nonselective biodegradation of the full range of contaminant components. The bacteria are nonpathogenic, environment safe, not genetically engineered, European Federation of Biotechnology class I, produced under French and EEC regulations.
- 2) Biofixations (BIOSMOSE process): mineral natural support, specific to different parameters (microbial, environment, pollutants). They allow the in situ action of the microbial consortia (oxygen source, dispersion limitation, nutrients source...).
- 3) Biosurfactants (BIOSURF process): produced by selected bacteria, they are specific and make the necessary preemulsion of hydrophobic molecules. They implement the bacterial action. BIONERGIES masters this biosurfactant production in industrial processes as well as in the field (bioreactor).

Product/Service Maturity: Commercial use experience

Performance History: Contact company for performance data.

Comments: The BIONERGIES know-how includes the production of biological products (micro-organisms, biosurfactants, nutrients, biofixations) adapted for the treatment (depending on the qualitative and quantitative analysis of effluents and pollutants agents and of the treatment objectives in terms of final concentration, degree of treatment desired, delay and so on).

Each case is analyzed in order to optimize the treatment and the on site materials and personnel. BIONERGIES operates treatment on site by using bioreactor if needed.

BIONERGIES know-how:

*BIOTREATMENT of GREASES:

*restaurants: grease traps, pumping stations, network pipes, waste water collectors

*communities: waste water pipes, water-gates, sanitation, water mains, sewers...

*industries: collection, food and beverage industry: grease tanks; waste water network, waste treatment plant

***BIOTREATMENT of HYDROCARBONS:**

*contaminated water / industrial effluents: waste water, waste water treatment plant, main pipes, unballasting tank waters, trickling water, waste collectors...

*polluted soils: fallow lands, accidental or chronic organic pollutions, service stations...

*oil tank bottom: sludge liquefaction.

Source of Information: International TechCon

Company Name/POC	Bionergies Laboratories, Biosurf/M. Jacques FAUDIN 59-100, rue des 4 termes B.P. 1009 Z.I. des Paluds 13781 AUBAGNE Cedex, France		
E-Mail Address			
Product/Service	Bionergies, Biosmose, Biosurf	Phone Number	33 42 84 30 07
Process Type	Slurry Phase Biological Treatment	Fax Number	33 42 84 23 33

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: Bioremediation of organic pollution in soils (in surface, in depth), water, (lagoons, basins, lakes), effluents (domestic, collective, urban, industrial) by using:

- 1) Exogenous specific bacterial consortium in order to control a full, complete and nonselective biodegradation of the full range of contaminant components. The bacteria are nonpathogenic, environment safe, not genetically engineered, European Federation of Biotechnology class I, produced under French and EEC regulations.
- 2) Biofixations (BIOSMOSE process): mineral natural support, specific to different parameters (microbial, environment, pollutants). They allow the in situ action of the microbial consortia (oxygen source, dispersion limitation, nutrients source...).
- 3) Biosurfactants (BIOSURF process): produced by selected bacteria, they are specific and make the necessary preemulsion of hydrophobic molecules. They implement the bacterial action. BIONERGIES masters this biosurfactant production in industrial processes as well as in the field (bioreactor).

Product/Service Maturity: Commercial use experience

Performance History: Contact company for performance data.

Comments: The BIONERGIES know-how includes the production of biological products (micro-organisms, biosurfactants, nutrients, biofixations) adapted for the treatment (depending on the qualitative and quantitative analysis of effluents and pollutants agents and of the treatment objectives in terms of final concentration, degree of treatment desired, delay and so on).

Each case is analyzed in order to optimize the treatment and the on site materials and personnel. BIONERGIES operates treatment on site by using bioreactor if needed.

BIONERGIES know-how:

*BIOTREATMENT of GREASES:

*restaurants: grease traps, pumping stations, network pipes, waste water collectors

*communities: waste water pipes, water-gates, sanitation, water mains, sewers...

*industries: collection, food and beverage industry: grease tanks, waste water network, waste treatment plant

***BIOTREATMENT of HYDROCARBONS:**

*contaminated water / industrial effluents: waste water, waste water treatment plant, main pipes, unballasting tank waters, trickling water, waste collectors...

*polluted soils: fallow lands, accidental or chronic organic pollutions, service stations...

*oil tank bottom: sludge liquefaction.

Source of Information: International TechCon

Company Name/POC	Bionergies Laboratories, Biosurf/M. Jacques FAUDIN 59-100, rue des 4 termes B.P. 1009 Z.I. des Paluds 13781 AUBAGNE Cedex, France		
E-Mail Address			
Product/Service	Bionergies, Biosmose, Biosurf	Phone Number	33 42 84 30 07
Process Type	Bioreactors	Fax Number	33 42 84 23 33

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: Bioremediation of organic pollution in soils (in surface, in depth), water, (lagoons, basins, lakes), effluents (domestic, collective, urban, industrial) by using:

- 1) Exogenous specific bacterial consortium in order to control a full, complete and nonselective biodegradation of the full range of contaminant components. The bacteria are nonpathogenic, environment safe, not genetically engineered, European Federation of Biotechnology class I, produced under French and EEC regulations.
- 2) Biofixations (BIOSMOSE process): mineral natural support, specific to different parameters (microbial, environment, pollutants). They allow the in situ action of the microbial consortia (oxygen source, dispersion limitation, nutrients source...).
- 3) Biosurfactants (BIOSURF process): produced by selected bacteria, they are specific and make the necessary preemulsion of hydrophobic molecules. The implement the bacterial action. BIONERGIES masters this biosurfactant production in industrial processes as well as in the field (bioreactor).

Product/Service Maturity: Commercial use experience

Performance History: Contact company for performance data.

Comments: The BIONERGIES know-how includes the production of biological products (micro-organisms, biosurfactants, nutrients, biofixations) adapted for the treatment (depending on the qualitative and quantitative analysis of effluents and pollutants agents and of the treatment objectives in terms of final concentration, degree of treatment desired, delay and so on).

Each case is analyzed in order to optimize the treatment and the on site materials and personnel. BIONERGIES operates treatment on site by using bioreactor if needed.

BIONERGIES know-how:

*BIOTREATMENT of GREASES:

*restaurants: grease traps, pumping stations, network pipes, waste water collectors

- *communities: waste water pipes, water-gates, sanitation, water mains, sewers...
- *industries: collection, food and beverage industry: grease tanks, waste water network, waste treatment plant

*BIOTREATMENT of HYDROCARBONS:

- *contaminated water / industrial effluents: waste water, waste water treatment plant, main pipes, unballasting tank waters, trickling water, waste collectors...
- *polluted soils: fallow lands, accidental or chronic organic pollutions, service stations...
- *oil tank bottom: sludge liquefaction.

Source of Information: International TechCon

Company Name/POC	Bioremediation Technology Services/Paul Richey P.O. Box 3246 Sonora, California 95370		
E-Mail Address			
Product/Service	Bioremediation Technology Services (BTS)	Phone Number	209 984-4963
Process Type	Solid Phase Biological Treatment	Fax Number	209 984-3226

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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 weekswill have destroyed the contaminate converting it into CO2 and water. The same process reduces chlorinated hydrocarbons to levels approved by the EPA.

Product/Service 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: Vendor

Treatment

Company Name/POC Bioscience, Inc./T.G. Zitrides
1550 Valley Center Parkway
Suite 140
Bethlehem, Pennsylvania 18017

E-Mail Address

Product/Service Bioslurry
Process Type Slurry Phase Biological Treatment

Phone Number 610 974-9693

Fax Number 610 691-2170

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: Suspend highly concentrated sludges in water, aerate, settle, separate. Semi-continuous process.

Product/Service Maturity: Commercial use experience

Performance History: In use since 1984. Clients included: Environmental Science and Engineering, Inc.; Bethlehem Steel Corporation-Burns Harbor, IN; Woodward Clyde Consultants-Plymouth Meeting, PA; El Camino Crop Supply-Gilroy, CA; ATEC-Columbia, MD; R.E. Wright-Middletown, PA; U.S. Army Corps of Engineers; and numerous others.

Comments: None.

Other contaminants identified as heavy sludges and creosote.

Source of Information: Vendor

Company Name/POC	Bioscience, Inc./T.G. Zitrides 1550 Valley Center Parkway Suite 140 Bethlehem, Pennsylvania 18017		
E-Mail Address			
Product/Service	Biopile Treatment System	Phone Number	610 974-9693
Process Type	Bioventing	Fax Number	610 691-2170

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: In situ or ex situ soil treatment for removal of VOC's with simultaneous stimulation of microbial degeneration of organics in situ.

Product/Service Maturity: Commercial use experience

Performance History: In use since 1984. Clients included: Environmental Science and Engineering, Inc.; Bethlehem Steel Corporation-Burns Harbor, IN; Woodward Clyde Consultants-Plymouth Meeting, PA; El Camino Crop Supply-Gilroy, CA; ATEC-Columbia, MD; R.E. Wright-Middletown, PA; U.S. Army Corps of Engineers; and numerous other confidential organizations.

Comments: None.

Source of Information: Vendor

Treatment

Company Name/POC Bioscience, Inc./T.G. Zitrides
1550 Valley Center Parkway
Suite 140
Bethlehem, Pennsylvania 18017

E-Mail Address

Product/Service Microcat (R) - XBS/NPN/SH/SL/PH

Phone Number 610 974-9693

Process Type Biodegradation (In Situ)

Fax Number 610 691-2170

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: Biotreatment additives to control soil/water conditions and stimulate microbial growth.

Product/Service Maturity: Commercial use experience

Performance History: Extensive range of applications. Contact vendor for more information.

Comments: None.

Source of Information: Vendor

Company Name/POC	Bioscience, Inc./T.G. Zitrides 1550 Valley Center Parkway Suite 140 Bethlehem, Pennsylvania 18017		
E-Mail Address			
Product/Service	Bioreactors	Phone Number	610 974-9693
Process Type	Bioreactors	Fax Number	610 691-2170

Contaminants

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

Media

☒ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: On site

Brief Description: Totally-enclosed, modular, factory-fabricated biotreaters. Capable of aerobic/anoxic/anaerobic operation.

Product/Service Maturity: Field demo complete

Performance History: Contact vendor for performance data.

Comments: None.

Source of Information: Vendor

Treatment

Company Name/POC Bioscience, Inc./T.G. Zitrides
1550 Valley Center Parkway
Suite 140
Bethlehem, Pennsylvania 18017

E-Mail Address

Product/Service Microcat - EZ (EZDM)

Phone Number 610 974-9693

Process Type Solidification/Stabilization (Ex Situ)

Fax Number 610 691-2170

Contaminants

- ☒ Pesticides/Herbicides
- ☒ Petroleum Hydrocarbons
- ☐ Nonhalogenated VOC

- ☐ Heavy Metals
- ☐ Radionuclides
- ☐ Halogenated VOC

- ☒ PCB
- ☐ SVOC
- ☐ N/A

- ☒ Explosives/Propellants
- ☒ Other Contaminant

Media

- ☐ Surface Impoundment
- ☐ Construction Materials/Debris
- ☒ Sediments in Water
- ☒ Process Wastes and Sludge

- ☒ Soil
- ☐ Landfills
- ☐ Vapor Phase

- ☐ Process Water
- ☐ Drums/Tanks/Piping
- ☐ Free Product

- ☐ Surface Water
- ☐ Containers/Equipment
- ☐ Ground Water

Application: Ex-situ Off site On site

Brief Description: Microcat-EZ is an additive to the Soil-Cement process for the solidification of soil. It is a compound of over 10 different inorganic materials.

As soil is treated by cement with Microcat-EZ, cement hydrate penetrates deep into soil particles and connects the soil particles via fine needle-like crystals grown from the surface of the particle. This creates a porous structure which exhibits ion exchange capability and adsorptivity excellent for capturing hazardous heavy metal ions from contaminated soil or from groundwater.

Microcat-EZ treated soil will continue the reaction of hydration over a long period of time and will maintain its strength, thus preventing possible erosion by acids or alkalis.

Product/Service Maturity: Commercial use experience

Performance History: Hydrocarbon and metal contaminated soils, sludges and drilling muds.

Comments: None.

Source of Information: Vendor

Company Name/POC	Bioscience, Inc./T.G. Zitrides 1550 Valley Center Parkway Suite 140 Bethlehem, Pennsylvania 18017		
E-Mail Address			
Product/Service	Microcat - EZ (EZDM)	Phone Number	610 974-9693
Process Type	Solidification/Stabilization (In Situ)	Fax Number	610 691-2170

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: Microcat-EZ is an additive to the Soil-Cement process for the solidification of soil. It is a compound of over 10 different inorganic materials.

As soil is treated by cement with Microcat-EZ, cement hydrate penetrates deep into soil particles and connects the soil particles via fine needle-like crystals grown from the surface of the particle. This creates a porous structure which exhibits ion exchange capability and adsorptivity excellent for capturing hazardous heavy metal ions from contaminated soil or from groundwater.

Microcat-EZ treated soil will continue the reaction of hydration over a long period of time and will maintain its strength, thus preventing possible erosion by acids or alkalis.

Product/Service Maturity: Commercial use experience

Performance History: Hydrocarbon and metal contaminated soils, sludges and drilling muds.

Comments: None.

Source of Information: Vendor

Company Name/POC	Bioscience, Inc./T.G. Zitrides 1550 Valley Center Parkway Suite 140 Bethlehem, Pennsylvania 18017		
E-Mail Address			
Product/Service	Biostimulation	Phone Number	610 974-9693
Process Type	Biodegradation (In Situ)	Fax Number	610 691-2170

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: In situ biostimulation for soil, groundwater, surface water. Injection of biostimulants and mobilizers; extraction of water to biotreater; reinjection to subsurface.

Product/Service Maturity: Commercial use experience

Performance History: In use since 1984. Clients included: Environmental Science and Engineering, Inc.; Bethlehem Steel Corporation-Burns Harbor, IN; Woodward Clyde Consultants-Plymouth Meeting, PA; ATEC-Columbia, MD; R.E. Wright-Middletown, PA; U.S. Army Corps of Engineers; and numerous other confidential organizations.

Comments: None.

Source of Information: Vendor

Company Name/POC	Bioscience, Inc./T.G. Zitrides 1550 Valley Center Parkway Suite 140 Bethlehem, Pennsylvania 18017		
E-Mail Address			
Product/Service	Biofarming	Phone Number	610 974-9693
Process Type	Solid Phase Biological Treatment	Fax Number	610 691-2170

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Semi-solid mixing, aeration of contaminated soil matrix to stimulate biodegradation.

Product/Service Maturity: Commercial use experience

Performance History: In use since 1984. Clients included: Environmental Science and Engineering, Inc.; Bethlehem Steel Corporation-Burns Harbor, IN; Woodward Clyde Consultants-Plymouth Meeting, PA; El Camino Crop Supply-Gilroy, CA; ATEC-Columbia, MD; R.E. Wright-Middletown, PA; U.S. Army Corps of Engineers; and numerous others.

Comments: None.

Source of Information: Vendor

Company Name/POC	Biotol LTD./Dr. Philip Caunt 5 Chiltern Close Cardiff Industrial Park, Cardiff Glanorgan South W CF4 5DL, UK		
E-Mail Address			
Product/Service	White Rot Fungi For the Treatment of Recalcitrant Organics in Soil	Phone Number	1222 766716
Process Type	White Rot Fungus	Fax Number	1222 766945

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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

Company Name/POC	BioTrol, Inc./Dennis D. Chilcote 10300 Valley View Road, Suite 107 Eden Prairie, MN 55344-3546		
E-Mail Address			
Product/Service	Soil Washing	Phone Number	612 942-8032
Process Type	Soil Washing	Fax Number	612 942-8526

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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

Treatment

Company Name/POC	Bodem Sanering B.V./Mr. Bilsma or Mr. Olive BSN Wetering #2 6002 SM Weert Netherlands		
E-Mail Address			
Product/Service	High Pressure Water Jet	Phone Number	011 31 49 504 3035
Process Type	Soil Washing	Fax Number	011 31 49554 3035

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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).

Product/Service 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

Company Name/POC	BodemSanering Nederland BV/L. Biljsma Postbus 10128, 6000 GC Weert The Netherlands		
E-Mail Address			
Product/Service	Soil Washing Pressure jet	Phone Number	011 31 49 504 3035
Process Type	Soil Washing	Fax Number	011 31 49554 3035

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service Maturity: Commercial use experience

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

Comments: None.

Source of Information: International TechCon

Treatment

Company Name/POC	Bogart Environmental Services, Inc./Jim League P.O. Box 717 Mt. Juliet, Tennessee 37122	
E-Mail Address		
Product/Service	Bevrox Biotreatment Train Process	Phone Number 615 754-2847
Process Type	Slurry Phase Biological Treatment	Fax Number 615 754-2843

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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 slurring system for reuse.

Product/Service 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: Vendor

Company Name/POC	Bohn Biofilter Corp./Dr. Hinrich Bohn P.O. Box 44235 Tucson, Arizona 85733-4235		
E-Mail Address			
Product/Service	Off-Gas Treatment	Phone Number	520 621-7225
Process Type	Biofiltration	Fax Number	520 621-1647

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: Bohn Biofilter Corp. (BBC) has developed permanent and 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.

Product/Service 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: Vendor

Company Name/POC	Brice Environmental Services Corporation (BESCOP)/Craig Jones PO Box 73520 Fairbanks, Alaska 99707		
E-Mail Address			
Product/Service	Soil Washing	Phone Number	907 456-1955
Process Type	Soil Washing	Fax Number	907 452-5018

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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

Company Name/POC	British Columbia Research Corporation/Dr. James Hill 3650 Wesbrook Mall Vancouver, Canada V6S 2L2		
E-Mail Address	Hill@bcr.bc.ca		
Product/Service	Fly Ash Stabilization Process	Phone Number	604 224-4331
Process Type	Solidification/Stabilization (Ex Situ)	Fax Number	604 224-0540

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: On site

Brief Description: BCRI's Ash Stabilization Process is an accelerated natural chemical process designed to prevent the leaching of heavy metals from incinerator ash or other waste materials. The process was specifically developed for use with fly ash in municipal solid waste incinerators. The process enables ash disposal at greatly reduced costs in regular landfills rather than in special facilities for handling hazardous waste. The process can be deployed in batch or continuous operation modes.

Product/Service Maturity: Pilot plant testing

Performance History: Pilot operation met all regulatory requirements (e.g., 5<ppm lead) for disposal.

Comments: BCRI's process has significantly lower capital costs, lower operating and chemical supply costs, and allows lower cost disposal options.

Source of Information: Vendor

Company Name/POC	British Columbia Research Corporation/Dr. James Hill 3650 Wesbrook Mall Vancouver, Canada V6S 2L2		
E-Mail Address	Hill@bcr.bc.ca		
Product/Service	Sono-Chemical Treatment Process	Phone Number	604 224-4331
Process Type	Other	Fax Number	604 224-0540

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: BCRI has entered into an exclusive world wide license agreement with Arc Sonics to exploit the use of a patented low frequency sonic energy generator. This technology was originally developed for the grinding of ores with high feed rates and improved quality. Since this time, other possible areas of application including: enhanced oxidation, and synthetic chemistry have been found. BCRI develops and markets the technology for industrial chemistry and treatment processes. BCRI is also the technical applications partner to Arc Sonics for all applications of the core technology. Both a research prototype and commercial scale unit are in operation at BCRI. The use of sonic energy to accelerate reactions and make compounds more reactive has been established at high frequencies with ultrasound equipment. However, this is of little practical interest due to the high energy requirements and the limitation on application size. Low frequency sonic energy enables high through flows of materials in commercial quantities but until the development of the Arc Sonics technology no reliable and sustainable method of generating low frequency sonic energy existed.

Product/Service Maturity: Commercial use experience Pilot plant testing

Performance History: Pilot operation has shown excellent results.

Comments: This process has significantly improved treatment effectiveness and allows lower cost disposal options.

Source of Information: Vendor

Company Name/POC	British Nuclear Fuels plc/Janet Jackson H242 Hinton House Risley, Warrington Cheshire, England WA3 6AS		
E-Mail Address			
Product/Service	Cacitox Soil Washing Process	Phone Number	44 1925 835721
Process Type	Soil Washing	Fax Number	44 1925 835722

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Company Name/POC	British Nuclear Fuels plc/Janet Jackson H242 Hinton House Risley, Warrington Cheshire, England WA3 6AS	
E-Mail Address		
Product/Service	Electrochemical Decontamination Tank	Phone Number 44 1925 835721
Process Type	Electrical Separation	Fax Number 44 1925 835722

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service 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: Vendor

Company Name/POC British Nuclear Fuels plc/Janet Jackson
H242 Hinton House
Risley, Warrington Cheshire, England WA3 6AS

E-Mail Address**Product/Service****Process Type**

Glovebox Mounted Vacuum Cleaner

Mechanical Surface Cleaning

Phone Number 44 1925 835721**Fax Number** 44 1925 835722**Contaminants**

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC	British Nuclear Fuels plc/Janet Jackson H242 Hinton House Risley, Warrington Cheshire, England WA3 6AS		
E-Mail Address			
Product/Service	Chemical Decontamination of Metals	Phone Number	44 1925 835721
Process Type	Chemical Surface Cleaning	Fax Number	44 1925 835722

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service Maturity: Commercial use experience

Performance History: Several thousand metric tons 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: Vendor

Company Name/POC	Brown & Root Environmental (previously known as Halliburton NUS Env. Corp.)/Mark Spencer 4100 Clinton Drive Houston, Texas 77020		
E-Mail Address			
Product/Service	Subsurface Volatilization and Ventilation System	Phone Number	713 676-3011
Process Type	Oxygen Enhancement with Air Sparging	Fax Number	713 676-4109

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service 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 Russall, 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

Company Name/POC	Carl Bro Energy & Environment/Nils Bull/Torsten Toksvad Granskoven 8 DK-2600 Glostrup, Denmark		
E-Mail Address			
Product/Service	In Situ Soil Ventilation and Heating	Phone Number	45 43 48 60 60
Process Type	Air Sparging	Fax Number	45 43 96 44 14

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service Maturity: Commercial use experience

Performance History: Contact company for performance history.

Comments: None.

Source of Information: Vendor

Treatment

Company Name/POC	Carlo Environmental Technologies, Inc./Keith Flemingloss 44907 Trinity Drive Clinton Township, Michigan 48038		
E-Mail Address			
Product/Service	Medium Temperature Thermal Desorption	Phone Number	810 468 9580
Process Type	Low Temperature Thermal Desorption	Fax Number	810 468-9589

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ

Brief Description: Carlo Environmental Technologies, Inc., operates a portable medium temperature thermal desorption technology to remediate and recycle petroleum contaminated soils. Medium temperature thermal desorption is an ex-situ process using direct heat exchange to heat the waste material in order to volatilize the organic contaminants. The remediation plant is designed to handle soil contaminated with non-recycle, light distillate hydrocarbons including gasoline, jet fuel, diesel oil or up to No. 4 fuel oil. The unit is used to process most all soil types including clays and specialty materials such as drilling muds, slags and soils with high content of mesh fines. The volatilized organic materials are separated from the solids, creating a purge gas, which upon exit is treated by an off gas treatment system. The organic materials in this purge gas are destroyed in an afterburner.

Product/Service Maturity: Commercial use experience

Performance History: Contact vendor for performance data.

Comments: The design treatment capacity of the system is 30 tons per hour of contaminated soil. The gas output from the baghouse is induced through an exhaust fan into a thermal oxidizer/stack which reduces the hydrocarbon content of the gas stream with a destruction and removal efficiency (DRE) of 99%.

Source of Information: Vendor

Company Name/POC	CDS Research Ltd./Dr. Zoher Meratla 20 Brookbank Ave. North Vancouver, B.C. V7J2B8, Canada		
E-Mail Address			
Product/Service	Cryogenics	Phone Number	604 985-2865
Process Type	Containment	Fax Number	604 985-2812

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service 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

Company Name/POC CHEM-SECURITY (Alberta) Ltd./Art Mathes
#4 Manning Close N.E.
Calgary, Alberta, Canada T2E 7N5

E-Mail Address**Product/Service**

Waste Stabilization and Solidification

Phone Number 403 235-8361**Process Type**

Solidification/Stabilization (Ex Situ)

Fax Number 403 248-3430**Contaminants**

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Off site**Brief Description:** A fully functional 10,000 T.P.Y. facility which provided processes for immobilizing leachable materials through the use of specially formulated binders and additives.**Product/Service Maturity:** Commercial use experience**Performance History:** Please contact company for performance data.**Comments:** These processes are offered a part of the services provided by the Alberta Waste Treatment Centre, a fully integrated waste treatment and disposal facility located in Alberta, Canada.**Source of Information:** Vendor

Company Name/POC CHEM-SECURITY (Alberta) Ltd./Art Mathes
#4 Manning Close N.E.
Calgary, Alberta, Canada T2E 7N5

E-Mail Address

Product/Service

High Temperature Incineration

Phone Number 403 235-8361

Process Type

Incineration

Fax Number 403 248-3430

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Off site

Brief Description: Two high temperature rotary kiln incineration systems for the treatment of organic wastes including PCB waste. Also, a patented indirectly fired retort furnace for the decontamination of PCB contaminated transformers and other materials to enable recycling.

Product/Service Maturity: Commercial use experience

Performance History: Please contact company for performance data.

Comments: These processes are offered a part of the services provided by the Alberta Waste Treatment Centre, a fully integrated waste treatment and disposal facility located in Alberta, Canada.

Source of Information: Vendor

Company Name/POC CHEM-SECURITY (Alberta) Ltd./Art Mathes
#4 Manning Close N.E.
Calgary, Alberta, Canada T2E 7N5

E-Mail Address

Product/Service Transformer Furnace

Phone Number 403 235-8361

Process Type Low Temperature Thermal Desorption

Fax Number 403 248-3430

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Off site

Brief Description: A patented indirectly fired retort furnace for the decontamination of PCB contaminated transformers and other materials to enable recycling.

Product/Service Maturity: Commercial use experience

Performance History: Please contact company for performance data.

Comments: These processes are offered a part of the services provided by the Alberta Waste Treatment Centre, a fully integrated waste treatment and disposal facility located in Alberta, Canada.

Source of Information: Vendor

Company Name/POC: CHEM-SECURITY (Alberta) Ltd./Art Mathes
#4 Manning Close N.E.
Calgary, Alberta, Canada T2E 7N5

E-Mail Address

Product/Service

Neutralization, Oxidation, Precipitation

Phone Number 403 235-8361

Process Type

Chemical Oxidation

Fax Number 403 248-3430

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Off site

Brief Description: Neutralization - addition of acids or bases to a waste stream to create neutral salt solutions.
Oxidation - Oxidizing agents are added to the waste stream to break chemical bonds and convert hazardous components into less toxic substances.
Precipitation - Chemical flocculation techniques to separate solids from liquids.

Product/Service Maturity: Commercial use experience

Performance History: Please contact company for performance data.

Comments: These processes are offered a part of the services provided by the Alberta Waste Treatment Centre, a fully integrated waste treatment and disposal facility located in Alberta, Canada.

Source of Information: Vendor

Company Name/POC CHEM-SECURITY (Alberta) Ltd./Art Mathes
#4 Manning Close N.E.
Calgary, Alberta, Canada T2E 7N5

E-Mail-Address

Product/Service Neutralization, Reduction, Precipitation

Phone Number 403 235-8361

Process Type Chemical Reduction

Fax Number 403 248-3430

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Off site

Brief Description: Neutralization - addition of acids or bases to a waste stream to create neutral salt solutions.

Reduction - Reducing agents are added to the waste stream to break chemical bonds and convert hazardous components into less toxic substances.

Precipitation - Chemical flocculation techniques to separate solids from liquids.

Product/Service Maturity: Commercial use experience

Performance History: Please contact company for performance data.

Comments: These processes are offered as part of the services provided by the Alberta Waste Treatment Centre, a fully integrated waste treatment and disposal facility located in Alberta, Canada.

Source of Information: Vendor

Company Name/POC	Chemetrics, Inc./Rick Ferris Rt. 28 Calverton, Virginia 22016		
E-Mail Address			
Product/Service	Chemets	Phone Number	540 788-9026
Process Type	Biodegradation (In Situ)	Fax Number	540 788-4856

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Other Application

Brief Description: Test kit and instruments to determine contaminants, mainly inorganic.

Product/Service Maturity: Commercial use experience

Performance History: Products have been in use worldwide for over 25 years.

Comments: None.

Source of Information: Vendor

Company Name/POC ChemPete, Inc./John Peterson
405 E. Pierce Street
Elburn, Illinois 60119

E-Mail Address

Product/Service

Bioremediation

Phone Number 708 365-2007

Process Type

Biodegradation (In Situ)

Fax Number 708 365-9099

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Product/Service 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

Company Name/POC	Clyde Engineering Services/Robert Clyde P.O. Box 740644 New Orleans, Louisiana 70174		
E-Mail Address			
Product/Service	Bioremediation	Phone Number	504 362-7929
Process Type	White Rot Fungus	Fax Number	N/A

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application:

Brief Description: Patent 4,530,763 by Clyde-Whipple covers bacteria on fibers to remove toxic metals. We have found that Zymomonas on Tyvek fiber removes lead and Cr6 in two seconds. Others have found that uranium, strontium, and cesium can be removed with bacteria.

Product/Service Maturity:

Performance History: Bench scale tests only have been performed, but we see no reason it couldn't be scaled up.

Comments: All bacteria are not poisonous, in fact, Zymomonas has been found to be therapeutic for stomach problems. When bacteria alone are used, they are hard to filter, but when immobilized on fibers, continuous runs can be made.

Source of Information: Vendor

Company Name/POC Clyde Engineering Services/Robert Clyde
P.O. Box 740644
New Orleans, Louisiana 70174

E-Mail Address**Product/Service****Process Type**

Biofiltration

Biofiltration

Phone Number 504 362-7929**Fax Number** N/A**Contaminants**

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On site**Brief Description:** This technology uses the zymomonas family of bacteria attached to tyvek fibers to remove lead, Cr6, uranium, strontium and cesium from water.**Product/Service Maturity:** Bench scale testing only**Performance History:** Bench-scale testing only.**Comments:** When bacteria alone are used, they are hard to filter, but when immobilized on fibers, continuous runs can be made.**Source of Information:** Vendor

Company Name/POC Clyde Engineering Services/Robert Clyde
P.O. Box 740644
New Orleans, Louisiana 70174

E-Mail Address

Product/Service Bioremediation

Phone Number 504 362-7929

Process Type White Rot Fungus

Fax Number N/A

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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 enzymes provided by the fungus degrades the chlorinated compounds present in the media.

Product/Service 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.

The fungus also degrades PAH's (poly cyclic aromatic hydrocarbons).

Source of Information: Vendor

Company Name/POC	COGNIS, Inc./Dr. K. Mackay 2331 Circadian Way Santa Rosa, California 95407		
E-Mail Address			
Product/Service	Bioremediation	Phone Number	707 575-7155
Process Type	Biodegradation (In Situ)	Fax Number	707 575-7833

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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.

January 1997

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Environmental Cleanup Privatization
Products and Services Directory

Source of Information: Vendor

Treatment

Company Name/POC COGNIS, Inc./Dr. William E. Fristad
2331 Circadian Way
Santa Rosa, California 95407

E-Mail Address

Product/Service

Soil Washing-TERRAMET

Phone Number 707 576-6235

Process Type

Soil Washing

Fax Number 707 575-7833

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC	COGNIS, Inc./Ron Wilson 2331 Circadian Way Santa Rosa, California 95407		
E-Mail Address			
Product/Service	Bioremediation	Phone Number	707 575-7155
Process Type	Solid Phase Biological Treatment	Fax Number	707 575-7833

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Treatment

Company Name/POC COGNIS, Inc./Ron Wilson
2331 Circadian Way
Santa Rosa, California 95407

E-Mail Address

Product/Service

Process Type

Slurry Phase Bioremediation

Slurry Phase Biological Treatment

Phone Number 707 575-7155

Fax Number 707 575-7833

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC	Compact Membrane Systems, Inc./Dr. Stuart Nemser 325 Hampton Road Wilmington, Delaware 19803		
E-Mail Address			
Product/Service	Off-Gas Treatment	Phone Number	302 984-1762
Process Type	Membrane Separation	Fax Number	302 984-1763

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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).

Product/Service 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

Company Name/POC Container Products Corporation/J. Hughes, J. King, J. Grantham
P.O. Box 3767
Wilmington, North Carolina 28406

E-Mail Address

Product/Service SCARP Coatings Removal System

Phone Number 910 392-6100

Process Type Mechanical Surface Cleaning

Fax Number 910 392-6778

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service Maturity: Field demo complete

Performance History: Contact company for performance data.

Comments: None.

Source of Information: TechCon

Company Name/POC	Container Products Corporation/J. King, J. Hughes, J. Grantham P.O. Box 3767 Wilmington, North Carolina 28406		
E-Mail Address			
Product/Service	KELLY Decon Glove Booth	Phone Number	910 392-6100
Process Type	Mechanical Surface Cleaning	Fax Number	910 392-6778

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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 psig

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

Company Name/POC	ConTeck Environmental Services, Inc./Chris Kreger 22460 Highway 169 NW Elk River, Minnesota 55330		
E-Mail Address	ConTeck@IXNetcom.com		
Product/Service	Environmental Clean up and Construction	Phone Number	612 441-4965
Process Type	Low Temperature Thermal Desorption	Fax Number	612 441-0135

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: ConTeck Environmental Services, Inc., provides "turn-key" services for environmental construction projects, and environmental consultation services for civil construction projects. The company specializes in soil remediation projects requiring thermal treatment options-with special emphasis upon cleaning hydrocarbon-contaminated soil with on-site Low Temperature Thermal Volatilization (LTTV). ConTeck has designed, built, and tested a low-temperature volatilization plant. The plant has successfully operated at throughput volumes of 55 tons/hour and can generate a consistent temperature up to 950 degrees Fahrenheit.

The thermal unit has an afterburner, cyclones and a baghouse for air emissions control and pollution prevention. When the thermal plant has finished processing the contaminated soil, depending upon the contaminants, little or no residual volatile organics remain in the soil.

Product/Service Maturity: Commercial use experience.

Performance History: Work history includes: Kelley Air Force Base, Texas - Cleaned wet clay soils contaminated with JP-4 and hydraulic fluids. Cleanup level was less than 10 ppm using EPA Modified 418.1. Grain Belt Brewery, Minneapolis, Minnesota - Cleaned fuel oil-contaminated soils to less than .005 ppm BETX and less than 5 ppm. for fuel oil using EPA Method 8020.

Minnesota Department of Transportation, Champlin Minnesota - Cleaned fuel oil and gasoline-contaminated soils to less than 0.10 ppm BETX, less than .5 ppm for gasoline and less than 5.0 ppm for fuel oil using EPA Method 8020 and modified 8020.

Minnesota Department of Natural Resources, Montrose, Minnesota - Treated gasoline-contaminated soils to less than .010 ppm BETX, and less than .5 ppm gasoline using EPA Method 8020 and modified 8020.

Comments: None.

Source of Information: Vendor

Company Name/POC	Corpex Technologies Inc./Vance Syphers 5400 S. Miami Boulevard Suite 154 Durham, North Carolina 27703		
E-Mail Address			
Product/Service	Soil Washing	Phone Number	919 941-0847
Process Type	Soil Washing	Fax Number	919 941-0652

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: The CORPEX (R) Nuclear Decontamination Process is based on the use of various aqueous based, near neutral pH, and environmentally friendly reagents. The reagents remove oil, grease and grime and dissolve metal oxide layers from any surface. The CORPEX (R) Nuclear Decontamination Process is typically a two step process: oil, grease and grime are removed from surfaces with heavy duty, low foam industrial cleaner degreasers; metal oxide layers are removed with a patented molecular structure. The CORPEX (R) Nuclear Decontamination Process may be applied to: piping systems and their components, such as, pumps, valves, tanks and heat exchangers; fuel pools or basins; hot cells, manipulators, gloveboxes; scrap metal, tools and components.

Product/Service Maturity: Field demo complete Bench scale testing only

Performance History: The CORPEX (R) Nuclear Decontamination Process and its predecessors have successfully decontaminated hot cells, primary piping systems, lead shielding and various contaminated components and scrap metal.

Comments: The CORPEX (R) Nuclear Decontamination Process is very flexible and can be tailored to the waste disposal needs of the client's facilities. The systems used to deliver the chemistry are self contained and require deionized water and electric power (pumps and heaters). No permits are required to use the chemistry, the application of the chemistry is normally provided by an applicator licensed to use the CORPEX products. Bids are usually fixed priced and performance based.

Source of Information: Vendor

Company Name/POC Corpex Technologies Inc./Vance Syphers
5400 S. Miami Boulevard
Suite 154
Durham, North Carolina 27703

E-Mail Address

Product/Service Chemical Surface Cleaning

Phone Number 919 941-0847

Process Type Chemical Surface Cleaning

Fax Number 919 941-0652

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: The CORPEX (R) Nuclear Decontamination Process is based on the use of various aqueous based, near neutral pH, and environmentally friendly reagents. The reagents remove oil, grease and grime and dissolve metal oxide layers from any surface. The CORPEX (R) Nuclear Decontamination Process is typically a two step process: oil, grease and grime are removed from surfaces with heavy duty, low foam industrial cleaner degreasers; metal oxide layers are removed with a patented molecular structure.

The CORPEX (R) Nuclear Decontamination Process may be applied to: piping systems and their components, such as, pumps, valves, tanks and heat exchangers; fuel pools or basins; hot cells, manipulators, gloveboxes; scrap metal, tools and components.

Product/Service Maturity: Field demo complete Bench scale testing only

Performance History: The CORPEX (R) Nuclear Decontamination Process and its predecessors have successfully decontaminated hot cells, primary piping systems, lead shielding and various contaminated components and scrap metal.

Comments: The CORPEX (R) Nuclear Decontamination Process is very flexible and can be tailored to the waste disposal needs of the client's facilities. The systems used to deliver the chemistry are self contained and require deionized water and electric power (pumps and heaters). No permits are required to use the chemistry, the application of the chemistry is normally provided by an applicator licensed to use the CORPEX products. Bids are usually fixed priced and performance based.

Source of Information: Vendor

Company Name/POC	CURE International/Daniel L. Eide 1001 North U.S. Highway One Suite 409 Jupiter, Florida 33477		
E-Mail Address	phsolution@aol.com		
Product/Service	CURE Wastewater Treatment	Phone Number	407 575-3500
Process Type	Electrical Separation	Fax Number	407 575-9510

Contaminants

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

Media

☒ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On site

Brief Description: The CURE (R) patented wastewater system provides continuous electrocoagulation for quick and efficient removal of dissolved heavy metals, radionuclides and other pollutants from wastewater. It utilizes a unique concentric tube configuration to remove upwards to 99% of heavy metals, oils, dissolved organics and radionuclides while producing a non-leachable sludge. Fixed-site systems can range in size from 0.5 gpm to 1000gpm. The CURE (R) system can be made transportable as a trailer mounted unit for use at remote and temporary locations. Smaller portable and laboratory test units can be utilized to perform on-site testing.

Product/Service Maturity: Commercial use experience Pilot plant testing Field demo complete

Performance History: The CURE (R) system has demonstrated effectiveness (99.9% removal) on radionuclides and heavy metals at RFETS and numerous commercial applications, including, metal plating, and finishing, steam cleaning and pressure washing, oil field wastewater remediation, municipal sewage stream treatment, mine water discharge cleanup, food processing plant waste cleanup, hazardous waste site remediation, and the Marine & Boating Industry.

Comments: The CURE (R) technology has been tested under the guidance and supervision of the EPA and DOE on radioactive contaminated wastewaters containing Americium, uranium and plutonium and a variety of other contaminants. During bench testing at Rocky Flats Environmental Facility in Golden, Colorado, in August of 1995, more than 99.7% removal rate was achieved. Similar results were obtained at Los Alamos Laboratories when testing radioactive contaminated wastewaters with a far higher concentration of uranium and plutonium. In full scale tests at Rocky Flats, similar removal rates were achieved and a non-leachable sludge was produced. "Other" contaminant identified as fog.

Source of Information: Vendor

Company Name/POC	Cytec Industries/Environmental Services Dept. P.O. Box 31 Linden, New Jersey 07036		
E-Mail Address			
Product/Service	Bioremediation	Phone Number	908 862-6000 x815
Process Type	Bioremediation	Fax Number	908 862-4163

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: The Environmental Services Department (ESD) of Cytec has the responsibility for technology use for remediation, compliance activities, and pollution prevention. Cytec, is a chemical company, (previously a part of American Cyanamid) which has a long history in the chemical industry (45 manufacturing locations/65 superfund sites). ESD must develop/implement cost-effective environmental solutions to address the wide variety of environmental projects within the company.

Product/Service Maturity: Commercial use experience Pilot plant testing Field demo complete

Performance History: A) Pilot demonstration of biological process to treat highly contaminated (PAHs, volatile or semi volatiles) tarry sludges.

B) Pilot demonstration of biological process in conjunction with soil venting to treat styrene/toluene in vadose soil.

C) Pilot demonstration of biological process to treat groundwater contaminated with DCA and methylene chloride.

Comments: None.

Source of Information: Vendor

Company Name/POC	Dames & Moore, Inc./John Forsyth 2325 Maryland Road Willow Grove, Pennsylvania 19090		
E-Mail Address	PHLJVF@DAMES.COM		
Product/Service	Bioremediation	Phone Number	215 657-5000
Process Type	Biodegradation (In Situ)	Fax Number	215 657-5454

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: Dames & Moore provides the integrated waste management, engineering, design, environmental, and regulatory support services necessary for the successful bioremediation of contaminated soils, water, groundwater, slurries, and hazardous materials and wastes. Dames & Moore has completed numerous bioremediation projects, including feasibility studies and laboratory studies leading to implementation of full-scale systems for in-situ/ex-situ bioremediation.

Product/Service Maturity: Commercial use experience Pilot plant testing Field demo complete Bench scale testing only

Performance History: Refineries, chemical manufacturing plants, pesticide operations, airport and military facilities, underground storage tanks, transportation facilities.

Comments: All potential bioremediation projects are approached with the knowledge that each site will exhibit different characteristics and require a specific bioremediation plan. Dames & Moore's approach to bioremediation starts with site characterization (to determine whether bioremediation appears to be feasible and to develop a rough estimate of the time and cost) followed by screening analyticals, biotreatability studies (if applicable) and ending with a fully developed work plan, budget, and project management plan for the full-scale bioremediation project. Each phase requires specific information about the site and uses this information to develop a more thorough approach for final design. Dames & Moore has applied these technologies to a wide range of organic contaminants.

Source of Information: Vendor

Treatment

Company Name/POC Dames & Moore, Inc./John Forsyth
2325 Maryland Road
Willow Grove, Pennsylvania 19090

E-Mail Address PHLJVF@DAMES.COM

Product/Service Bioremediation

Process Type Bioreactors

Phone Number 215 657-5000

Fax Number 215 657-5454

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: Dames & Moore provides the integrated waste management, engineering, design, environmental, and regulatory support services necessary for the successful bioremediation of contaminated soils, water, groundwater, slurries, and hazardous materials and wastes. Dames & Moore has completed numerous bioremediation projects, including feasibility studies and laboratory studies leading to implementation of full-scale systems for in-situ/ex-situ bioremediation.

Product/Service Maturity: Commercial use experience Pilot plant testing Field demo complete Bench scale testing only

Performance History: Refineries, chemical manufacturing plants, pesticide operations, airport and military facilities, underground storage tanks, transportation facilities.

Comments: All potential bioremediation projects are approached with the knowledge that each site will exhibit different characteristics and require a specific bioremediation plan. Dames & Moore's approach to bioremediation starts with site characterization (to determine whether bioremediation appears to be feasible and to develop a rough estimate of the time and cost) followed by screening analyticals, biotreatability studies (if applicable) and ending with a fully developed work plan, budget, and project management plan for the full-scale bioremediation project. Each phase requires specific information about the site and uses this information to develop a more thorough approach for final design. Dames & Moore has applied these technologies to a wide range of organic contaminants.

Source of Information: Vendor

Company Name/POC	Dames & Moore, Inc./John Forsyth 2325 Maryland Road Willow Grove, Pennsylvania 19090		
E-Mail Address	PHLJVF@DAMES.COM		
Product/Service	Air Sparging/Bioremediation	Phone Number	215 657-5000
Process Type	Air Sparging	Fax Number	215 657-5454

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: Dames & Moore provides the integrated waste management, engineering, design, environmental, and regulatory support services necessary for the successful bioremediation of contaminated soils, water, groundwater, slurries, and hazardous materials and wastes. Dames & Moore has completed numerous bioremediation projects, including feasibility studies and laboratory studies leading to implementation of full-scale systems for in-situ/ex-situ bioremediation.

Product/Service Maturity: Commercial use experience Pilot plant testing Field demo complete Bench scale testing only

Performance History: Refineries, chemical manufacturing plants, pesticide operations, airport and military facilities, underground storage tanks, transportation facilities.

Comments: All potential bioremediation projects are approached with the knowledge that each site will exhibit different characteristics and require a specific bioremediation plan. Dames & Moore's approach to bioremediation starts with site characterization (to determine whether bioremediation appears to be feasible and to develop a rough estimate of the time and cost) followed by screening analyticals, biotreatability studies (if applicable) and ending with a fully developed work plan, budget, and project management plan for the full-scale bioremediation project. Each phase requires specific information about the site and uses this information to develop a more thorough approach for final design. Dames & Moore has applied these technologies to a wide range of organic contaminants.

Source of Information: Vendor

Treatment

Company Name/POC	Dames & Moore, Inc./John Forsyth 2325 Maryland Road Willow Grove, Pennsylvania 19090		
E-Mail Address	PHLJVF@DAMES.COM		
Product/Service	Bioremediation	Phone Number	215 657-5000
Process Type	Slurry Phase Biological Treatment	Fax Number	215 657-5454

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: Dames & Moore provides the integrated waste management, engineering, design, environmental, and regulatory support services necessary for the successful bioremediation of contaminated soils, water, groundwater, slurries, and hazardous materials and wastes. Dames & Moore has completed numerous bioremediation projects, including feasibility studies and laboratory studies leading to implementation of full-scale systems for in-situ/ex-situ bioremediation.

Product/Service Maturity: Commercial use experience Pilot plant testing Field demo complete Bench scale testing only

Performance History: Refineries, chemical manufacturing plants, pesticide operations, airport and military facilities, underground storage tanks, transportation facilities.

Comments: All potential bioremediation projects are approached with the knowledge that each site will exhibit different characteristics and require a specific bioremediation plan. Dames & Moore's approach to bioremediation starts with site characterization (to determine whether bioremediation appears to be feasible and to develop a rough estimate of the time and cost) followed by screening analyticals, biotreatability studies (if applicable) and ending with a fully developed work plan, budget, and project management plan for the full-scale bioremediation project. Each phase requires specific information about the site and uses this information to develop a more thorough approach for final design. Dames & Moore has applied these technologies to a wide range of organic contaminants.

Source of Information: Vendor

Company Name/POC	Dames & Moore, Inc./John Forsyth 2325 Maryland Road Willow Grove, Pennsylvania 19090		
E-Mail Address	PHLJVF@DAMES.COM		
Product/Service	Bioremediation	Phone Number	215 657-5000
Process Type	Bioventing	Fax Number	215 657-5454

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: Dames & Moore provides the integrated waste management, engineering, design, environmental, and regulatory support services necessary for the successful bioremediation of contaminated soils, water, groundwater, slurries, and hazardous materials and wastes. Dames & Moore has completed numerous bioremediation projects, including feasibility studies and laboratory studies leading to implementation of full-scale systems for in-situ/ex-situ bioremediation.

Product/Service Maturity: Commercial use experience Pilot plant testing Field demo complete Bench scale testing only

Performance History: Refineries, chemical manufacturing plants, pesticide operations, airport and military facilities, underground storage tanks, transportation facilities.

Comments: All potential bioremediation projects are approached with the knowledge that each site will exhibit different characteristics and require a specific bioremediation plan. Dames & Moore's approach to bioremediation starts with site characterization (to determine whether bioremediation appears to be feasible and to develop a rough estimate of the time and cost) followed by screening analyticals, biotreatability studies (if applicable) and ending with a fully developed work plan, budget, and project management plan for the full-scale bioremediation project. Each phase requires specific information about the site and uses this information to develop a more thorough approach for final design. Dames & Moore has applied these technologies to a wide range of organic contaminants.

Source of Information: Vendor

Company Name/POC: Dames & Moore, Inc./John Forsyth
2325 Maryland Road
Willow Grove, Pennsylvania 19090

E-Mail Address: PHLJVF@DAMES.COM

Product/Service: Bioremediation

Phone Number: 215 657-5000

Process Type: Solid Phase Biological Treatment

Fax Number: 215 657-5454

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: Dames & Moore provides the integrated waste management, engineering, design, environmental, and regulatory support services necessary for the successful bioremediation of contaminated soils, water, groundwater, slurries, and hazardous materials and wastes. Dames & Moore has completed numerous bioremediation projects, including feasibility studies and laboratory studies leading to implementation of full-scale systems for in-situ/ex-situ bioremediation.

Product/Service Maturity: Commercial use experience Pilot plant testing Field demo complete Bench scale testing only.

Performance History: Refineries, chemical manufacturing plants, pesticide operations, airport and military facilities, underground storage tanks, transportation facilities.

Comments: All potential bioremediation projects are approached with the knowledge that each site will exhibit different characteristics and require a specific bioremediation plan. Dames & Moore's approach to bioremediation starts with site characterization (to determine whether bioremediation appears to be feasible and to develop a rough estimate of the time and cost) followed by screening analyticals, biotreatability studies (if applicable) and ending with a fully-developed work plan, budget, and project management plan for the full-scale bioremediation project. Each phase requires specific information about the site and uses this information to develop a more thorough approach for final design. Dames & Moore has applied these technologies to a wide range of organic contaminants.

Source of Information: Vendor

Company Name/POC	Dames & Moore, Inc./Joseph Tarsavage, P.E. 2325 Maryland Road Willow Grove, Pennsylvania 19090		
E-Mail Address	PHLJMT@DAMES.COM		
Product/Service	Two-Phase Vacuum Extraction	Phone Number	215 657-5000
Process Type	Dual Phase Extraction	Fax Number	215 657-5454

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Dames & Moore Co-developed a patented two-phase vacuum extraction (VE) system that simultaneously remediates the groundwater and the soil without downhole pumping equipment. The two-phase VE process has been documented to increase groundwater yields in low-permeability soils, such as clays, up to one order of magnitude. The extraction process can also substantially reduce the VOC concentrations in the recovered groundwater by up to 99 percent, thereby reducing or eliminating the need for additional equipment, such as air strippers or liquid-phase GAS units. Case histories prove that vacuum extraction enhancement of pump and treat systems is a cost-effective remediation technique.

Product/Service Maturity: Commercial use experience

Performance History: Dames & Moore has extensive project experience in designing, installing, and operating two-phase VE systems to remediate soil contaminated with petroleum hydrocarbons, chlorinated solvents (e.g., trichlorethylene, perchlorethylene, trichloroethane, and methylene chloride, and other substances (e.g., mineral spirits). The system has also been used to recover floating and sinking free-phase product. We have successfully applied two-phase VE in various geologic strata, including sands, compact clays, and fractured bedrock, in projects that have included deep and shallow water table conditions. Dames & Moore's two-phase VE project experience ranges from gasoline service stations to manufacturing plants. The system is most often employed in low-permeability soils. It has increased recovery rates and capture zones in low permeability formations by as much as a factor of 10. When biodegradable compounds are present, the system can be used to introduce oxygen to the subsurface to stimulate biological activity.

Comments: None.

Source of Information: Vendor

Company Name/POC	Dames & Moore, Inc./Joseph Tarsavage, P.E. 2325 Maryland Road Willow Grove, Pennsylvania 19090		
E-Mail Address	PHLJMT@DAMES.COM		
Product/Service	Two-Phase Vacuum Extraction	Phone Number	215 657-5000
Process Type	Biodegradation (In Situ)	Fax Number	215 657-5454

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Dames & Moore co-developed a patented two-phase vacuum extraction (VE) system that simultaneously remediates the groundwater and the soil without downhole pumping equipment. The two-phase VE process has been documented to increase groundwater yields in low-permeability soils, such as clays, up to one order of magnitude. The extraction process can also substantially reduce the VOC concentrations in the recovered groundwater by up to 99 percent, thereby reducing or eliminating the need for additional equipment, such as air strippers or liquid-phase GAS units. Case histories prove that vacuum extraction enhancement of pump and treat systems is a cost-effective remediation technique.

Product/Service Maturity: Commercial use experience

Performance History: Dames & Moore has extensive project experience in designing, installing, and operating two-phase VE systems to remediate soil contaminated with petroleum hydrocarbons, chlorinated solvents (e.g., trichlorethylene, perchlorethylene, trichloroethane, and methylene chloride, and other substances (e.g., mineral spirits). The system has also been used to recover floating and sinking free-phase product. We have successfully applied two-phase VE in various geologic strata, including sands, compact clays, and fractured bedrock, in projects that have included deep and shallow water table conditions. Dames & Moore's two-phase VE project experience ranges from gasoline service stations to manufacturing plants. The system is most often employed in low-permeability soils. It has increased recovery rates and capture zones in low permeability formations by as much as a factor of 10. When biodegradable compounds are present, the system can be used to introduce oxygen to the subsurface to stimulate biological activity.

Comments: None.

Source of Information: Vendor

Company Name/POC	Dames & Moore, Inc./Joseph Tarsavage, P.E. 2325 Maryland Road Willow Grove, Pennsylvania 19090		
E-Mail Address	PHLJMT@DAMES.COM		
Product/Service	Two-Phase Vacuum Extraction	Phone Number	215 657-5000
Process Type	Vacuum Vapor Extraction	Fax Number	215 657-5454

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Dames & Moore co-developed a patented two-phase vacuum extraction (VE) system that simultaneously remediates the groundwater and the soil without downhole pumping equipment. The two-phase VE process has been documented to increase groundwater yields in low-permeability soils, such as clays, up to one order of magnitude. The extraction process can also substantially reduce the VOC concentrations in the recovered groundwater by up to 99 percent, thereby reducing or eliminating the need for additional equipment, such as air strippers or liquid-phase GAS units. Case histories prove that vacuum extraction enhancement of pump and treat systems is a cost-effective remediation technique.

Product/Service Maturity: Commercial use experience

Performance History: Dames & Moore has extensive project experience in designing, installing, and operating two-phase VE systems to remediate soil contaminated with petroleum hydrocarbons, chlorinated solvents (e.g., trichlorethylene, perchlorethylene, trichloroethane, and methylene chloride, and other substances (e.g., mineral spirits). The system has also been used to recover floating and sinking free-phase product. We have successfully applied two-phase VE in various geologic strata, including sands, compact clays, and fractured bedrock, in projects that have included deep and shallow water table conditions. Dames & Moore's two-phase VE project experience ranges from gasoline service stations to manufacturing plants. The system is most often employed in low-permeability soils. It has increased recovery rates and capture zones in low permeability formations by as much as a factor of 10. When biodegradable compounds are present, the system can be used to introduce oxygen to the subsurface to stimulate biological activity.

Comments: None.

Source of Information: Vendor

Company Name/POC	Dames & Moore, Inc./Joseph Tarsavage, P.E. 2325 Maryland Road Willow Grove, Pennsylvania 19090		
E-Mail Address	PHLJMT@DAMES.COM		
Product/Service	Two-Phase Vacuum Extraction	Phone Number	215 657-5000
Process Type	Bioventing	Fax Number	215 657-5454

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Dames & Moore co-developed a patented two-phase vacuum extraction (VE) system that simultaneously remediates the groundwater and the soil without downhole pumping equipment. The two-phase VE process has been documented to increase groundwater yields in low-permeability soils, such as clays, up to one order of magnitude. The extraction process can also substantially reduce the VOC concentrations in the recovered groundwater by up to 99 percent, thereby reducing or eliminating the need for additional equipment, such as air strippers or liquid-phase GAS units. Case histories prove that vacuum extraction enhancement of pump and treat systems is a cost-effective remediation technique.

Product/Service Maturity: Commercial use experience

Performance History: Dames & Moore has extensive project experience in designing, installing, and operating two-phase VE systems to remediate soil contaminated with petroleum hydrocarbons, chlorinated solvents (e.g., trichlorethylene, perchlorethylene, trichloroethane, and methylene chloride, and other substances (e.g., mineral spirits). The system has also been used to recover floating and sinking free-phase product. We have successfully applied two-phase VE in various geologic strata, including sands, compact clays, and fractured bedrock, in projects that have included deep and shallow water table conditions. Dames & Moore's two-phase VE project experience ranges from gasoline service stations to manufacturing plants. The system is most often employed in low-permeability soils. It has increased recovery rates and capture zones in low permeability formations by as much as a factor of 10. When biodegradable compounds are present, the system can be used to introduce oxygen to the subsurface to stimulate biological activity.

Comments: None.

Source of Information: Vendor

Company Name/POC	Dames & Moore, Inc./Joseph Tarsavage, P.E. 2325 Maryland Road Willow Grove, Pennsylvania 19090		
E-Mail Address	PHLJMT@DAMES.COM		
Product/Service	Two-Phase Vacuum Extraction	Phone Number	215 657-5000
Process Type	Soil Vapor Extraction (In Situ)	Fax Number	215 657-5454

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Dames & Moore co-developed a patented two-phase vacuum extraction (VE) system that simultaneously remediates the groundwater and the soil without downhole pumping equipment. The two-phase VE process has been documented to increase groundwater yields in low-permeability soils, such as clays, up to one order of magnitude. The extraction process can also substantially reduce the VOC concentrations in the recovered groundwater by up to 99 percent, thereby reducing or eliminating the need for additional equipment, such as air strippers or liquid-phase GAS units. Case histories prove that vacuum extraction enhancement of pump and treat systems is a cost-effective remediation technique.

Product/Service Maturity: Commercial use experience

Performance History: Dames & Moore has extensive project experience in designing, installing, and operating two-phase VE systems to remediate soil contaminated with petroleum hydrocarbons, chlorinated solvents (e.g., trichlorethylene, perchlorethylene, trichloroethane, and methylene chloride, and other substances (e.g., mineral spirits). The system has also been used to recover floating and sinking free-phase product. We have successfully applied two-phase VE in various geologic strata, including sands, compact clays, and fractured bedrock, in projects that have included deep and shallow water table conditions. Dames & Moore's two-phase VE project experience ranges from gasoline service stations to manufacturing plants. The system is most often employed in low-permeability soils. It has increased recovery rates and capture zones in low permeability formations by as much as a factor of 10. When biodegradable compounds are present, the system can be used to introduce oxygen to the subsurface to stimulate biological activity.

Comments: None.

Source of Information: Vendor

Company Name/POC	Daub & Associates/G. J. Daub 1985 South Broadway Grand Junction, Colorado 81503-9593		
E-Mail Address	daubers@iti2.net		
Product/Service	Contaminant Detection, Assessment, and Characterization	Phone Number	970 241-0964
Process Type	Other	Fax Number	970 242-8438

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: On site

Brief Description: Daub & Associates is a competent and qualified service oriented company offering cost effective consulting services the environmental industry. The company has the ability to draw from a pool of numerous, experienced professionals from various fields. Areas of expertise include geology, geohydrology, permitting, geologic hazards, hydrology, reclamation, project management, and environmental investigations. Daub & Associates specializes in environmental considerations in the exploration, development and production of oil, gas, minerals, and risk assessment.

Product/Service Maturity:

Performance History: Results oriented company providing a full range of services to the environmental and energy resources industry on a world-wide basis since 1982. References and client lists are available upon request at the address and phone numbers listed above.

Comments: Experience and extensive knowledge base regarding the environmental problems and related technologies being used at the U.S. Department of Energy sites.

Source of Information: Vendor

Company Name/POC	Davis Environmental/Joseph Stagner, P.E. 2305 Inverness Place El Dorado Hills, California 95762		
E-Mail Address	jcstagner.vcdavis.edu		
Product/Service	Multi-Stage In-Well Aerator	Phone Number	916 985-0930
Process Type	Air Stripping	Fax Number	916 752-6273

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone)

Brief Description: 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 f

Product/Service Maturity: Commercial use experience

Performance History: Field evaluations of the TET 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.sts.

Comments: The technology has been demonstrated commercially at small scale (<6,000 cubic yards of soil). The primary soil contaminants were pentachlorophenol or nitro-aromatics (explosives). Other recalcitrant compounds have been degraded in laboratory settings or in small plot tests.

Source of Information: Vendor

Company Name/POC Davis Industrial Waste Systems/Don King
1828 Metcalf Avenue
Thomasville, Georgia 31792

E-Mail Address

Product/Service Chemical Reduction

Phone Number 800 841-1550

Process Type Chemical Reduction

Fax Number 912 228-0312

Contaminants

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

Media

☒ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: On site

Brief Description: Turnkey provider of water and wastewater treatment systems.

Product/Service Maturity: Commercial use experience

Performance History: Incorporated in 1958 - Sales, 1995, in excess of \$220,000,000.

Comments: None.

Source of Information: Vendor

Company Name/POC Davis Industrial Waste Systems/Don King
1828 Metcalf Avenue
Thomasville, Georgia 31792

E-Mail Address

Product/Service Bioreactors

Process Type Bioreactors

Phone Number 800 841-1550

Fax Number 912 228-0312

Contaminants

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

Media

☒ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: On site

Brief Description: Turnkey provider of water and wastewater treatment systems.

Product/Service Maturity: Commercial use experience

Performance History: Incorporated in 1958 - Sales, 1995, in excess of \$220,000,000.

Comments: None.

Source of Information: Vendor

Company Name/POC Davis Industrial Waste Systems/Don King
1828 Metcalf Avenue
Thomasville, Georgia 31792

E-Mail Address**Product/Service** Filtration**Phone Number** 800 841-1550**Process Type** Filtration**Fax Number** 912 228-0312**Contaminants**

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

Media

☒ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: On site**Brief Description:** Turnkey provider of water and wastewater treatment systems.**Product/Service Maturity:** Commercial use experience**Performance History:** Incorporated in 1958 - Sales, 1995, in excess of \$220,000,000.**Comments:** None.**Source of Information:** Vendor

Company Name/POC	Davis Industrial Waste Systems/Don King 1828 Metcalf Avenue Thomasville, Georgia 31792		
E-Mail Address			
Product/Service	Chemical Oxidation	Phone Number	800 841-1550
Process Type	Chemical Oxidation	Fax Number	912 228-0312

Contaminants

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

Media

☒ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: On site

Brief Description: Turnkey provider of water and wastewater treatment systems.

Product/Service Maturity: Commercial use experience

Performance History: Incorporated in 1958 - Sales, 1995, in excess of \$220,000,000.

Comments: None.

Source of Information: Vendor

Company Name/POC	Davy International/George Rowden Ashmore House Richardson Rd. Stockton-on-Tees, Cleveland T5183RE England		
E-Mail Address			
Product/Service	In-Pulp Decontamination of Contaminated Soil	Phone Number	011 44 1642 602221
Process Type	Other	Fax Number	011 44 1642 341001

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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 adsorbent in a concentrated form for further treatment, disposal, or recovery.

Product/Service 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: Vendor

Company Name/POC	Dehydro-Tech Corp./Theodore D. Trowbridge 6 Great Meadow Lane East Hanover, New Jersey 07936	
E-Mail Address		
Product/Service	Carver-Greenfield Process	Phone Number 201 887-2182
Process Type	Chemical Extraction	Fax Number 201 887-2548

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ

Brief Description: The Carver-Greenfield (C-G) Process can be used to treat sludges, soils, and other water-bearing wastes containing hydrocarbon soluble 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.

Product/Service 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: Vendor

Company Name/POC Delft Geotechnics/Mr. Viergever #2, Stieltjesweg, P.O. Box 69 2600 AB 2628CK Delft, Netherlands	
E-Mail Address	
Product/Service	Delft Centrifuge
Process Type	Other
Phone Number	011 31 152 693500
Fax Number	011 31 152 610 821

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On site

Brief Description: World's largest centrifuge for accelerated soil testing. 15 meter arm, 5000 kg sample at 300g gravity.

Product/Service 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

Company Name/POC Delta Cooling Towers, Inc./John T. Halligan
134 Clinton Road
Fairfield, NJ 07004-2970

E-Mail Address

Product/Service Vanguard Air Strippers

Phone Number 201 227-0300

Process Type Air Stripping

Fax Number 201 227-0458

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: On site

Brief Description: Standard designs from 1' to 5' diameter packed columns and custom designed systems over 5' diameter. Complete system optional equipment for single source responsibility.

Product/Service Maturity: Commercial use experience

Performance History: Experienced based on field installations from 1980 removing a wide variety of common and difficult VOC's including ammonia, etc.

Comments: None.

Source of Information: Vendor

Treatment

Company Name/POC	Department of Chemical and Environmental Engineering/Paul R. Anderson 10W 33rd Street Chicago, Illinois 60616		
E-Mail Address			
Product/Service	Oxide-coated GAC Adsorbent	Phone Number	312 567-3531
Process Type	Ion Exchange	Fax Number	312 567-8874

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On site

Brief Description: The technology uses an oxide to provide a strong chemical affinity for many inorganic contaminants. The GAC substrate provides an appropriate practical size for column processes and the potential for organics removal. Metal removal to trace levels is possible. Regeneration at different pH can recover metals in a concentrated form and prepare absorbent for reuse.

Product/Service Maturity: Bench scale testing only

Performance History: Lab experience only.

Comments: Pretreatment appropriate to filtration required. Loadings similar to ion exchange expected. Complexed metals may be difficult to remove.

Source of Information: Vendor

Company Name/POC	Desalination Systems, Inc./Sales Dept. 760 Shadowridge Dr. Vista, California 92083		
E-Mail Address			
Product/Service	Spiral Wound Membrane Technology	Phone Number	619 598-3334
Process Type	Membrane Separation	Fax Number	619 598-3335

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

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.

Product/Service 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: Vendor

Company Name/POC	Divesco Technologies/Bill Strickland 216 Old Oak Circle Brandon, MS 39042	
E-Mail Address		
Product/Service	Portable Hi-Volume Washer	Phone Number 601 825-4644
Process Type	Soil Washing	Fax Number 601 825-4644

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: Soil put in hopper and washed free of contaminants with water/surfactant. Clean soil returned. Contaminated water cleaned with polymers and recycled. Contaminant concentrate put in drums for disposal in licensed facility.

Product/Service Maturity: Commercial use experience

Performance History: Cost per ton much lower than conventional.

Comments: Surfactants and polymers tailored to contaminants on site-by-site needs.

Source of Information: Vendor

Company Name/POC	DuPont/Dr. Ernest Mayer Engineering Dept. N6440 1007 Market Street Wilmington, DE 19898 //Oberlin Filter Co./Mr. Mike Hughes/404 Pilot Cou		
E-Mail Address			
Product/Service	Microfiltration	Phone Number	302 774-1000
Process Type	Filtration	Fax Number	302 774-2457

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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).

Product/Service 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: Vendor

Company Name/POC	Dynaphore, Inc./N. Rainer 2709 Willard Rd Richmond, Virginia 23294		
E-Mail Address			
Product/Service	Forager (TM) Sponge for Heavy Metals	Phone Number	804 288-7109
Process Type	Ion Exchange	Fax Number	804 282-1325

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Product/Service Maturity: Field demo complete

Performance History: FORAGER (TM) Sponge is currently being sold for the treatment of groundwater. 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. In a full scale remediation, groundwater is being treated at 5 gal./min. to achieve 50% removal of Arsenic initially at 420 ppb.

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: Vendor

Company Name/POC	EA Technology Ltd./John Bancroft Capenhurst Chester CH16ES England, UK		
E-Mail Address	jlb@eatl.co.uk		
Product/Service	Porocell	Phone Number	151 347 2522
Process Type	Electrical Separation	Fax Number	151 347 2138

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Other Application

Brief Description: Electrochemical, porous cathode cell capable of removing metal ions from water to sub-ppm levels. Often used in conjunction with ion exchange to provide pre-treatment, treatment of regeneration of acids for reuse, so giving no liquid waste.

Product/Service Maturity: Commercial use experience

Performance History: Operating in over 20 installations in industries such as scotch distilling (copper recovery), electronics manufacture (copper recovery), metal finishing (cadmium recovery), nuclear treatment (Tc and Cs) and many others.

Comments: Recovers metals as element (or alloy) in a high surface area from. Easy to recycle hydro-or pyro-metallurgically.

Source of Information: Vendor

Treatment

Company Name/POC	EA Technology Ltd./L. Smith Capenhurst Chester CH16ES England, UK	
E-Mail Address		
Product/Service	Waste Destruction Furnace	Phone Number 151 347 2522
Process Type	Vitrification (Ex Situ)	Fax Number 151 347 2138

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service 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 traveling 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 ton 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: Vendor

Company Name/POC	Earth Remediation Services, Inc./Larry Bee 21 Business Park Drive Branford, Connecticut 06405		
E-Mail Address	earthtct@callnet.com		
Product/Service	Filtration	Phone Number	203 488-6713
Process Type	Filtration	Fax Number	202 488-3628

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: On site

Brief Description: Filtration units are constructed to treat various media waste streams; particulates and dissolved contaminants can be treated via granular activated carbon units, sand filters, bag filters, reverse osmosis and other filtration technologies.

Product/Service Maturity: Commercial use experience

Performance History: Contact ERS for additional information.

Comments: Contact ERS for additional information.

Source of Information: Vendor

Company Name/POC	Earth Remediation Services, Inc./Larry Bee		
	21 Business Park Drive		
	Branford, Connecticut 06405		
E-Mail Address	earthct@callnet.com		
Product/Service	High Vacuum Vapor Extraction	Phone Number	203 488-6713
Process Type	Vacuum Vapor Extraction	Fax Number	202 488-3628

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: In-situ (vadose zone) On site**Brief Description:** Contact ERS for additional information.**Product/Service Maturity:** Commercial use experience**Performance History:** Contact ERS for additional information.**Comments:** Contact ERS for additional information.**Source of Information:** Vendor

Company Name/POC	Earth Remediation Services, Inc./Larry Bee 21 Business Park Drive Branford, Connecticut 06405		
E-Mail Address	earthct@callnet.com		
Product/Service	Dual Phase Extraction	Phone Number	203 488-6713
Process Type	Dual Phase Extraction	Fax Number	202 488-3628

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Dual phase extraction involves the withdrawal of both air and water simultaneously, applying two technologies, pump and treat and VES, at a lower cost than separate extraction systems.

Product/Service Maturity: Commercial use experience

Performance History: Contact ERS for additional information.

Comments: Contact ERS for additional information.

Source of Information: Vendor

Treatment

Company Name/POC	Earth Remediation Services, Inc./Larry Bee 21 Business Park Drive Branford, Connecticut 06405		
E-Mail Address	earthct@callnet.com		
Product/Service	Vapor Extraction	Phone Number	203 488-6713
Process Type	Bioventing	Fax Number	202 488-3628

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Bioventing is basically a soil venting system which can be augmented by the addition of nutrients in order to enhance the productivity of indigenous fungi and bacteria which degrade contaminants.

Product/Service Maturity: Commercial use experience

Performance History: Cleanup goals can be achieved rather quickly, and it can be instituted without exposure to large amounts of contaminated media.

Comments: Control of off gas emissions is dictated on a state-by-state basis. Granular activated carbon, thermal destruction via catalytic burners and incineration units, as well as UV and OZONE are implemented in order to control the emission of off gases.

Source of Information: Vendor

Company Name/POC	Earthfax Engineering, Inc./Larry DuShane 7324 South Union Park Avenue Suite 100 Midvale, Utah 84047		
E-Mail Address			
Product/Service	White Rot Fungi	Phone Number	801 561-1555
Process Type	White Rot Fungus	Fax Number	801 561-1861

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

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.

Product/Service 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

Company Name/POC ECO-TEC, Inc./Ecology Technology, Inc./Herbert R. Pearse
P.O. Box 1113
Issaquah, Washington 98027-1113

E-Mail Address**Product/Service**

Biocatalytic Contaminant Degradation (BCD)

Phone Number 206 392-0304**Process Type**

Biodegradation (In Situ)

Fax Number 206 392-0575**Contaminants**

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: ECO-TEC, Inc., (ETI), utilized EMG, a proprietary biocatalyst to dramatically accelerate biodegradation of petroleum hydrocarbons and other biodegradable contaminants. The Biocatalytic Contaminant Degradation, (BCD), process can be used to biodegrade organic contaminants in soil, groundwater, slurries, process water and surface water either in situ or ex situ. A Balanced Microbial Inoculum, (BMI), in an aqueous solution of EMG, indigenous "Sole Source Carbon" selected microbes and pH balanced trace minerals is created. The BMI is applied to the contaminated media incorporating site and contaminant specific procedures. ETI is a full service remediation contractor with the capability of supplying services for permitting, assessment and reporting in conjunction with site remediation.

Product/Service Maturity: Commercial use experience

Performance History: The Biocatalytic contaminant degradation, (BCD), technology has been successfully applied on numerous full-scale remediation projects. Please contact ECO-TEC, INC. for performance data.

Comments: The BCD technology can be applied to a diversity of sites, media and contaminants and can be implemented utilizing equipment that is readily available.

Source of Information: Vendor

Company Name/POC	ECO-TEC, Inc./Ecology Technology, Inc./Herbert R. Pearse P.O. Box 1113 Issaquah, Washington 98027-1113	
E-Mail Address		
Product/Service	Biocatalytic Contaminant Degradation (BCD)	Phone Number 206 392-0304
Process Type	Bioventing	Fax Number 206 392-0575

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: ECO-TEC, Inc., (ETI), utilized EMG, a proprietary biocatalyst to dramatically accelerate biodegradation of petroleum hydrocarbons and other biodegradable contaminants. The Biocatalytic Contaminant Degradation, (BCD), process can be used to biodegrade organic contaminants in soil, groundwater, slurries, process water and surface water either in situ or ex situ. A Balanced Microbial Inoculum, (BMI), in an aqueous solution of EMG, indigenous "Sole Source Carbon" selected microbes and pH balanced trace minerals is created. The BMI is applied to the contaminated media incorporating site and contaminant specific procedures. ETI is a full service remediation contractor with the capability of supplying services for permitting, assessment and reporting in conjunction with site remediation.

Product/Service Maturity: Commercial use experience

Performance History: The Biocatalytic contaminant degradation, (BCD), technology has been successfully applied on numerous full-scale remediation projects. Please contact ECO-TEC, INC. for performance data.

Comments: The BCD technology can be applied to a diversity of sites, media and contaminants and can be implemented utilizing equipment that is readily available.

Source of Information: Vendor

Company Name/POC ECO-TEC, Inc./Ecology Technology, Inc./Herbert R. Pearce
P.O. Box 1113
Issaquah, Washington 98027-1113

E-Mail Address

Product/Service Biocatalytic Contaminant Degradation (BCD)

Phone Number 206 392-0304

Process Type Composting

Fax Number 206 392-0575

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: ECO-TEC, Inc., (ETI), utilized EMG, a proprietary biocatalyst to dramatically accelerate biodegradation of petroleum hydrocarbons and other biodegradable contaminants. The Biocatalytic Contaminant Degradation, (BCD), process can be used to biodegrade organic contaminants in soil, groundwater, slurries; process water and surface water either in situ or ex situ. A Balanced Microbial Inoculum, (BMI), in an aqueous solution of EMG, indigenous "Sole Source Carbon" selected microbes and pH balanced trace minerals is created. The BMI is applied to the contaminated media incorporating site and contaminant specific procedures. ETI is a full service remediation contractor with the capability of supplying services for permitting, assessment and reporting in conjunction with site remediation.

Product/Service Maturity: Commercial use experience

Performance History: The Biocatalytic contaminant degradation, (BCD), technology has been successfully applied on numerous full-scale remediation projects. Please contact ECO-TEC, INC. for performance data.

Comments: The BCD technology can be applied to a diversity of sites, media and contaminants and can be implemented utilizing equipment that is readily available.

Source of Information: Vendor

Company Name/POC	ECO-TEC, Inc./Ecology Technology, Inc./Herbert R. Pearse P.O. Box 1113 Issaquah, Washington 98027-1113	
E-Mail Address		
Product/Service	Biocatalytic Contaminant Degradation (BCD)	Phone Number 206 392-0304
Process Type	Slurry Phase Biological Treatment	Fax Number 206 392-0575

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: ECO-TEC, Inc., (ETI), utilized EMG, a proprietary biocatalyst to dramatically accelerate biodegradation of petroleum hydrocarbons and other biodegradable contaminants. The Biocatalytic Contaminant Degradation, (BCD), process can be used to biodegrade organic contaminants in soil, groundwater, slurries, process water and surface water either in situ or ex situ. A Balanced Microbial Inoculum, (BMI), in an aqueous solution of EMG, indigenous "Sole Source Carbon" selected microbes and pH balanced trace minerals is created. The BMI is applied to the contaminated media incorporating site and contaminant specific procedures. ETI is a full service remediation contractor with the capability of supplying services for permitting, assessment and reporting in conjunction with site remediation.

Product/Service Maturity: Commercial use experience

Performance History: The Biocatalytic contaminant degradation, (BCD), technology has been successfully applied on numerous full-scale remediation projects. Please contact ECO-TEC, INC. for performance data.

Comments: The BCD technology can be applied to a diversity of sites, media and contaminants and can be implemented utilizing equipment that is readily available.

Source of Information: Vendor

Company Name/POC	Ecology Technologies International, Inc./Mr. Pete Condy 1225 So. 48th Street Suite 2 Tempe, Arizona 85281		
E-Mail Address			
Product/Service	FyreZyme	Phone Number	602 985-5524
Process Type	Slurry Phase Biological Treatment	Fax Number	602 985-2988

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: FyreZyme 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.

Product/Service Maturity: Commercial use experience

Performance History: Performance data are available.

FyreZyme 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.

Over 2 million cubic yards cleaned to closure levels over past 5 years.

Comments: 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: Vendor

Company Name/POC	Ecology Technologies International, Inc./Mr. Pete Condry 1225 So. 48th Street Suite 2 Tempe, Arizona 85281		
E-Mail Address			
Product/Service	FyreZyme	Phone Number	602 985-5524
Process Type	Solid Phase Biological Treatment	Fax Number	602 985-2988

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor
Environmental Cleanup Privatization
Products and Services Directory

January 1997
T 153

Company Name/POC	Ecology Technologies International, Inc./Mr. Pete Condy 1225 So. 48th Street Suite 2 Tempe, Arizona 85281		
E-Mail Address			
Product/Service	FyreZyme	Phone Number	602 985-5524
Process Type	Bioreactors	Fax Number	602 985-2988

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC	Ecology Technologies International, Inc./Mr. Pete Condry 1225 So. 48th Street Suite 2 Tempe, Arizona 85281		
E-Mail Address			
Product/Service	FyreZyme	Phone Number	602 985-5524
Process Type	Biodegradation (In Situ)	Fax Number	602 985-2988

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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. Full scale production has been complete in Florida and other locations.

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: Vendor

Company Name/POC	EET, Inc./Mike Bonem 4710 Bellaire Blvd, Suite 300 Bellaire, Texas 77401	
E-Mail Address		
Product/Service	Contaminant Extraction Technology	Phone Number 713 662-0727
Process Type	Chemical Surface Cleaning	Fax Number 713 662-2322

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: EET's TechXtract (TM) 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.

Product/Service 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 80 - 99 percent 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 (80-99 percent per one-day cycle). EET's chemicals contain no TCLP 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 0.05-0.10 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: Vendor

Company Name/POC	EG&G Environmental, Inc./Dick Samuels Foster Plaza 6 Suite 400 681 Andersen Drive Pittsburgh, Pennsylvania 15220		
E-Mail Address	rsamuels@ix.netcom.com		
Product/Service	NoVOCs (TM)	Phone Number	412 920-5401
Process Type	Biodegradation (In Situ)	Fax Number	412 920-5402

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone) On site

Brief Description: NoVOCs (TM) is an innovative, patented process for extracting VOC contamination from groundwater. With NoVOCs (TM), only VOC contamination is brought to the surface. Groundwater is recirculated within a treatment zone in-situ, and is not extracted to the surface, thus eliminating permitting and discharge concerns. Three to 12 treatment cycles through the NoVOCs (TM) treatment zone can be achieved, making cleanup to below MCLs attainable at many sites. NoVOCs (TM) is effective in both hot spot remediation and plume containment applications. Since NoVOCs (TM) oxygenates groundwater within its treatment zone, it stimulates naturally occurring microorganisms that consume petroleum hydrocarbons and other biodegradable contaminants. With modifications, NoVOCs (TM) can simultaneously treat VOCs and heavy metals at appropriate sites. At radioactive sites, NoVOCs (TM) selectively extracts the VOC contaminants from the groundwater while leaving the radionuclides in the ground.

Product/Service Maturity: Commercial use experience

Performance History: The first commercial NoVOCs (TM) installation successfully closed down after only 18 months of operation. Another pilot scale demonstration closed down after a year of highly successful operation. Several other commercial and pilot scale systems are currently operating successfully.

Comments: NoVOCs (TM) has been licensed for exclusive use at DOE's Savannah River Site. NoVOCs (TM) has also been installed at two Air Force Bases, a Naval Air Station, and is contracted for installation at several other DoD installations and several private sites.

NoVOCs (TM) offers faster groundwater cleanup than pump and treat, with lower first cost and lower O&M costs. NoVOCs (TM) is generally a superior alternative to pump and treat.

Source of Information: Vendor

Company Name/POC	Electro-Petroleum, Inc./Dr. J. Kenneth Wittle 996 Old Eagle School Road Suite 1118 Wayne, Pennsylvania 19087		
E-Mail Address			
Product/Service	Electrokinetics	Phone Number	610 687-9070
Process Type	Electrical Separation	Fax Number	610 964-8570

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service 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: Vendor

Company Name/POC	Electro-Pyrolysis, Inc./Dr. J. Kenneth Wittle 996 Old Eagle School Road Suite 1118 Wayne, Pennsylvania 19087	
E-Mail Address		
Product/Service	DC Graphite Arc	Phone Number 610 687-9070
Process Type	Vitrification (Ex Situ)	Fax Number 610 964-8570

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor/Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

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.

Product/Service Maturity: Pilot plant testing

Performance History: Performance data are available.

A 3000 pound/hour unit has been built; a 750 pound/hour unit in operation at MIT; a 50 pound/hour unit in operation at Clemson Vitrification Center.

Comments: Useful for all types of solid waste. However, a cost penalty is paid for energy for high water content waste.

Source of Information: Vendor

Company Name/POC ELI Eco Logic International Inc./Jim Nash
143 Dennis Street
Rockwood, Ontario, Canada NOB2KO

E-Mail Address**Product/Service**

Gas Phase Chemical Reduction

Phone Number 519 856-9591**Process Type**

Chemical Reduction

Fax Number 519 856-9235**Contaminants**

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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 Harbor, Ontario, Canada. Demonstrations on sediment contaminated with 300,000 ppm PAH and 500 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 on 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 writing, (May 1995) a commercial-scale SE25 ELI Destructor is operational in Perth, Western Australia, treating PCBs and pesticide residuals. A second unit is destroying PCBs for General Motors of Canada Ltd. in St. Catharines, Ontario. In addition, projects have been announced with General Electric Canada Inc., the United States Department of Energy, and Dofasco Inc. Additionally, the ECO LOGIC process is being evaluated by the United States Army Chemical Demilitarization Program.

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 amendable to traditional methods of disposal. The ECO LOGIC Process is mobile and mounted on several drop-deck highway trailers. 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: Vendor

Company Name/POC	ENPAC Corporation/James Rudesill 121 Industrial Parkway Chardon, Ohio 44024		
E-Mail Address			
Product/Service	Secondary Containment, Spill Prevention Products	Phone Number	216 285-5305
Process Type	Containment	Fax Number	216 286-9297

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On site

Brief Description: ENPAC Corporation provides a complete line-up of products for hazardous material containment and spill prevention. The polyethylene construction provide strength, durability and compatibility with most chemicals.

Product/Service Maturity: Commercial use experience

Performance History: Performance data are available. Salvage drums and lab packs are certified under UN Chap. 9 Transportation of Hazardous Goods, and DOT by 49 CFR 173.3 (c); 173.12 (b). Secondary containment compliance follows 40 CFR 264.175 and 29 CFR 1910 (HAZWOPER).

Comments: Products help control hazardous materials whether in transportation or storage. We have the best stationary and portable containment systems in the industry.

Source of Information: Vendor

Treatment

Company Name/POC ENSR Consulting and Engineering/Ellen Moyer, Ph.D. P.E.
35 Nagog Park
Acton, Massachusetts 01720

E-Mail Address

Product/Service Bioventing

Phone Number 508 635-9500

Process Type Bioventing

Fax Number 508 635-9180

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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 vadose 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 bioventing at a particular site is determined by field tests to measure the soil permeability and the vertical or horizontal vent radius of influence. In situ respirometry is also conducted to determine potential oxygen utilization rates and related stoichiometry based contaminant degradation rates.

Product/Service Maturity: Commercial use experience

Performance History: ENSR, along with many other environmental engineering firms, 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 bioventing of vadose zone soils include low soil permeability, low moisture or nutrient levels or inability to distribute moisture and nutrients, excessive contaminant levels affecting soil toxicity or soil wetting characteristics, low temperature restriction of degradation rates, low inherent biodegradability of contaminants of concern, presence of more easily degradable or preferred alternative carbon sources, and extreme soil pH.

Source of Information: Vendor

Company Name/POC	ENSR Consulting and Engineering/Gregory Smith 740 Posquinelli Drive Westmont, Illinois 60559		
E-Mail Address			
Product/Service	Anaerobic Biotransformation	Phone Number	708 837-1700
Process Type	Biodegradation (In Situ)	Fax Number	708 850-5307

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service Maturity: Commercial use experience

Performance History: ENSR has been operating a full scale remediation system based on biotransformation combined with steam injection for approximately five 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 was completed September 1995. 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 may require a permit in most states depending upon the nature of the aquifer.

Source of Information: Vendor

Treatment

Company Name/POC ENSR Consulting and Engineering/Ralph Baker, Ph.D. CPSS 35 Nagog Park Acton, Massachusetts 01720		
E-Mail Address		
Product/Service	Bioremediation	Phone Number 508 635-9500
Process Type	Solid Phase Biological Treatment	Fax Number 508 635-9180

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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 effective permeable barrier to contaminant migration. During construction of the treatment cell the soil is thoroughly mixed and nutrients or bulking agents are added as appropriate.

Product/Service Maturity: Commercial use experience

Performance History: For larger projects, it may be necessary to demonstrate the process at the site on a pilot-scale basis 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 minimizing 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: Vendor

Company Name/POC	Entec Europe/Dr. I. J. Fletcher 160-162, Abbey Foregate Shrewsbury Shropshire, U.K. SY26AL	
E-Mail Address		
Product/Service	Murr System for Remediation of Contaminated Soils	Phone Number 01743 236464
Process Type	Solid Phase Biological Treatment	Fax Number 1743 236303

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service 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, Edelhoft, 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: Vendor

Company Name/POC	Entropic Systems, Inc./R. Kaiser P.O. Box 397 Winchester, Massachusetts 01890		
E-Mail Address			
Product/Service	Fluorocarbon Surfactant Decontamination	Phone Number	617 938-7588
Process Type	Chemical Surface Cleaning	Fax Number	617 938-7589

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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 dried within the enclosure of the system. 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.

Product/Service 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: 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. A large scale decontamination system

that will be capable to handling items up to 50 cm in length is currently under construction. However, there are no inherent technology limitations for decontamination of large scale industrial equipment. Site requirements to be determined.

Source of Information: Vendor

Company Name/POC	Envirex, Inc./Michael Doyle, P.E. 1901 South Prairie Avenue Waukesha, Wisconsin 53186
E-Mail Address	
Product/Service	GAC Fluid Bed Reactor
Process Type	Bioreactors
	Phone Number 414 547-0141
	Fax Number 414 547 4120

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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 inch 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 five 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: Vendor

January 1997
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Environmental Cleanup Privatization
Products and Services Directory

Company Name/POC	Enviro-Soil Remediation, Inc./Dmitri Wilkinson/Tom Evans P.O. Box 2212 Matthews, North Carolina 28106		
E-Mail Address	dmitriw@usa.pipeline.com		
Product/Service	Desorption Machine	Phone Number	704 821-6000
Process Type	Low Temperature Thermal Desorption	Fax Number	704 821-4036

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: Small Footprint LTDD Unit. Capacity 10-20 TPH. 1/2 day setup plus take down times. Unit contained on one 50 foot trailer and one 10 foot discharge conveyor. Uses liquid propane as heat source and diesel generator for electrical power supply. Unit is highly mobile and can be mobilized for relatively small volumes of contaminated soil (>100 cubic yards).

Product/Service Maturity: Commercial use experience

Performance History: Unit has been used commercially in sites in North Carolina. Successfully treated many types of soil at various levels of contamination.

Comments: Fully permitted in North Carolina.

Source of Information: Vendor

Company Name/POC Envirogen, Inc./William J. Guarini
4100 Quakerbridge Rd.
Lawrenceville, New Jersey 08648

E-Mail Address**Product/Service** Biodegradation of VOCs**Phone Number** 609 936-9300**Process Type** Bioreactors**Fax Number** 609 936-9221**Contaminants**

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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

Product/Service Maturity: Field demo complete**Performance History:** Technology based on successful pilot results in U.S. Air Force funded project.**Comments:** Full-scale fluidized bed reactor system commercially available.**Source of Information:** TechCon

Company Name/POC	Envirogen, Inc./William J. Guarini 4100 Quakerbridge Rd. Lawrenceville, New Jersey 08648		
E-Mail Address			
Product/Service	In Situ Bioremediation	Phone Number	609 936-9300
Process Type	Biodegradation (In Situ)	Fax Number	609 936-9221

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service 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

Company Name/POC	EnviroMetal Technologies, Inc./Larry Kwicinski 42 Arrow Road Guelph Ontario Canada N1K 1S6		
E-Mail Address	lkwicinski@beak.com.ca		
Product/Service	Metal-Enhanced Abiotic Degradation of Chlorinated Organic Compounds	Phone Number	519 824-0432
Process Type	Passive Treatment Walls	Fax Number	519 763-2378

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

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 is 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.

Product/Service 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 EnvironMetal 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. Site installations follow a phased approach. Phase 1 is a feasibility evaluation using data reviews to determine if the site geochemical and hydrogeologic conditions can support the technology. Phase 2 is a bench-scale column study using site groundwater to determine the VOC degradation rates. The data from this study is used in the design of the treatment zone. Phase 3 includes design and construction of the full-scale treatment system. Phase 4 is the monitoring of system performance.

Source of Information: TechCon

Company Name/POC Environmental Alternatives, Inc./Randy Martin
P.O. Box 160
564 B, Route 9
West Chesterfield, NH 03466

E-Mail Address**Product/Service**

CO2 Blast Cleaning

Phone Number 603 256-6440**Process Type**

Mechanical Surface Cleaning

Fax Number 603 256-6741**Contaminants**

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Company Name/POC	Environmental Compliance Products/Judy Robinson 19800 Mac Arthur Blvd Suite 510B Irvine, California 92715	
E-Mail Address		
Product/Service	Hazardous Material Storage	Phone Number 714 260-3888
Process Type	Containment	Fax Number 714 260-2299

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Off site On site

Brief Description: The latest and best concept in hazardous materials storage bldgs. Double stacking of drums (Factory Mutual approved), Seismic Secondary Containments Shelving (TM) for storage of flammables, combustibles, corrosives, chemicals, acids and pesticides. For use by Federal, State and Industrial. Units are forklift portable.

Product/Service Maturity: Commercial use experience

Performance History: County of Orange Household Hazardous Waste Centers.

Comments: None.

Source of Information: Vendor

Treatment

Company Name/POC	Environmental Dimensions, Inc./Stanley J. Waligora 4206 Louisiana Blvd, NE. Suite B Albuquerque, New Mexico 87109		
E-Mail Address			
Product/Service	Occupational and Environmental Health Physics and Industrial Hygiene Support Services	Phone Number	505 881-9427
Process Type	Other	Fax Number	505 881-0372

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application:

Brief Description: EDI has a unique combination of expertise and experience which is applied to environmental characterizations, assessments, surveillance, and restoration; all within the context of waste management requirements. Risk assessments use various models and scenarios for both radiological and non-radiological contaminants. Applied experience in analytical laboratory operations allows implementation of new requirements for quality assurance, certification, and regulatory compliance.

Product/Service Maturity: Commercial use experience

Performance History: For over five years, EDI has provided support for a DOE CERCLA site with the development of RI/FS work plans and assessments with RCRA integration. Waste characterization and management is a key aspect of work for several DOE Contractors. A major contract entailed multi-year continuous on-site quality assurance oversight of all aspects of the restoration of a large commercial uranium mill. Applied health physics support has been provided to NRC Licensees and to a number of DOE facilities.

Comments: None.

Source of Information: Vendor

Company Name/POC	Environmental Fuel Systems, Inc./Cal Chapman P.O. Box 1899 709 Main Street Bandera, Texas 78003		
E-Mail Address			
Product/Service	RECLAIM (TM) In Situ VOCs Partitioning/Extraction	Phone Number	210 796-7767
Process Type	Other	Fax Number	210 796-7484

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone) In-situ (vadose 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 contaminated media.

Product/Service Maturity: Commercial use experience

Performance History: The company has performed "RECLAIM" service commercially at 50 sites with VOC contamination in soil and/or groundwater for periods up to 10 months. TPH and BTEX levels have been consistently 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 recovered fuel residues.

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 (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: Vendor

Company Name/POC	Environmental Resource Center/Micheal Randall 101 Center Pointe Drive Cary North Carolina 27513		
E-Mail Address	mrandall@ercweb.com		
Product/Service	Environmental Cleanup Under RCRA and Superfund (seminar)	Phone Number	919 469-1585
Process Type	Other	Fax Number	919 469-4137

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application:

Brief Description: Seminar on environmental cleanup under RCRA and superfund.

Product/Service Maturity:

Performance History: Training has been provided to ALCOA, Boeing, Coca-Cola, Corning, Chevron, Dow Chemical, General Electric, IBM, Lockheed, Monsanto, PepsiCo, RJR Nabisco, Shell Oil, TRW, Texaco, U.S. Air Force, U.S. EPA, Union Camp, Volvo, Westinghouse and Xerox.

Comments: Courses offered include RCRA Overview, Identification of Hazardous Waste Under RCRA, RCRA Subtitle C Closure, RCRA Subtitle I Corrective Action, RCRA Subtitle C Corrective Action, CERCLA/SARA/NCP Overview, Preliminary Assessments/Site Inspections and the NPL, Expedited Response Actions, Risk Assessments, Remedial Investigations and Feasibility Studies, Record of Decisional and the Administrative Record, Remedial Design, Overview of Remediation Technologies, NPL Deletion and Post-Closure Certification, and Other Applicable Laws and Regulations.

Source of Information: Vendor

Company Name/POC	Environmental Tech. of N. America, Inc./Michael J. Lamore, P.E. 311-J S. Westgate Drive Greensboro, North Carolina 27407		
E-Mail Address			
Product/Service	Bioremediation	Phone Number	910 299-9998
Process Type	Solid Phase Biological Treatment	Fax Number	910 299-0655

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service 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

Company Name/POC	Environmental Technologies International/Troy DuGuay P.O. Box 453 Shillington, Pennsylvania 19607	
E-Mail Address		
Product/Service	Metals Recovery & Recycling System	Phone Number 610 796-9102
Process Type	Chemical Extraction	Fax Number 610 796-1453

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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. ETI completed a remediation project for lead and chromium in soils at the Stone Container site in Salt Lake City, Utah. ETI also completed full scale treatment of mercury in soils at Bedford, OH treatment facility.

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: Vendor

Company Name/POC	EnviroWall/Louis Breaux 1075 Brookhaven Drive Aiken, South Carolina 29803		
E-Mail Address	envirowall@dragon.gateway.net		
Product/Service	EnviroWall (TM)	Phone Number	803 641-6203
Process Type	Containment	Fax Number	803 641-7311

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: The Guide Box is constructed of various components that, when assembled, provide trench stability while maintaining a sediment/debris free open area in which to place barrier or treatment media. Guide Boxes are 8 feet long and interconnected to one another, along the length of the trench. Five to seven Guide Boxes are used in a "leap frog" type procedure. Removal of the Guide Box from the excavation is accomplished by disassembling into components and lifting from the trench. The width of the Guide Box determines the width of the open area that can be used for the installation of piping and filter/reaction material. An HDPE geomembrane is generally installed as the barrier material.

Product/Service Maturity: Field demo complete

Performance History: A new, innovative funnel and gate reactive barrier was successfully demonstrated for the U.S. Department of Energy, at their Savannah River Site in Aiken, South Carolina.

Comments: All construction methods used for the installation of the EnviroWall (TM) system are conducted in accordance with OSHA 1926 requirements.

Source of Information: Vendor

Company Name/POC	EODT Services, Inc./Matt Kaye, Monirul Haque 10511 Hardin Valley Road Building C Knoxville, Tennessee 37932		
E-Mail Address	EODTG@aol.com		
Product/Service	Biotechnical Processing of Explosives	Phone Number	423 690-6061
Process Type	Slurry Phase Biological Treatment	Fax Number	423 690-6065

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: EODT Services, Inc., in association with Oak Ridge National Laboratory, has developed several amoebae-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.

Product/Service 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: Vendor

Company Name/POC	EODT Services, Inc./Matt Kaye, Monirul Haque 10511 Hardin Valley Road Building C Knoxville, Tennessee 37932		
E-Mail Address	EODTG@aol.com		
Product/Service	Soil Flushing & Bioremediation	Phone Number	423 690-6061
Process Type	Soil Flushing	Fax Number	423 690-6065

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service 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: Vendor

Company Name/POC	EODT Services, Inc./Matt Kaye, Monirul Haque 10511 Hardin Valley Road Building C Knoxville, Tennessee 37932		
E-Mail Address	EODTG@aol.com		
Product/Service	Soil Flushing & Bioremediation	Phone Number	423 690-6061
Process Type	Bioreactors	Fax Number	423 690-6065

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC	EODT Services, Inc./Matt Kaye, Monirul Haque 10511 Hardin Valley Road Building C Knoxville, Tennessee 37932		
E-Mail Address	EODTG@aol.com		
Product/Service	Neutralization of Explosives and Hazardous Wastes	Phone Number	423 690-6061
Process Type	Other	Fax Number	423 690-6065

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: EODT Services, Inc. has the capability to provide on-site neutralization services of explosives and hazardous wastes. EODT-S' mobile Biotechnical Processing Unit (MBPU) can be mobilized on-site to extract/collect hazardous wastes from contaminated facility/site into the pressure vessel reactor and neutralized using appropriate neutralizing chemicals or EODT-S proprietary BIODISPERSANTS. The neutralized residue is disposed of according to local and federal laws and regulations.

Product/Service Maturity: Commercial use experience

Performance History: Oak Ridge Associated University (ORAU) under contract no DE-AC05-76OR00033 with the U.S. Department of Energy (DOE), issued a contract to EODT Services for reactive materials neutralization services. The project was conducted on-site at the Scarboro facility in Oak Ridge. EODT Services mobilized its fully equipped Mobile Biotechnical Processing Unit (MBPU) on site. In this project neutralization of perchloric acid with alkali solution was performed in the pressure vessel at normal pressure. The final residue had pH 10 and having no oxidizing capacity. The final residue volume was about 30 gallons having primarily low concentration of base salts.

Comments: The on-site neutralization service is safe, time-efficient, and cost effective when compared to off-site treatment/incineration.

Source of Information: Vendor

Company Name/POC	EPG Companies Inc./Jim Bailey P.O. Box 410 Rogers, Minnesota 55374	
E-Mail Address		
Product/Service	Vapor Extraction Systems	Phone Number 612 424-2613
Process Type	Vacuum Vapor Extraction	Fax Number 612 493-4812

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (vadose zone)

Brief Description: Vapor extraction system used to extract VOCs from contaminated soils in situ.

Product/Service Maturity: Commercial use experience

Performance History: A building mounted vapor extraction system was installed in Eagan, Minnesota, for Loral Defense Systems/DOD.

Comments: Project is ongoing. The contaminants are mostly TCE in low concentrations.

Source of Information: Vendor

Treatment

Company Name/POC	EPG Companies Inc./Jim Bailey P.O. Box 410 Rogers, Minnesota 55374		
E-Mail Address			
Product/Service	Thermal Oxidizers	Phone Number	612 424-2613
Process Type	Oxidation	Fax Number	612 493-4812

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (vadose zone)

Brief Description: Thermal Oxidizer used to destroy petroleum hydrocarbon vapors from a vapor extraction system.

Product/Service Maturity: Commercial use experience

Performance History: The Thermal Oxidizer was used at the Naples truck stop in Naples, Utah, for IT Corporation/USDOE.

Comments: Contamination levels dropped after eight months to warrant discontinuing use of thermal oxidizer.

Source of Information: Vendor

Company Name/POC	EPS Environmental, Inc./Noel Spindler 520 Victor Street Saddle Brook, New Jersey 07663		
E-Mail Address			
Product/Service	Mercon (TM)	Phone Number	201 368-7902
Process Type	Other	Fax Number	201 368-8522

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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 "MBS" that specializes in remediation of soils, sludges, etc.
"Other" contaminant identified as mercury.

Source of Information: Vendor

Company Name/POC ERM Group, The/Mary Beth Clay
855 Springdale Drive
Exton, Pennsylvania 19341

E-Mail Address mkt_info@erm.com

Product/Service Environmental Health and Safety Consulting

Phone Number 800 544-3117

Process Type Other

Fax Number 610 524-7335

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application:

Brief Description: The Environmental Resources Management (ERM) Group is a global consulting organization of 2,400 environmental, health and safety specialists in more than 90 locations in 22 countries. ERM is one of the world's largest providers of environmental consulting and engineering services, and offers air quality management; site remediation; water/wastewater treatment; hazardous and solid waste management; human health and ecological risk assessment; process safety; strategic environmental management; permitting assistance; health, safety and toxicology; and turnkey construction, providing a single source for all environmental challenges.

Product/Service Maturity:

Performance History: Contact company for performance data.

Comments: None.

Source of Information: Vendor

Company Name/POC	Etus, Inc./Richard Dunkel 1511 kastner Place Building #1 Technology Drive Sanford, Florida 32771		
E-Mail Address			
Product/Service	CNP-Plus Bioremediation	Phone Number	407 321-7910
Process Type	Solid Phase Biological Treatment	Fax Number	407 321-3098

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: The CNP-Plus is a specialty blended 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.

Product/Service 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

Treatment

Company Name/POC	Etus, Inc./Richard Dunkel 1511 Kastner Place Building #1 Technology Drive Sanford, Florida 32771		
E-Mail Address			
Product/Service	TR-Detox	Phone Number	407 321-7910
Process Type	Chemical Reduction	Fax Number	407 321-3098

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

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.

Product/Service 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

Company Name/POC	Exploration Products/Dennis Meddna N. 3005 Industrial Lane Bldg. S-21 Spokane, Washington 99216		
E-Mail Address			
Product/Service	Containment	Phone Number	800 448-7312
Process Type	Containment	Fax Number	509 927-8559

Contaminants

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

Media

☒ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application:

Brief Description: Portable tanks, bladders, berms, shelters, buildings and enclosures.

Product/Service Maturity: Commercial use experience

Performance History: Exploration Products - tanks, bladders, berms, and buildings - are used at DOE sites, military sites, and remote locations worldwide.

Comments: None.

Source of Information: Vendor

Company Name/POC	Filter Flow Technology, Inc./Tod S. Johnson, Ph.D. 122 Texas Ave. League City, Texas 77573	
E-Mail Address		
Product/Service	Solids Removal with Colloid Polishing Filter Method (R) (CPFM [R])	Phone Number 713 332-3438
Process Type	Filtration	Fax Number 713 332-3644

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On site

Brief Description: The Four-Stage Treatment Train for heavy metals and LLRW sludge remediation consists of : Stage I - Solids Slurry using an inexpensive, efficient, proprietary powder sorption and body feed product (ChemSorb-500 [R]); Stage II - Solids Separation in batch or continuous mode, solids filtration and dewatering employing rapid, high efficiency, bulk solids filtration and dewatering; Stage III - Colloid Polishing Filter Method (R) (CPFM [R]) treatment of the sludge secondary wastewater to remove colloidal, ionic and aggregated heavy metals and non-tritium radionuclides; and Stage IV - Solids Stabilization consisting of either direct pozolonic stabilization or fly ash mixing and hydraulic pressure stabilization to form structural blocks for safe disposal. A wide range of metals sludges, high salts metals sludges, oil hydrocarbon sludges, LLRW, TRU sludges and even LLMW sludges can be cost-effectively processed.

Product/Service Maturity: Commercial use experience

Performance History: The treatment train represents a hybrid system of which each of the treatment stages has extensive scientific and engineering basis, proof-of-principle testing data and applications base. The Stage I - ChemSorb-500 (R) slurry technique has been tested at more than 20 sludge projects and extensive lab and field test data are available to demonstrate method efficacy. The basic Stage II - Solids Separation Method has been used commercially for five years and equipment improvements and operational cost-reductions have been incorporated into the FFT design. The CPFM (R) (Stage III) has been tested at numerous groundwater sites and more than 50 industrial wastewater sites and is recognized by the USEPA and USDOE as an innovative technology for removing radionuclides and heavy metals from water. The Stage IV methods are based on extensive bench, field and commercial solids stabilization projects and represent state-of-the-art methodology for meeting EPA Paint filter and TCLP leaching criteria.

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 radionuclide 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: Vendor

Treatment

Company Name/POC	Filter Flow Technology, Inc./Tod S. Johnson, Ph.D. 122 Texas Ave. League City, Texas 77573		
E-Mail Address			
Product/Service	Colloid Polishing Filter Method (R) (CPFM [R])	Phone Number	713 332-3438
Process Type	Filtration	Fax Number	713 332-3644

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On site

Brief Description: Efficient, cost-effective polishing filter for colloidal, ionic heavy metals and non-tritium, radionuclide groundwater pollutants. Reusable, deep beds cartridges or disposable filter packs (for field mobile units) have been designed to remove inorganic metallic pollutants by chem-sorption, chemical binding and exchange phenomena to ppb and lower concentrations for strict discharge MCLs. The methodology represents a hybrid/sorption and ion exchange technique employing sorption bed particles (Filter Flow-1000 [R]) consisting of a blend of several high meq/g, reusable, inorganic crystalline materials that can be used to treat a wide range of mono-, di-, tri- and high valence metals and alpha or beta emitting isotopes excluding 3H by modifying the bend and using single or mixed bed configurations. The methodology has application for groundwater remediation at uranium, LLRW and LLMW sites in addition to heavy metals treatment. Water recycling is optional. Reduced remediation costs of contaminated water can be achieved via high performance plus volume minimization of the secondary solid wastes.

Product/Service Maturity: Commercial use experience

Performance History: Extensive lab and field testing have been conducted. Technical reports and publications are available with representative data for some 40 groundwater sites around the USA. Methodology was evaluated under EPA SITE Demo Program at DOE Rocky Flats and designated as a BAT for heavy metals, uranium, plutonium, americium and LLRW. Field test data 90 Sr obtained by Bechtel Hanford Company and CH2M Hill Engineering at the Hanford 100N Springs Groundwater Project and Westinghouse Waltz Mill Plant (PA) has demonstrated efficacy of methodology. Test data for 18 heavy metals, uranium, TRU, 90 Sr, 60 Co, 137 Cs and NORM removal has been reported. Removal Efficiencies in the range of 99 - >99.9% with high DF values have been consistently observed when the influent TSS and TPH are kept low and adequate sorption bed residence times employed.

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 radionuclide pollutants in primary and secondary wastewater down to ppb, ppt, but cannot process moderate or high TSS water (Requires pre-solids removal). This

January 1997

T 198

Environmental Cleanup Privatization
Products and Services Directory

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: Vendor

Company Name/POC	First Environment, Inc./Rick Dorrier 90 Riverdale Road Riverdale, New Jersey 07457		
E-Mail Address			
Product/Service	FE-Active (TM)	Phone Number	201 616-9700
Process Type	Dual Phase Extraction	Fax Number	201 616-1930

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone) In-situ (vadose 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 rapidly lowering the water table by high vacuum dewatering. The next step, air injection, 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.

Product/Service 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, Raoult's and Henry's Law constants. Video available on request.

Source of Information: Vendor

Company Name/POC	FLO TREND Systems, Inc./Gerald Lott 707 Lehman Houston, Texas 77018		
E-Mail Address			
Product/Service	Soil Washing	Phone Number	713 699-0152
Process Type	Soil Washing	Fax Number	713 699-8054

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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
Environmental Cleanup Privatization
Products and Services Directory

January 1997
T 201

Company Name/POC Flow International Environmental Application Division/Tom Cross
23500 64th South
Kent, Washington 98032

E-Mail Address

Product/Service Ultrahigh - Pressure Waterjet Equipment

Phone Number 206 813-9370

Process Type Mechanical Surface Cleaning

Fax Number 206 813-3285

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Company Name/POC	Fluid Tech, Inc./Dean Rowsell 4335 West Tropicana Avenue Suite 3 Las Vegas, Nevada 89103		
E-Mail Address			
Product/Service	Treatment Agents for In-Situ Infiltration	Phone Number	702 871 1884
Process Type	Solidification/Stabilization (In Situ)	Fax Number	702 871-3629

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service 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: Vendor

Company Name/POC	Fluid Tech, Inc./Dean Rowsell 4335 West Tropicana Avenue Suite 3 Las Vegas, Nevada 89103		
E-Mail Address			
Product/Service	Treatment Agents for In-Situ Infiltration	Phone Number	702 871 1884
Process Type	Containment	Fax Number	702 871-3629

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service 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: Vendor

Company Name/POC	Fluor Daniel GTI/Jim V. Rouse 1626 Cole Boulevard Golden, Colorado 80401		
E-Mail Address			
Product/Service	In-situ Fixation (FIX) of Radionuclides and Heavy Metals	Phone Number	303 231-8913
Process Type	Solidification/Stabilization (In Situ)	Fax Number	303 231-8901

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone)

Brief Description: Achieves in-situ remediation of uranium, chromium, molybdenum, and selenium 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 metals 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.

Product/Service Maturity: Commercial use experience

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 applied at 4 sites with 1 closure.

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

Treatment

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.

Home Fax number (303) 526-2795

Source of Information: Vendor

Company Name/POC	Foss Environmental Services/Rick Janecek 5420 N. Lagoon Portland, Oregon 97217		
E-Mail Address			
Product/Service	PCB Line Cleaning	Phone Number	503 283-1150
Process Type	Chemical Surface Cleaning	Fax Number	503 289-6568

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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

Company Name/POC Four Seasons Environmental Inc./Bill Ballance
3107 S. Elm-Eugene Street
Greensboro, North Carolina 27406

E-Mail Address**Product/Service** Horizontal Soil Vapor Extraction**Phone Number** 910 273-2718**Process Type** Soil Vapor Extraction (In Situ)**Fax Number** 910 274-5798**Contaminants**

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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

Company Name/POC	G.E.M., Inc./Cleve A. Bond P.O. Box 397 Highway 67 South Malvern, Arkansas 72104	
E-Mail Address		
Product/Service	Chemical Treatment-Reduction	Phone Number 501 337-9410
Process Type	Chemical Reduction	Fax Number 501 337-1208

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On site Non-intrusive

Brief Description: The operating principle is based upon the reaction of acid to dissolve wood treated with chrome, copper arsenate and other materials and taking the metals into solution. The acids and metals are then separated, leaving the metals to be reused or disposed of properly, and the acids to be reused or neutralized.

Product/Service Maturity: Bench scale testing only

Performance History: Performance data are available.

Comments: The process was developed to dispose of chromated copper arsenate wood treating plant waste, although hazardous waste site storage is marginally more economical at the present time, for this waste, it does not eliminate the waste. This process can be used to dispose of waste such as munitions boxes and crates, mine timbers and other wood waste containing arsenate.

Source of Information: Vendor

Company Name/POC G.E.M., Inc./Cleve A. Bond
P.O. Box 397
Highway 67 South
Malvern, Arkansas 72104

E-Mail Address**Product/Service** Chemical Treatment-Oxidation**Phone Number** 501 337-9410**Process Type** Chemical Oxidation**Fax Number** 501 337-1208**Contaminants**

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On site Non-intrusive

Brief Description: The operating principle is based upon the reaction of acid to dissolve wood treated with chrome, copper arsenate and other materials and taking the metals into solution. The acids and metals are then separated, leaving the metals to be reused or disposed of properly, and the acids to be reused or neutralized.

Product/Service Maturity: Bench scale testing only**Performance History:** Performance data are available.

Comments: The process was developed to dispose of chromated copper arsenate wood treating plant waste, although hazardous waste site storage is marginally more economical at the present time, for this waste, it does not eliminate the waste. This process can be used to dispose of waste such as munitions boxes and crates, mine timbers and other wood waste containing arsenate.

Source of Information: Vendor

Company Name/POC	GDT Corporation/P.K. Overbeck 20805 N. 19th Ave. Suite 1 Phoenix, Arizona 85027	
E-Mail Address		
Product/Service	GDT Process Oxidation/Degasification	Phone Number 602 587-8858
Process Type	Air Sparging	Fax Number 602 587-1511

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: On site

Brief Description: The GDT Process is an extremely efficient, cost-effective patent pending treatment process for removing unwanted gases and organics from water/waste water. The solution to be treated undergoes a dynamic introduction of treatment gas (air/oxygen or nitrogen) through a Mazzei injector. Unwanted material is forced from solution and removed immediately by a patented centrifugal degas-separator. The total treatment process is conducted under pressure which maximizes gas transfer efficiency while eliminating fouling typical in packed tower/shallow tray atmospheric processing.

This same technology can be used to generate high efficiency mass transfer of ozone to solution for disinfection, advanced organic oxidation and microflocculation.

Product/Service Maturity: Commercial use experience Field demo complete

Performance History: The GDT Process has been used successfully in municipal H₂S removal, high concentration ozone mass transfer for disinfection and industrial entrained gas removal and deoxygenation. Pilot plant and field studies on Radon, CO₂ and VOC reduction have shown success and competitive advantage to conventional technologies.

Comments: The GDT Process operates under pressure eliminating packing and surface fouling; experienced with conventional technologies.

Source of Information: Vendor

Company Name/POC	General Atomics/Anthony Gattuso 3550 General Atomics Court San Diego, California 92121	
E-Mail Address		
Product/Service	Acoustic Barrier Particulate Separator	Phone Number 619 455-2910
Process Type	Filtration	Fax Number 619 455-3679

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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

Company Name/POC	General Carbon Corporation/Bob Muller 33 Paterson Street Paterson, New Jersey 07501		
E-Mail Address			
Product/Service	Activated Carbon and Related Filtration Equipment	Phone Number	201 523-2223
Process Type	Filtration	Fax Number	201 523-1494

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application:

Brief Description: We are the General Carbon Corporation and we have been in the activated carbon business for over 35 years. We carry a large inventory of carbon for the treatment of both air and water. We have many different types of carbon available for immediate shipment, including pelletized, granular, powdered and reactivated, made out of several different materials such as coal, coconut shell and wood.

We also carry a complete line of carbon adsorption equipment. Vessels, canisters and panels of all sizes are available for the purification of vapor and liquid streams. In addition to the selling of equipment, we also have the capability to service all existing carbon systems on site. This includes the removal and regeneration of the spent carbon, and its replacement with new carbon.

General Carbon also specializes in impregnated carbons, and in specialty packaging. We have on site the machinery to impregnate carbon for specific needs. In addition, we possess the machinery to package activated carbon in most any way for most any custom application.

Product/Service Maturity: Commercial use experience

Performance History: Performance data are available.
Activated carbon filtration since 1957.

Comments: Activated carbon is an efficient and inexpensive way to remove organic contaminants from vapor or liquid streams. The carbon can be housed in any number of different filtration systems suitable for most any application. Once the carbon becomes saturated with contaminants, the spent product can be recycled through reactivation.

Source of Information: Vendor

Treatment

Company Name/POC	General Electric, Corp. R&D/Mark Sneeringer P.O. Box 8, K1-3C3; Schenectady, New York 12301		
E-Mail Address			
Product/Service	Mercury Removal	Phone Number	518 387-5334
Process Type	Soil Washing	Fax Number	518 387-7611

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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

January 1997
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Environmental Cleanup Privatization
Products and Services Directory

Company Name/POC	Geo-Microbial Technologies, Inc./D.O. Hitzman P.O. Box 132, East Main Street Ochelata, Oklahoma 74051		
E-Mail Address			
Product/Service	Anaerobic Metal Removal Technology (AMR)	Phone Number	918 535-2281
Process Type	Biodegradation (In Situ)	Fax Number	918 535-2564

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

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

Product/Service 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: Vendor

Company Name/POC	Geo-Microbial Technologies, Inc./D.O. Hitzman P.O. Box 132, East Main Street Ochelata, Oklahoma 74051	
E-Mail Address		
Product/Service	Anaerobic Metal Removal Technology (AMR)	Phone Number 918 535-2281
Process Type	Bioreactors	Fax Number 918 535-2564

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service Maturity: Bench scale testing only

Performance History: Development for removal of metals from spent coal liquefaction 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: Vendor

Company Name/POC	Geosafe Corporation/James E. Hansen 2950 George Washington Way Richland, Washington. 99352	
E-Mail Address		
Product/Service	In Situ Vitrification	Phone Number 509 375-0710
Process Type	In Situ Vitrification	Fax Number 509 375-7721

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

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) in the dry zone, which is adjacent to the melt zone. Melt temperatures typically range from 1,600 degrees Celsius to 2,000 degrees Celsius. 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, pesticides, explosives, PCPs, 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. The process has been demonstrated, and is capable of treating large amounts of waste and debris together with the contaminated earthen media. Debris types that have been successfully processed include concrete, asphalt, scrap metal, drums, glass, rock, plastic, wood, vegetation, HEPA filters, and similar materials.

Product/Service Maturity: Commercial use experience

Performance History: The ISV process has been tested/demonstrated over 200 times at various scales. It is currently being applied with the large-scale on a commercial basis, where in three projects totaling 15,000 tons have been completed. Numerous 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.

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 at 37 wt percent has been successfully demonstrated. 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 a full operating crew and related management, are available. For more information contact the vendor.

Source of Information: Vendor

Company Name/POC	Geotech Environmental/Crif Chilson/Jeff Sauck 1441 W 46th Ave. #17 Denver, Colorado 80211		
E-Mail Address	geotech@ix.netcom.com		
Product/Service	Filtration	Phone Number	800 833-7958
Process Type	Filtration	Fax Number	303 477-1230

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Broad range of groundwater monitoring, sampling, filtration, analysis and remediation equipment.

Product/Service Maturity: Commercial use experience

Performance History: Performance data are available. 20 years in business.

Comments: None.

Source of Information: Vendor

Company Name/POC	Global Environmental Engineering/Robert H. Douglas 2640 Aero Park Dr. Traverse City, Michigan 49686		
E-Mail Address			
Product/Service	Bioventing by Global Environmental Inc.	Phone Number	616 947-1000
Process Type	Bioventing	Fax Number	619 947-1044

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service 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

Company Name/POC	Global Environmental Engineering/Robert H. Douglas 2640 Aero Park Dr. Traverse City, Michigan 49686	
E-Mail Address		
Product/Service	Bioventing by Global Environmental Inc.	Phone Number 616 947-1000
Process Type	Co-Metabolic Processes	Fax Number 619 947-1044

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service 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

Treatment

Company Name/POC Global Equipment Marketing Inc./Marshall Gralnick
P.O. Box 810483
Boca Raton, Florida 33481-0483

E-Mail Address

Product/Service Mastermag and GEM

Phone Number 407 750-8662

Process Type Other

Fax Number 407 750-9507

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Off site On site

Brief Description: Complete range of magnetic separators for every requirement and applications. Latest technology in permanents, electros and rare earth magnets. Self cleaning and suspension and pulleys available with short notice.

Product/Service Maturity: Commercial use experience

Performance History: Worldwide references available on request for any application or requirement.

Comments: Magnets built with highest grade strontium (ceramic) ferrite available to produce a quality magnet. Electro magnets built with copper and external expansion tanks.

Source of Information: Vendor

Company Name/POC	Global Equipment Marketing Inc./Marshall Gralnick P.O. Box 810483 Boca Raton, Florida 33481-0483		
E-Mail Address			
Product/Service	TurboWash	Phone Number	407 750-8662
Process Type	Mechanical Surface Cleaning	Fax Number	407 750-9507

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Off site On site

Brief Description: TurboWash is a complete system to thoroughly clean trucks and other vehicles that are leaving dirty or contaminated sites. Unique TurboWashing heads deliver volumes of water with moderate PSI.

Product/Service Maturity: Commercial use experience

Performance History: Relatively new with several installations complete.

Comments: Dirty water and/or contaminated water can be collected in contained areas pumped into barriers and carted away for proper disposal, if necessary.

Source of Information: Vendor

Company Name/POC	Global Technologies/Customer Service 4927 N. Lydell Ave. Milwaukee, Wisconsin 53217		
E-Mail Address			
Product/Service	Catalytic Oxidizers, Thermal Incinerators, Caustic HCL Scrubbers	Phone Number	414 332-5987
Process Type	Incineration	Fax Number	414 332-4375

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ In-situ (saturated zone) In-situ (vadose zone) On site Non-intrusive

Brief Description: Global Technologies Vapor Treatment Module (VTM) Remedi-Cat (TM) catalytic oxidizer, destroys organic vapor contaminants that are discharged from soil vapor extraction and groundwater treatment systems, such as airstrippers, during site remediation.

The Remedi-Cat model is selected based on volume and airflow and desired destruction efficiency. During operation, VOC-laden air is drawn into the Remedi-Cat's fan and is discharged into the system's heat exchanger. The air passes through the tube side of the heat exchanger and into the burner, where the contaminated air is raised to the oxidizing temperature. When the VOC-laden air passes through the catalyst, an exothermic reaction takes place. The VOC's in the air stream are converted to carbon dioxide and water vapor.

The hot, purified air then passes on the shell side of the heat exchanger where the energy released by the reaction is used to preheat the incoming air. This minimized the system's fuel costs; in many cases the Remedi-Cat is self-sustaining. Finally, the contaminant-free air is exhausted into the atmosphere.

Product/Service Maturity: Commercial use experience

Performance History: Over 200 installed and operational systems.

Comments: None.

Source of Information: Vendor

Company Name/POC	Global Technologies/Customer Service 4927 N. Lydell Ave Milwaukee, Wisconsin 53217		
E-Mail Address			
Product/Service	Catalytic Oxidizers, Thermal Incinerators, Caustic HCL Scrubbers	Phone Number	414 332-5987
Process Type	Oxidation	Fax Number	414 332-4375

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ In-situ (saturated zone) In-situ (vadose zone) On site Non-intrusive

Brief Description: Global Technologies Vapor Treatment Module (VTM) Remedi-Cat (TM) catalytic oxidizer, destroys organic vapor contaminants that are discharged from soil vapor extraction and groundwater treatment systems, such as airstrippers, during site remediation.

The Remedi-Cat model is selected based on volume and airflow and desired destruction efficiency. During operation, VOC-laden air is drawn into the Remedi-Cat's fan and is discharged into the system's heat exchanger. The air passes through the tube side of the heat exchanger and into the burner, where the contaminated air is raised to the oxidizing temperature. When the VOC-laden air passes through the catalyst, an exothermic reaction takes place. The VOC's in the air stream are converted to carbon dioxide and water vapor.

The hot, purified air then passes on the shell side of the heat exchanger where the energy released by the reaction is used to preheat the incoming air. This minimized the system's fuel costs; in many cases the Remedi-Cat is self-sustaining. Finally, the contaminant-free air is exhausted into the atmosphere.

Product/Service Maturity: Commercial use experience

Performance History: Over 200 installed and operational systems.

Comments: None.

Source of Information: Vendor

Company Name/POC	Global Technologies/Customer Service 4927 N. Lydell Ave Milwaukee, Wisconsin 53217		
E-Mail Address			
Product/Service	Catalytic Oxidizers, Thermal Incinerators, Caustic HCL Scrubbers	Phone Number	414 332-5987
Process Type	Other	Fax Number	414 332-4375

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ In-situ (saturated zone) In-situ (vadose zone) On site Non-intrusive

Brief Description: Global Technologies Vapor Treatment Module (VTM) Remedi-Cat (TM) catalytic oxidizer, destroys organic vapor contaminants that are discharged from soil vapor extraction and groundwater treatment systems, such as airstrippers, during site remediation. The Remedi-Cat model is selected based on volume and airflow and desired destruction efficiency. During operation, VOC-laden air is drawn into the Remedi-Cat's fan and is discharged into the system's heat exchanger. The air passes through the tube side of the heat exchanger and into the burner, where the contaminated air is raised to the oxidizing temperature. When the VOC-laden air passes through the catalyst, an exothermic reaction takes place. The VOC's in the air stream are converted to carbon dioxide and water vapor. The hot, purified air then passes on the shell side of the heat exchanger where the energy released by the reaction is used to preheat the incoming air. This minimized the system's fuel costs; in many cases the Remedi-Cat is self-sustaining. Finally, the contaminant-free air is exhausted into the atmosphere.

Product/Service Maturity: Commercial use experience

Performance History: Over 200 installed and operational systems.

Comments: None.

Source of Information: Vendor

Company Name/POC	Goodway Technologies Corporation/Customer Service 420 West Avenue Stamford, Connecticut 06902-6384		
E-Mail Address			
Product/Service	VAC-2.1-HEPA (Wet/Dry)	Phone Number	203 359-4708
Process Type	Filtration	Fax Number	203 359-9601

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application:

Brief Description: The Goodway Model VAC-2.1-HEPA Vacuum is ideal for all nuclear plant and toxic waste cleanup applications. With its dual motors and HEPA filter located under the containment tank, the operator can quickly change sealed tanks without exposure to the recovered material. Oversized carrying handles make moving the tank easy, even when wearing heavy gloves.

The VAC-2.1-HEPA is modular in design, which is perfect for hazardous waste removal. The top section is a sealed recovery tank which can be changed simply by unlatching and removing the tank, and locking a new tank in position. The lower modular units contain the HEPA filter and vacuum motors for easy maintenance. When recovering dry debris, the lower intake is used.

A disposable paper filter bag traps the majority of material - capacity 5 gallons (19 liters). Fine particles are filtered to 0.3 microns by a cloth filter, a Dacron insert bag, and ultimately, the HEPA filter. When recovering liquids or bulk materials, the upper intake is used - capacity 10 gallons (38 liters). Revolutionary AutoOff circuitry shuts off the motors when the tank is full.

Product/Service Maturity: Commercial use experience

Performance History: Developed in conjunction with local nuclear power plant to exactly match the needs of the nuclear industry, as well as other toxic material recovery applications.

Comments: None.

Source of Information: Vendor

Company Name/POC	Grace Dearborn, Inc./I.J. Marvan 3451 Erindale Station Road P.O. Box 3060 Station A Mississauga, Ontario L5A 3T5	
E-Mail Address		
Product/Service	Daramond	Phone Number 905 279-2222
Process Type	Biodegradation (In Situ)	Fax Number 905 279-0020

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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

Company Name/POC	Grace Dearborn, Inc./I.J. Marvan 3451 Erindale Station Road P.O. Box 3060 Station A Mississauga, Ontario L5A 3T5		
E-Mail Address			
Product/Service	Daramond	Phone Number	905 279-2222
Process Type	Solid Phase Biological Treatment	Fax Number	905 279-0020

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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

Company Name/POC	Great Lakes Environmental, Inc./David Field 315 S. Stewart Ave. Addison, Illinois 60101-3300		
E-Mail Address	grtlakesi@aol.com		
Product/Service	Filtration	Phone Number	708 543-9444
Process Type	Filtration	Fax Number	708 543-1169

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: On site

Brief Description: Great Lakes Environmental, Inc., was incorporated in October 1978 to supply industrial wastewater pretreatment equipment to the industrial market.

The Model SRC Slant Rib Coalescing Oil Water Separator was the first product marketed by GLE. It was well received and development of other industrial wastewater pretreatment products soon followed. Currently, GLE manufactures a complete line of Oil Water Separators, a range of Inclined Plate Clarifiers, Dissolved Air Flotation Systems, Rotary Vacuum Precoat Filters, and an automatic backwashing multi-media sand filter. The unique feature of Great Lakes Environmental, Inc. is our ability to incorporate the complete physical chemical treatment packages and system controls around the central core of products. We offer a complete treatment package to the consultant and end user.

Complete process design and mechanical specifications are prepared by dedicated GLE staff at the corporate Headquarters in Addison, IL. Fabrication is accomplished by a core of competent, independent fabrication shops while component assembly, performance checks, and inspection of the integrated unitized skids are completed at our shop. Experienced personnel assist in operator training and start up after installation. We offer lifetime back up support.

Product/Service Maturity: Commercial use experience

Performance History: Asahi Motor Wheel - Kentucky: Plant manufactures wheel covers for most of the Japanese cars built in the U.S. Design flow was 50 GPM, system now running over 75 GPM. Wastewater contained oils and most heavy metals which required reduction to various levels.

Exide Battery - South Carolina: Plant manufactures lead batteries. Treatment system was for rain run-off and drainage which was contaminated with lead and zinc. Discharge point is a creek. Water is collected and stored in a 3,000,000 gallon pond. Treatment system runs near continuously. Influent lead shows 3.35 mg/l on composites and zinc .510. Composite effluents values are .022 mg/l for lead and <.050 for zinc.

Watec - Texas: There are two sites, Odessa I and Odessa II. Both are designed for approximately 100 GPM. Influent chrome levels ranged from 2.3 mg/l to 3.1 mg/l at Odessa I and .37 mg/l to .53 mg/l at Odessa II. Effluent are generally less than .050 mg/l.

January 1997

T 230

Environmental Cleanup Privatization
Products and Services Directory

Merced - California: Project is the treatment of contaminated groundwater. Design flow is 350 GPM. Influent metals range up to 10.0 mg/l as hexavalent chrome. Effluent values are consistently below .003 mg/l.

Comments: None.

Source of Information: Vendor

Company Name/POC	Groundwater & Environmental Services, Inc./Bob Rousseau		
	1340 Campus Parkway		
	P.O. Box 1750		
	Wall, New Jersey 07719		
E-Mail Address			
Product/Service	Soil Vapor Extraction	Phone Number	908 919-1646
Process Type	Soil Vapor Extraction (In Situ)	Fax Number	908 919-1678

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Soil Venting is ideally suited for remediation of the unsaturated zone. However, GES has utilized this technology in tandem with groundwater extraction to enhance site remediation activities. The contaminant must be relatively volatile and exert vapor pressure $P(v)$ 0.001 atm at the ambient temperature. Gasoline and trichloroethylene are examples of such solvents suitable for soil vapor extraction. Soil should be relatively permeable to air flow; a permeability of more than 1 darcy (silty sands) is a good guideline.

Product/Service Maturity: Commercial use experience

Performance History: GES has utilized Soil Vapor Extraction at numerous remediation sites. At a retail service station site in Villanova, Pennsylvania, GES augmented an existing groundwater remedial system with a soil vapor extraction system. The soil vapor extraction consisted of five horizontal vapor legs and four vertical air infiltration points. A phased remedial approach for the removal and treatment of petroleum hydrocarbon vapors from the vadose soils was implemented at this site. Initially, in-situ soil remediation was conducted using a trailer-mounted, internal combustion treatment unit capable of vacuums up to eighteen inches of mercury and providing self-sufficient destruction of the petroleum hydrocarbon vapors. Through pilot testing efforts, GES designed a pattern of vapor leg configurations which continuously alternated during the thirty day remedial effort to allow the most efficient removal of petroleum hydrocarbons. Field and laboratory monitoring of the vapor stream data sets exhibited a downward trend in hydrocarbon concentrations.

Comments: None.

Source of Information: Vendor

Company Name/POC	Groundwater & Environmental Services, Inc./Bob Rousseau 1340 Campus Parkway P.O. Box 1750 Wall, New Jersey 07719		
E-Mail Address			
Product/Service	Air Sparging	Phone Number	908 919-1646
Process Type	Air Sparging	Fax Number	908 919-1678

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone) On site

Brief Description: The technology referred to air sparging is a process by which air is injected under pressure below the water table. The air bubbles which have formed traverse laterally (i.e., vertically and horizontally) through the soil column creating air filled regimes in the saturated zone. Volatile compounds that are exposed in this sparged air environment "evaporate" and are carried by the air movement into the vadose zone where they can be captured by a vent system.

Product/Service Maturity: Commercial use experience

Performance History: At a Benjamin Moore industrial site in Millford, Massachusetts, GES is currently conducting a source area reduction measure using air sparging and vapor extraction for bioremediation purposes. Potential cost savings for this remediation technique will approach \$500,000 when compared to excavation and off-site disposal.

A remedial system consisting of groundwater and soil vapor recovery, bioremediation and air sparging were designed for Sun Company, Inc. in Atlantic City, New Jersey, to remediate soils and groundwater impacted by separate and dissolved phase hydrocarbons. This system includes hydraulic control of groundwater beneath the site utilizing recovery wells, a hydraulic drain consisting of a trench backfilled with highly permeable material and groundwater recovery from two existing monitoring wells. An air sparge system was installed to enhance remediation of groundwater and soil. This recovery system is capable of recovering vapors from soils in the unsaturated zone.

Comments: None.

Source of Information: Vendor

Company Name/POC	Groundwater & Environmental Services, Inc./Bob Rousseau	
	1340 Campus Parkway	
	P.O. Box 1750	
	Wall, New Jersey 07719	
E-Mail Address		
Product/Service	Dual Phase Extraction	Phone Number 908 919-1646
Process Type	Dual Phase Extraction	Fax Number 908 919-1678

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: GES has expertise in dual phase extraction. This is a remedial technique which removes liquid (groundwater, free product) and vapor phases from the subsurface. Typically, the process includes the application of a moderate to high vacuum. The liquid phases can be extracted together or separately. Properly applied it can out perform conventional pump and treat technologies by orders of magnitude.

Product/Service Maturity: Commercial use experience

Performance History: GES was contracted to design, and construct a two-well groundwater remedial system at this retail petroleum facility in Spring City, Pennsylvania. Contaminants of concern include benzene, toluene, ethylbenzene, and xylenes (BTEX). GES designed and installed the remedial system which included the use of high vacuum extraction to extract vapor phase hydrocarbons from the vadose sediments. At an Oil Terminal in Holbrook, New Jersey, GES designed a remedial system consisting of dual phase extraction and separate phase product recovery which was designed to remediate separate, and dissolved phase hydrocarbon impacted soils and groundwater. Active recovery efforts will be followed by a period of post-remedial monitoring. The remedial system was implemented in January of 1995.

Comments: None.

Source of Information: Vendor

Company Name/POC	Groundwater Technology, Inc./Christopher Nelson 6436 S. Racine Circle Suite 200 Englewood, Colorado 80111		
E-Mail Address			
Product/Service	In Situ Ozonation	Phone Number	303 799-4241
Process Type	Oxidation	Fax Number	303 799-4274

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Product/Service Maturity: Field demo complete

Performance History: Laboratory to full-scale application on several different contaminants and sites.

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: Vendor

Company Name/POC	Groundwater Technology, Inc./Richard Brown 310 Horizon Center Dr. Trenton, New Jersey 08691		
E-Mail Address			
Product/Service	Air Sparging	Phone Number	609 587-0300
Process Type	Air Sparging	Fax Number	609 587-7908

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Company Name/POC Groundwater Technology, Inc./Richard Brown
310 Horizon Center Dr.
Trenton, New Jersey 08691

E-Mail Address**Product/Service**

Bioaugmented Soil Vapor Extraction (BSVE)

Phone Number 609 587-0300**Process Type**

Solid Phase Biological Treatment

Fax Number 609 587-7908**Contaminants**

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

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.

Product/Service 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: Vendor

Company Name/POC Groundwater Technology, Inc./Richard Brown
310 Horizon Center Dr.
Trenton, New Jersey 08691

E-Mail Address

Product/Service Bioaugmented Soil Vapor Extraction (BSVE)

Phone Number 609 587-0300

Process Type Bioventing

Fax Number 609 587-7908

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

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.

Product/Service 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: Vendor

Treatment

Company Name/POC	GRS/G. Pottecher 13 Villa Croix Nivert 75015 Paris, France	
E-Mail Address		
Product/Service	OAG-X Solvent Extraction	Phone Number 33 1 53 69 61 80
Process Type	Chemical Extraction	Fax Number 33 1 4734 6855

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service 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: Vendor

Company Name/POC	GRS/G. Pottecher 13 Villa Croix Nivert 75015 Paris, France	
E-Mail Address		
Product/Service	In-Situ Surfactants Flushing (ISSF)	Phone Number 33 1 53 69 61 80
Process Type	Soil Flushing	Fax Number 33 1 4734 6855

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service Maturity: Pilot plant testing

Performance History: One field pilot test. 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 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: Vendor

Company Name/POC GRS/Pier Mantovani 13 Villa Croix Nivert 75015 Paris, France		
E-Mail Address		
Product/Service	In-Situ Trench Stripping (ISTS)	Phone Number 33 1 53 69 61 80
Process Type	Passive Treatment Walls	Fax Number 33 1 4734 6855

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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).

Product/Service Maturity: Bench scale testing only

Performance History: In-situ well stripping is widely used and successfully implemented on VOC contaminated aquifers in Europe and the U.S.. ISTS 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 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 is 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: Vendor

Company Name/POC	GTS Duretek, Inc./William Greenman 8955 Gillford Road Suite 200 Columbia, Maryland 21046		
E-Mail Address			
Product/Service	Vitrification	Phone Number	410 312-5100
Process Type	Vitrification (Ex Situ)	Fax Number	301 621-8211

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: Vitrification processes wastes into stable, non-degradable, chemically durable glass that is highly leach resistant. GTS Duretek 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.

Product/Service Maturity: Commercial use experience

Performance History: Performance data are available.

GTS Duretek 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

Company Name/POC	GZA Geoenvironmental, Inc./John J. Balco 320 Needham Street Newton Upper Falls, Massachusetts 02164		
E-Mail Address			
Product/Service	Cut Off Walls/Hydrodynamic Isolation	Phone Number	617 969-0700
Process Type	Containment	Fax Number	615 965-7769

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service 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 aerial 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

Company Name/POC	H. Krantz-TKT/Martinsteig, Hans P.O. Box 20 40 52022 Aachen, Germany		
E-Mail Address			
Product/Service	H. Krantz-TKT GmbH	Phone Number	0241 434 371
Process Type	Filtration	Fax Number	011 4924 1434 591

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site Other Application

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).

Product/Service 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 dropled 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.

Other applications include: Flue-gas purification, dust filtration, and oil mist filtration.

Source of Information: Vendor

Company Name/POC	H2O, Inc./c/o ADTECHS, Inc./a wholly owned subsidiary of JGC Corp./Lou Reynolds/Dennis Wilkie 2411 Dulles Corner Park Suite 520 Herndon, Virginia 22071		
E-Mail Address			
Product/Service	E-Process	Phone Number	703 713-9000
Process Type	Chemical Reduction	Fax Number	703 713-9101

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Off site On 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.

Product/Service 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: Vendor

Company Name/POC H2O Science, Inc./Mark P. Ausburn
5500 Bolsa Avenue
Suite 105
Huntington Beach, California 92649

E-Mail Address

Product/Service Bioventing

Phone Number 714 379-1157

Process Type Bioventing

Fax Number 714 379-1160

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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 reaction.

Product/Service Maturity: Commercial use experience

Performance History: H2O Science is currently operating a bioventing system for a gas plant in Alberta, Canada. During 2.5 years of operation, system has removed 25,000 Kg of hydrocarbons. Due to removal of hydrocarbons, biodegradation rate has fallen from 50 to less than 1 mg/Kg/day. Confirmation/sampling planned for Spring of 1996.

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: Vendor

Company Name/POC	Hansa Projekt Anlagentechnik GmbH/Michael Szukala Tarpenring 4 22419 Hamburg, Germany		
E-Mail Address			
Product/Service	High Power Impulse Decontamination	Phone Number	49 40 527 02 62
Process Type	Mechanical Surface Cleaning	Fax Number	49 40 527 56 64

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: This technology can be used in cases where CO₂/ice and chemical deco methods are not sufficient. Especially crystalline contamination in tanks with high activity can be decontaminated.

Product/Service 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 automatized process, can be connected to remotely operated equipment.

Source of Information: Vendor

Company Name/POC	HazTech News/Cathy Dombrowski 14120 Huckleberry Lane Silver Spring, Maryland 20906-2012		
E-Mail Address	HazTECH@ix.netcom.com		
Product/Service	Publication	Phone Number	301 871-3289
Process Type	Other	Fax Number	301 460-5859

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Other Application

Brief Description: HazTech News described technologies for cleaning contaminated soil and groundwater and managing hazardous wastes.

Product/Service Maturity:

Performance History: Published since 1986.

Comments: None.

Source of Information: Vendor

Company Name/POC	Hedeselskabet/Mr Thomas Larsen Ringstedvej 20 DK-4000 Roskilde, Denmark		
E-Mail Address			
Product/Service	Mobile Cleaning Unit (Biotreatment)	Phone Number	45 4630 03 10
Process Type	Other	Fax Number	45 4630 0311

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: Technology Type: Biodegradation (Ex-situ). Biodegradation of VOCs and PAHs in water (aerobic degradation). Replaces activated carbon.

Product/Service 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

Treatment

Company Name/POC Heyl and Patterson Inc./Customer Service
Renneburg Division
P.O. Box 36
Pittsburg, Pennsylvania 15730

E-Mail Address

Product/Service Thermal Desorbtion Equipment (calciners)
Process Type High Temperature Thermal Desorption

Phone Number 412 788-6900

Fax Number 412 788-6913

Contaminants

☒ Pesticides/Herbicides
☒ Petroleum Hydrocarbons
☒ Nonhalogenated VOC

☒ Heavy Metals
☒ Radionuclides
☒ Halogenated VOC

☒ PCB
☒ SVOC
☐ N/A

☒ Explosives/Propellants
☒ Other Contaminant

Media

☐ Surface Impoundment
☐ Construction Materials/Debris
☐ Sediments in Water
☐ Process Wastes and Sludge

☐ Soil
☐ Landfills
☐ Vapor Phase

☐ Process Water
☐ Drums/Tanks/Piping
☐ Free Product

☐ Surface Water
☐ Containers/Equipment
☐ Ground Water

Application: Ex-situ On site

Brief Description:

Product/Service Maturity: Commercial use experience Pilot plant testing Bench scale testing only

Performance History: Companies include: OHN; Rust, Battelle, Carpender Tech; GNB; Gopher; and East Penn.

Comments:

Source of Information: Vendor

Company Name/POC	High Voltage Environmental Applications, Inc./William J. Cooper, Pres., Mike Nickelsen 9562 Doral Boulevard Miami, Florida 33178		
E-Mail Address	hvea@shadow.net		
Product/Service	Electron Beam Hazardous Waste Treatment (E-Beam)	Phone Number	305 593-5330
Process Type	Electron Beam	Fax Number	305 593-0071

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: The electron beam process is based on radiation chemistry. 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. The electron beam process can be used as a replacement technology for UV/O₃, UV/H₂O₂, and other advanced oxidation processes (AOPs), and in some cases incineration. The E-Beam equipment can also be easily incorporated into "treatment trains" that utilize a combination of treatment technologies (e.g., UV/H₂O₂ followed by E-Beam, followed by bioremediation), for the remediation of highly recalcitrant chemicals and/or complex media.

Product/Service Maturity: Commercial use experience

Performance History: HVEA's electron beam treatment systems are part of the EPA SITE Program, and are available for use on Superfund Sites. HVEA's mobile treatment system has been successfully demonstrated, as part of the EPA SITE Program, on solvent contaminated ground water at DOE's Savannah River Site, South Carolina in the fall of 1993. The electron beam process has demonstrated the successful destruction of over 140 hazardous organic chemicals from a variety of matrices: groundwater, surface water, industrial process wastewater, raw sewage, and slurried soils, sediments, and sludges. HVEA's mobile unit was been shipped to Germany on three occasions, where it has successfully treated numerous hazardous waste streams.

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 460 VAC electrical power, (4) 120 VAC electrical power, and (5) effluent discharge site. Soils, sediments, and sludges must

be suspended in an aqueous matrix. 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. Equipment is leased to the customer with payment based on system performance (i.e., \$ per volume treated).

Source of Information: Vendor

Company Name/POC	HRUBETZ Environmental Services, Inc./Barbara Hrubetz 5949 Sherry Lane Suite 525 Dallas, Texas 75225		
E-Mail Address			
Product/Service	Hrubout (TM)	Phone Number	214 363-7833
Process Type	High Temperature Thermal Desorption	Fax Number	214 691-8545

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

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.

Product/Service 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: Vendor

Company Name/POC Ice Blast West Inc./Rory Clarke
1801 130th Ave., NE
Bellevue, Washington 98005

E-Mail Address

Product/Service Ice Blast
Process-Type Mechanical Surface Cleaning

Phone Number 206 883-1470

Fax Number 206 881-6843

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service Maturity: Commercial use experience

Performance History: Very successful operation at Hanford's "T" plant.

Comments: None.

Source of Information: Vendor

Company Name/POC	IEG - Industrie Eng./Marc R. Sick Lilienthalstr.6 D72770 Reutlingen, Germany	
E-Mail Address		
Product/Service	Vacuum Vaporizer Well	Phone Number 49 7121 506665
Process Type	Dual Phase Extraction	Fax Number 49 7121 579236

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service Maturity: Commercial use experience

Performance History: Performance data are available:
120 cases in Germany; 17 reached closure within 10 years of operation.
40 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: Vendor

Company Name/POC	IEG Technologies Corp./Eric J. Klingel, Ph.D. 5015-D West W.T. Harris Blvd. Charlotte, North Carolina 28269		
E-Mail Address			
Product/Service	Vacuum-Vaporizer Well (UVB)	Phone Number	704 599-4818
Process Type	Air Sparging	Fax Number	704 599-4815

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Company Name/POC	Integrated Chemistries/Anthony Grooms 1970 Oakcrest Avenue Suite 215 St. Paul, Minnesota 55113		
E-Mail Address	capsule@pclink.com		
Product/Service	Pentagone	Phone Number	612 636-2380
Process Type	Chemical Surface Cleaning	Fax Number	612 636-3106

Contaminants

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

Media

☒ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Non-intrusive

Brief Description: A product designed to clean solid surfaces contaminated with pentachlorophenol, creosote, petroleum hydrocarbons, chlorinated hydrocarbons, polynuclear hydrocarbons, select pesticides and herbicides.

Product/Service Maturity: Commercial use experience

Performance History: Clients report cleaning efficiencies of 90%+ during each cleaning cycle.

Comments: National stock numbers are pending. Verbal notification of acceptance by DGSC (Cliff Meyers) examiner, NSN is scheduled for issue in April 1996.

Source of Information: Vendor

Company Name/POC	Integrated Chemistries/Anthony Grooms 1970 Oakcrest Avenue Suite 215 St. Paul, Minnesota 55113		
E-Mail Address	capsule@pclink.com		
Product/Service	Metraxt	Phone Number	612 636-2380
Process Type	Chemical Surface Cleaning	Fax Number	612 636-3106

Contaminants

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

Media

☒ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Non-intrusive

Brief Description: Foam applied extraction product for the extraction removal of heavy metals. In the pilot study stage for evaluation on radionuclide decontamination.

Product/Service Maturity: Commercial use experience

Performance History: Heavy metals documentation attached. Project data generated on a superfund site.

Comments: NSN's # 6850-01-417-1805, 6850-01-417-1812.

Source of Information: Vendor

Company Name/POC	Integrated Chemistries/Anthony Grooms 1970 Oakcrest Avenue Suite 215 St. Paul, Minnesota 55113		
E-Mail Address	capsule@pclink.com		
Product/Service	Capsur (R)	Phone Number	612 636-2380
Process Type	Chemical Surface Cleaning	Fax Number	612 636-3106

Contaminants

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

Media

☒ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Non-intrusive

Brief Description: Foam applied extraction system, effective at removing PCB contamination in non-earthen surfaces to a depth of 1.5" - 2".

Product/Service Maturity: Commercial use experience

Performance History: PCB concentrations reduced by orders of magnitude; final concentrations as low as nondetect depending on original concentration and number of applications of product. Contact vendor for additional information.

Comments: NSN's 6850-01-423-1059, 6850-01-423-1061.

Source of Information: Vendor

Company Name/POC	International Reserve Equipment Corporation/Sales Dept. Fourth South Prospect Ave. P.O. Box 198 Clarendon Hills, Illinois 60514-0198	
E-Mail Address		
Product/Service	Separators, Centrifuges	Phone Number 630 325-7040
Process Type	Filtration	Fax Number 630 325-7045

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: On site

Brief Description: Since 1970, International Reserve Equipment Corporation has been a leading supplier of good, used and reconditioned centrifuges and separators (all major brands: Bird, Sharples, Alfa-Laval, Dorr-Oliver, Tolhurst, Baker-Perkins, Kruger, Western States, Westfalia/Centricon, and others), to the environmental cleanup field for sludge dewatering, pollution control, wastewater treatment and liquids-solids separations applications.

Product/Service Maturity: Commercial use experience

Performance History: Not applicable.

Comments: Our machines are available for "immediate" sale and delivery as opposed to three months to two years wait for delivery of new equipment. Also, our machines are priced at approximately 50 percent of the cost of new.

Source of Information: Vendor

Company Name/POC	ISOTRON Corporation/Henry L. Lomasney 13152 Chef Menteur Hwy. New Orleans, Louisiana 70129		
E-Mail Address	isotron_usa@msn.com		
Product/Service	ISOTRONIC Flow Cell and ELECTROSORB (R) "D" Phone Number 504 254-4624 Electro-Oxidative Destructor Cell		
Process Type	Oxidation	Fax Number	504 254-5172

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: This advanced electrokinetic process provides a two step mediated electro-oxidative destruction along with electrokinetic extraction of ionic impurities from aqueous streams by means of a proprietary flow cell design. The design combines high surface area electrodes, optionally a state-of-the-art membrane technology and innovative cell geometry.

Product/Service Maturity: Commercial use experience Pilot plant testing

Performance History: The tandem electrochemical destruction cell for organic removal and the electrokinetic extraction cell for metals removal, are available in several designs:

- One design is ready for commercial scale usage;
- Other designs are more recent and experience has not reached such an advanced stage.

Comments: For certain applications, the cell configuration is modified such that functional zeolite fillers provide the capturing repository for the target ions. The use of electrical potential results in significant improvement in efficiency. Capacity of the functional zeolite sorbent is significantly improved. Order of magnitude increase has been observed.

Source of Information: Vendor

Company Name/POC ISOTRON Corporation/Henry L. Lomasney
13152 Chef Menteur Hwy.
New Orleans, Louisiana 70129

E-Mail Address isotron_usa@msn.com

Product/Service ELECTROSORB (R) "S"

Process Type Other

Phone Number 504 254-4624

Fax Number 504 254-5172

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Electrokinetic process for decontamination of soil, either in-situ or ex-situ. Patented technology includes environmentally friendly solubilizing solutions for mobilizing contaminant metals and Electrokinetic Separation Module (ESM) for recycling of reagent electrolytes. ELECTROSORB (R) process captures contaminants at the point of extraction from soil.

Product/Service Maturity: Pilot plant testing

Performance History: Experience with "real soils" contaminated with uranium shows that this process can remove 97 percent of uranium burden, thus realizing the decon factor necessary for "free release" of soil (generally accepted number is 52 ppm). The process is especially attractive for high clay content soils, where decon is difficult. Economics is attractive inasmuch as excavation, transport, burial and worker exposures to occupational hazards are avoided.

Comments: Most recent work with humate media and plant root exudates are showing that this process can provide a highly viable complement to the "natural attenuation processes."

Source of Information: Vendor

Company Name/POC	ISOTRON Corporation/Henry L. Lomasney 13152 Chef Menteur Hwy. New Orleans, Louisiana 70129		
E-Mail Address	isotron_usa@msn.com		
Product/Service	ELECTROSORB (R) "C"	Phone Number	504 254-4624
Process Type	Chemical Surface Cleaning	Fax Number	504 254-5172

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: On site

Brief Description: Electrokinetic process for decontamination of concrete. Patented technology utilizes a carpet-like extraction pad (called an SEEC Pad) to extract contaminants from concrete and to concentrate the same. An electrochemical module is connected by tubing to the pad. This functions like a kidney, continuously removing the contaminants from the electrolyte which circulates inside the SEEC Pad.

Product/Service Maturity: Field demo complete

Performance History: Experience with this process includes decon of thorium from concrete floors at Mound Facility in Ohio, and decon of uranium from concrete floors at K-25 Site in Tennessee.

Comments: Process provides its own enclosure, inasmuch as the carpet-like extraction pad confines the process. The electrical extraction process takes place within a region of negative pressure. A semiautomatic process requires a minimum of human interaction, thus, workers' exposure to radiation is reduced. Several options exist for wasteform.

Source of Information: Vendor

Company Name/POC	IT Corporation/Duane Graves 312 Directors Drive Knoxville, Tennessee 37923		
E-Mail Address			
Product/Service	In Situ Groundwater Bioremediation	Phone Number	423 690-3211
Process Type	Biodegradation (In Situ)	Fax Number	423 690-3626

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Company Name/POC	IT Corporation/Duane Graves 312 Directors Drive Knoxville, Tennessee 37923		
E-Mail Address			
Product/Service	Bioventing	Phone Number	423 690-3211
Process Type	Bioventing	Fax Number	423 690-3626

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Treatment

Company Name/POC IT Corporation/Duane Graves
312 Directors Drive
Knoxville, Tennessee 37923

E-Mail Address

Product/Service Biofast
Process Type Solid Phase Biological Treatment

Phone Number 423 690-3211
Fax Number 423 690-3626

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC	IT Corporation/Edward Alperin 312 Directors Drive Knoxville, Tennessee 37923	
E-Mail Address		
Product/Service	Acid Extraction	Phone Number 423 690-3211
Process Type	Chemical Extraction	Fax Number 423 694-9573

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On 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.

Product/Service Maturity: Pilot plant testing

Performance History: Pilot testing successfully completed.

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. Results >95% of VOC and metals removed.

Source of Information: Vendor

Treatment

Company Name/POC IT Corporation/Edward Alperin
312 Directors Drive
Knoxville, Tennessee 37923

E-Mail Address

Product/Service Low Temperature Thermal Desorption

Phone Number 423 690-3211

Process Type Chemical Reduction

Fax Number 423 694-9573

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: IT Corporation's Thermal Desorption System is a high capacity, continuous, transportable, cost-effective alternative for soil or sludge decontamination. The process involves heating soils or sludges to a temperature high enough to volatilize organic contaminants. Volatilized vapors are oxidized in a secondary combustion chamber or collected by physical/chemical treatment. The prototype thermal desorption system has been used for several years to demonstrate removal of chlorinated phenols, pesticides, polynuclear aromatics, dioxins, PCBs, solvents, and mercury.

There are two options for off-gas treatment: secondary combustion with an air pollution control system, and physical/chemical treatment.

Product/Service Maturity: Pilot plant testing

Performance History: Pilot-scale testing and demonstrations completed.

Comments: The process is limited to organic compounds and selected metals (those with significant vapor pressure at 650 degrees Celsius, e.g. mercury). Soil or sludge with other heavy metal contaminants will require additional treatment such as stabilization. Solids must be crushed to less than 2 inches to be processed in the system. A key concern with any physical separation process is the question of producing new hazards due to partial chemical degradation of the original contaminants.

Source of Information: Vendor

Company Name/POC	IT Corporation/Kandi Brown 312 Directors Drive Knoxville, Tennessee 37923		
E-Mail Address			
Product/Service	Slurry Phase Bioremediation	Phone Number	423 690-3211
Process Type	Slurry Phase Biological Treatment	Fax Number	423 690-3626

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

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.

Product/Service 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.

Treatment

Source of Information: Vendor

Company Name/POC	IT Corporation/Mike Capps 312 Directors Drive Knoxville, Tennessee 37923		
E-Mail Address			
Product/Service	In Situ Air Sparging (IAS)	Phone Number	423 690-3211
Process Type	Air Sparging	Fax Number	423 690-3626

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Company Name/POC IT Corporation/Mike Capps
312 Directors Drive
Knoxville, Tennessee 37923

E-Mail Address

Product/Service

Soil Vapor Extraction

Phone Number 423 690-3211

Process Type

Soil Vapor Extraction (In Situ)

Fax Number 423 690-3626

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Company Name/POC	IT Corporation/Mike Capps 312 Directors Drive Knoxville, Tennessee 37923		
E-Mail Address			
Product/Service	Vacuum Enhanced Pumping (VEP)	Phone Number	423 690-3211
Process Type	Dual Phase Extraction	Fax Number	423 690-3626

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service 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: Vendor
Environmental Cleanup Privatization
Products and Services Directory

January 1997
T 277

Company Name/POC	IT Corporation/Richard Miller 2140 NE 36th Ave Suite 100 Ocala, Florida 34470		
E-Mail Address			
Product/Service	Photocatalytic Oxidation (PCO) of VOCs in Air	Phone Number	352 867-7482
Process Type	Ultraviolet Oxidation	Fax Number	352 867-1320

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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 (typical concentrations in air are adequate for processing needs).

Source of Information: Vendor

Company Name/POC	IT Corporation/Richard W. Helsel 312 Directors Drive Knoxville, Tennessee 37923	
E-Mail Address		
Product/Service	Peroxide Oxidation of Formaldehyde in Soil	Phone Number 423 690-3211
Process Type	Chemical Reduction	Fax Number 423 690-3626

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Treatment

Company Name/POC	ITEX Environmental Services, Inc./Rich Studer 4570 West Grove Drive Suite 240 Addison, Texas 75248	
E-Mail Address		
Product/Service	In-Situ Soil Solidification and Stabilization (Archon)	Phone Number 214 407-0550
Process Type	Solidification/Stabilization (In Situ)	Fax Number 214 407-0634

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: ITEX performs solidification/stabilization treatment using innovative equipment designed, manufactured and maintained by its manufacturing personnel. In situ process involves specially-designed mixing heads attached to conventional heavy equipment, long-reach backhoes. Mixing heads receive required additives and power from sources independent of backhoe. Applies to heavy metals, KO62 waste, and petrochemical organic wastes. Process can be in-situ or ex-situ. Processes reviewed and accepted by USEPA for use at Superfund sites.

ITEX Archon process can be cost effective in treating or stabilizing hazards in situ. Treatment of hazardous metal waste to below TCLP, to non-hazardous allows for disposal in industrial waste landfill.

Product/Service Maturity: Commercial use experience

Performance History: Pickle liquor waste (listed K062) from wire mill, Central Illinois. Organic waste from refineries and petrochemical plants (excess of 3M CY).

Comments: Anaconda, MT: 20,000 tons hazardous flue dust containing As, Cd and Pb. Contact Martha Wolf, WPA Region 8, 303 312-6839. Bob Turley, On site repository built by ITEX; soils dust treated to reduce leachability.

Feed rate: Treatment capacity ranges from 75 tons/hr (smaller mobile units) to 5,000 CY/Day (large fixed-base units).

ITEX can prepare remedial work plans for review and approval by State and Federal regulators. Remedial work plans include quality assurance, sample analysis and health and safety plans. ITEX is a qualified bidder for fixation/stabilization services at EPA Superfund sites. Ref. Applications #PQOPS - TQS - 90 - FSSI.

Source of Information: Vendor

Company Name/POC	J. R. Simplot Company/Dr. Russ Kaake P.O. Box 912 Pocatello, Idaho 83201		
E-Mail Address	rkaake@simplot.com		
Product/Service	The SABRE (TM) Process	Phone Number	208 234-5367
Process Type	Slurry Phase Biological Treatment	Fax Number	208 234-5339

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: The SABRE (TM) process employs a bioreactor equipped for monitoring and periodic mixing. Excavation, screening, homogenization and possibly specialized separation equipment are required to prepare contaminated soils prior to introduction into the bioreactor. All equipment selected for final remediation is portable, modular and readily adaptable in the field. The soil is first screened to desired size, usually to one inch. Oversized material is water washed and undersized material is placed in the bioreactor with the oversize wash water.

For small commercial remediation sites, small portable bioreactors can be utilized. At larger sites, modular reactors or open lined pits can be utilized. When operated in the batch mode, each batch receives the specially-selected SABRE (TM) inoculum, which decreases the amount of time needed to degrade the nitroaromatics. During treatment, personnel are not required to be on site full time.

Product/Service Maturity: Commercial use experience

Performance History: At the Ellensburg SITE demonstration, concentrations of dinoseb were reduced by greater than 99.9% from a mean starting concentration of 28 ppm. The SABRE (TM) process reduced the concentration to below the analytical detection limit of 15 ppb within 23 days. At the Weldon Spring demonstration, TNT concentrations of 1500 ppm were reduced to an average concentration less than 10 ppm.

A pilot scale remediation of two different contaminated soils containing TNT, RDX, and DNT was performed in December 1994 at Bangor Naval Submarine Base in Washington State. Treatment goals for both soils were met within 105 days.

At Reedley, California, a full scale remediation was conducted in June 1995 on 270 cubic yards of soil with concentrations of 400 mg/kg and greater. Total treatment time was less than 35 days.

Comments: Remediated soils will be rich in organic carbon and minerals, with high nutritional value making them suitable for returning to the site.

Treatment can be completed in less than one season, with no liability for shipping contaminated soils off site.

Environmental Cleanup Privatization

Products and Services Directory

January 1997

T 281

Treatment

Company Name/POC KAM Biotechnology Ltd./Mongi Ferchichi
9710 187th St., #101
Surrey B.C. V4N 3N6

E-Mail Address

Product/Service

Biotechnology/Bioremediation

Phone Number 604 888-4336

Process Type

Slurry Phase Biological Treatment

Fax Number 604 888-6623

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: Biological treatment of soils and wastewater using a proprietary highly adapted microbes capable of breaking down a variety of toxics chemicals to a non-toxic end product, mainly CO₂ + H₂O. "Achieves a high level of decontamination in a short time." Inexpensive and environmentally sound.

Product/Service Maturity: Commercial use experience

Performance History: Successfully completed decontamination of over 45 sites between 1994 and 1995. Major contaminants: OCP (organo-chlorides-pesticides), Pentachlorophenol, Hydrocarbon, PAH, PCB's, Perchloroethylene.

Comments: Bacteria alone cannot do miracle when the concentration of the contaminant is high. KAM uses a combined treatment methodology by introducing a selected fungus to the waste for the dehalogenation phase, than a highly adapted mixed culture to metabolize the broken compounds. All biological additives are not controlled and are included in US EPA.

Source of Information: Vendor

Company Name/POC	KAP s.r.o./RNDr. Petr Kohout Skokanska 80 169 00 Praha 6 Czech Republic	
E-Mail Address	kappraha@login.cz	
Product/Service	Soil Vapor Extraction	Phone Number 42 2 24 31 36 30
Process Type	Soil Vapor Extraction (Ex Situ)	Fax Number 42 2 57 21 12 55

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (vadose zone)

Brief Description: Soil Vapor Extraction (SVE) is a process for the removal and treatment of volatile organic compounds (VOCs) from the vadose or unsaturated zone. Air streams contaminated with VOCs are extracted from wells and purified in a treatment unit. The system of extraction wells is predetermined according to the distribution of VOC contamination. A vacuum pump draws the subsurface contaminants from the wells to a gas separator; the contaminants are then treated by filter beds that contain activated carbon. This system is based on the regeneration adsorption method, which involves the use of one on-line treatment bed for incoming air while another bed undergoes a desorption cycle. This regeneration technology is a fully recyclable system that allows safe and continuous discharge of gases to the atmosphere.

Product/Service Maturity: Commercial use experience

Performance History: Ralsko-the Former Soviet Military Airbase (Czech Republic)/Ministry of Environmental of the Czech Republic/Mr. B. Novotny/42. 425. 331111/Remediation of groundwater and soil heavily contaminated by chlorinated and aromatic volatile hydrocarbons.

Ceske Budejovice (Czech Republic)/AKRA a.s./Mr. Fanta/42. 38. 807/Remediation of groundwater and soil contaminated by chlorinated and aliphatic volatile hydrocarbons.

Plzen/Pilsen-Bory-the Former of Czech Army Airbase (Czech Republic)/VUSS Plzen/Mr. Vicha/042. 19. 2182728/Remediation of groundwater and soil contaminated by aliphatic volatile hydrocarbons.

Kopisty (Czech Republic)/Chemopetrol-Litvinov a.s./Mr. Cir/42. 35.333923/Remediation of groundwater and soil contaminated with petroleum fuel as result of a railway accident.

Miletice (Czech Republic)/Chemopetrol-Litvinov a.s./Mr. Cir/42. 35. 333923/Remediation of groundwater and soil contaminated by ethylbenzene leaked from a supply pipeline.

Comments: The SVE technology can be applied to the in-situ and ex-situ remediation of contaminated soils. The process can treat soils that are contaminated with halogenated or nonhalogenated volatile organic compounds in the concentrations of greater than 0.1 grams/m3. The SVE is considered to be a full scale

technology. Treatment costs for contaminated soils are typically \$1,600, - per metric ton of extracted product produced from the regeneration adsorption process; this cost includes complete support services related to the SVE. This technology does not require expensive equipment or numerous personnel and can be left unattended for relative long periods of time. The system of handling off-gases is solved by a fully recyclable adsorption process that uses an activated carbon filter. The SVE is restricted by low soil permeability, which limits subsurface air flow rates and reduces process efficiency. Heterogeneous soil conditions may result in inconsistent removal rates. The effectiveness of the process is reduced by high humic content in soil which that inhibits contaminant volatilization.

Source of Information: Vendor

Company Name/POC	Keller Environmental Inc./Glen A. Gorski P.O. Box 72070 Roselle, Illinois 60172		
E-Mail Address	glengski@aol.com	Phone Number	630 529-2911
Product/Service	Bioinjection	Fax Number	630 529-2995
Process Type	Biodegradation (In Situ)		

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Bioinjection is a proprietary, in situ treatment process developed by Keller Environmental Inc. (Formerly Hayward Baker Environmental Inc.) 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 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.

Product/Service 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. Injection technology has been well proven by completing over 75 projects annually.

Source of Information: Vendor

Company Name/POC	Keller Environmental Inc./Glen A. Gorski P.O. Box 72070 Roselle, Illinois 60172		
E-Mail Address	glengski@aol.com		
Product/Service	MecTool (TM) Soil Mixer	Phone Number	630 529-2911
Process Type	Solidification/Stabilization (In Situ)	Fax Number	630 529-2995

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: MecTool (TM) provides unprecedented effectiveness in the delivery of in situ remedial agents. The MecTool (TM) 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 (TM) technology can replace ex-situ remediation strategies. MecTool (TM)'s ability to reach depths >60 feet and diameters up to 12 feet make this technology better and faster, thus more cost efficient. Containment and collection of off-gases from the mixing zone is facilitated by a portable shroud that protects onsite workers from fugitive vapors.

Product/Service Maturity: Commercial use experience

Performance History: Contact vendor for performance data.

Comments: Equipment requires overhead clearance >110 feet and minimum ground support to 25psi (with mats). Grounds cannot be pumped in temperatures consistently <40-degrees Fahrenheit due to potential freezing conditions.

Keller Environmental Inc. is part of the international Keller Group companies providing specialty geotechnical contracting services worldwide for more than 130 years. Large scale, technically challenging, subsurface construction problems are Keller's main focus.

Source of Information: Vendor

Company Name/POC	KEMA Nederland B.V./H.A.W. Cornelissen P.O. Box 9035, NL-6800 ET ARNHEM, The Netherlands		
E-Mail Address			
Product/Service	Surface Removal of Contamination from Concrete Surface Layers		Phone Number 31 26 356 6104
Process Type	Mechanical Surface Cleaning	Fax Number	31 26 351 5835

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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 a 18 kW equipment is 75-160 litres of concrete per hour.

Source of Information: Vendor

Company Name/POC KEMA Nederland B.V./H.A.W. Cornelissen
P.O. Box 9035, NL-6800 ET
ARNHEM, The Netherlands

E-Mail Address

Product/Service Radwaste Cementation and Process Control

Phone Number 31 26 356 6104

Process Type Solidification/Stabilization (Ex-Situ)

Fax Number 31 26 351 5835

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On 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 checked and improved. Various on-line measuring techniques have been developed to check the mechanical, chemical and radiological properties during the cementation process.

Product/Service 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: Vendor

Company Name/POC	KEMA Nederland B.V./J. van der Steen P.O. Box 9035 NL-6800 ET ARNHEM The Netherlands	
E-Mail Address		
Product/Service	Decontamination of Tubing	Phone Number 31 26 356 3370
Process Type	Mechanical Surface Cleaning	Fax Number 31 26 442 3635

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC	KEMA Nederland B.V./J. van der Steen P.O. Box 9035 NL-6800 ET ARNHEM The Netherlands	
E-Mail Address		
Product/Service	Decontamination of Tubing	Phone Number 31 26 356 3370
Process Type	Chemical Surface Cleaning	Fax Number 31 26 442 3635

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC	Kemron Environmental Services, Inc./James A. Novitsky 2987 Clairmont Road Suite 150 Atlanta, Georgia 30329		
E-Mail Address			
Product/Service	In Situ Groundwater Bioremediation	Phone Number	404 636-0928
Process Type	Biodegradation (In Situ)	Fax Number	404 636-7162

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Company Name/POC	Kernkraftwerke Gundremmingen/Norbert Eickelpasch Betriebsgesellschaft mbH Postfach 3 00 D-89355 Gundremmingen, Germany	
E-Mail Address		
Product/Service	Electropolishing with Acid Regeneration	Phone Number 49 8224 78 1
Process Type	Chemical Surface Cleaning	Fax Number 49 8224 78 3508

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Company Name/POC	Kraissl Company Inc./W. Henderson 299 Williams Ave. Hackensack, New Jersey 07601-5225		
E-Mail Address	kraissl@aol.com		
Product/Service	Strainers, Filters (Duplex, Simplex)	Phone Number	201 342-0008
Process Type	Filtration	Fax Number	201 342-0025

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☒ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On site

Brief Description: Kraissl Model 72 Simplex and Duplex Strainers and Filters for pipeline service in cast iron, steel, stainless steel, bronze, aluminum, and other alloys, used to protect pumps, heat exchangers, meters, nozzles, valves, and other expensive pipeline equipment. U.L. listed for fuel oil/flammable liquid service. Manufactured to international standard ASTM-F1199.

Product/Service Maturity: Commercial use experience

Performance History: Products in commercial use for over 50 years. Made in U.S.A.

Comments: Commonly used to remove particulates/solid contaminants from liquids in pipeline service.

Source of Information: Vendor

Company Name/POC	Kruger A.S./Kurt Ambo Nielsen 363 Gladsaxevejs 2860 Soeborg, Denmark		
E-Mail Address			
Product/Service	Autocatalytic Fluid Bed Heavy Metal Removal	Phone Number	011 45 396 90222
Process Type	Precipitation	Fax Number	011 45 31674950

Contaminants:

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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

Company Name/POC	KSE, Inc./James R. Kittrell 665 Amherst Road Sunderland, Massachusetts 01375 - P.O. Box 368 Amherst, Massachusetts 01004		
E-Mail Address			
Product/Service	Two Stage Absorption Integration Reaction (AIR-II)	Phone Number	413 549-5506
Process Type	Oxidation	Fax Number	413 549-5788

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Company Name/POC Landa Water Cleaning Systems/Hal Linton/Crismon Lewis
13705 NE Airport Way
Portland, Oregon 97230-1048

E-Mail Address hall@landa-inc.com

Product/Service Filtration

Process Type Filtration

Phone Number 800 645-2632

Fax Number 800 535-9164

Contaminants

- ☒ Pesticides/Herbicides
- ☒ Petroleum Hydrocarbons
- ☐ Nonhalogenated VOC

- ☒ Heavy Metals
- ☐ Radionuclides
- ☐ Halogenated VOC
- ☒ PCB
- ☐ SVOC
- ☐ N/A

- ☐ Explosives/Propellants
- ☐ Other Contaminant

Media

- ☐ Surface Impoundment
- ☐ Construction Materials/Debris
- ☐ Sediments in Water
- ☐ Process Wastes and Sludge

- ☐ Soil
- ☐ Landfills
- ☐ Vapor Phase

- ☒ Process Water
- ☐ Drums/Tanks/Piping
- ☐ Free Product

- ☐ Surface Water
- ☐ Containers/Equipment
- ☒ Ground Water

Application: Off site On site

Brief Description: Landa is America's largest manufacturer of pressure washers and water cleaning systems, including the Water Maze and Water Blaze.

* The Water Maze is a full recycling system for treating and reusing wash water, typically generated by a pressure washer.

* The Water Blaze is an industrial wastewater evaporation system that uses a patented, high-efficiency, submerged combustion technology for eliminating up to 98% of the water portion of a waste stream.

Product/Service Maturity: Commercial use experience

Performance History: The Water Maze recycle systems are successfully being used by all branches of the Military, State Road Departments, National Guard Units and many commercial enterprises. The Water Blaze evaporators are being used on a wide array of contaminated waste streams from groundwater remediation to condensate water from compressors. Please call Landa Inc. for references.

Comments: The Water Maze wash water filtration system allows companies or agencies to wash vehicles or equipment within the law. By recycling wash water, the need for an NPDES permit is eliminated. The Water Maze when used in accordance with written instructions will successfully reduce the contaminant levels of your waste stream allowing the water to either be reused or meet discharge requirements for disposal to sewer. The Water Blaze will reduce the water based portion of your waste stream by up to 98%. The Water Blaze is designed for 24 hour unattended operation. All waste streams are tested to determine if air emissions permitting will be necessary and to evaluate its potential as a candidate for evaporation. On site evaporation will reduce the high cost of hauling waste water and the large amount of associated paper work.

Source of Information: Vendor

Company Name/POC	Layne-Christensen Company/Dr. Joe Sopko W229 N5005 DuPlainville Rd. Pewaukee, Wisconsin 53072		
E-Mail Address			
Product/Service	Artificial Ground Freezing	Phone Number	414 246-4646
Process Type	Containment	Fax Number	414 246-4784

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service 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: Vendor

Company Name/POC	Lockheed Environmental Technologies Divisions/Matt Foster 201 3rd St. N.W. Suite 1600 Albuquerque, New Mexico		
E-Mail Address			
Product/Service	Acid Extraction	Phone Number	505 924-2500
Process Type	Chemical Extraction	Fax Number	505 924-2560

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Company Name/POC	Lockheed Environmental Technologies Divisions/Matt Foster 201 3rd St. N.W. Suite 1600 Albuquerque, New Mexico	
E-Mail Address		
Product/Service	Soil washing - TRUClean	Phone Number 505 924-2500
Process Type	Soil Washing	Fax Number 505 924-2560

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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

Product/Service 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: Vendor

Company Name/POC	Lopata Technical Service Corp./Jim Lopata 1130 N. Dearborn St. Suite 1702 Chicago, Illinois 60610		
E-Mail Address			
Product/Service	Catalytic Oxidation	Phone Number	312 280-1574
Process Type	Oxidation	Fax Number	312 951-0484

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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 catalyst that is not fouled or poisoned. Typical destruction efficiencies are 95-99.99%.

Product/Service 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 company start-up engineer for a "normal" maintenance worker or engineer is all that is required.

Source of Information: Vendor

Company Name/POC Lopata Technical Service Corp./Jim Lopata
 1130 N. Dearborn St.
 Suite 1702
 Chicago, Illinois 60610

E-Mail Address**Product/Service** Hydrocarbon/Water Separators**Phone Number** 312 280-1574**Process Type** Membrane Separation**Fax Number** 312 951-0484**Contaminants**

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: On site

Brief Description: The coalescing plate interceptors are very easy to operate. To make them work better: the use of positive displacement pumps (such as rotor/stator, diaphragm air, or peristaltic) is suggested . . . in order to minimize mechanical agitation as experienced in a centrifugal pump that has a tendency to cause the materials to become mechanically emulsified. The membrane filtration systems are slightly more complex to operate and may require up to two days to start up assistance and training by a company engineer/technician.

Product/Service Maturity: Commercial use experience

Performance History: The hydrocarbon/water separation takes two forms: a coalescing plate interceptor (CPI) to remove free product from aqueous phase and a membrane separation system for emulsified hydrocarbons in the aqueous phase. The separation in the CPI is based on Stoke's law for the separation of materials of differing phases and/or specific gravities. The CPI units are available either as atmospheric flow through units or as pressurized units to enable pumps to feed through the separator and on to additional treatment technologies. The membrane separation system utilizes a unique surface treated membrane of polyacrylonitrile that is not fouled by free hydrocarbons -- offering filtration/separation in the range from 0.001 to 0.05 microns. This filtration range will easily separate most hydrocarbon contaminants (C12 and larger) from water.

Comments: More than 25 commercial installations are available.**Source of Information:** Vendor

Company Name/POC	M. L. Energia, Inc./Dr. Moshe Lavid P.O. Box 470 Princeton, New Jersey 08542	
E-Mail Address		
Product/Service	Reductive Thermal Oxidation (RTO)/Reductive Photo-Thermal Oxidation (RPTO)	Phone Number 609 799-7970
Process Type	Chemical Oxidation	Fax Number 609 799-0312

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: These two processes have been originally developed to convert halogenated hydrocarbons to environmentally safe and useful materials. They are also applicable to non-halogenated hydrocarbons but further testing is needed. Both processes treat air streams laden with contaminants (e.g. discharge from soil venting extraction, industrial hoods, stacks, etc.). RTO converts VOCs at moderate temperatures without ultraviolet (UV) light. RPTO operates under similar conditions in the presence of UV. Subsequent reactions between ensuing radicals and the reducing gas results in chain-propagating reactions. The presence of oxygen (in air) during the conversion process accelerates the overall reaction rate without significant oxidation. Air stream laden with contaminants is mixed with reducing gas and passed into a photo-thermal reactor. Here, the mixture is heated to moderate temperatures to sustain chain-propagation. Depending on the physical/chemical characteristics of the particular waste, conversion can take place in two ways: RTO is pure thermal and RPTO is photo-thermal. After suitable residence time, HCl is scrubbed, and the treated mixture is stored for sale. Excess reducing gas is recycled and residual contaminants (ppm level of contaminants and CO) are treated by catalytic oxidation or flared.

Product/Service Maturity: Bench scale testing only

Performance History: Laboratory-scale experiments have been carried out with two representatives of saturated chlorohydrocarbons (dichloromethane and trichloromethane), and two unsaturated representatives (1,2 dichloroethylene and trichloroethylene). The RTO and RPTO processes have demonstrated greater than 99% conversion/dehalogenation with high selectivity towards valuable hydrocarbon products (methane and ethane). Based on these results, a very low cost of \$2.64 per pound of trichloroethylene treated has been achieved.

Comments: The feasibility study was funded, in part, by the National Science Foundation under an SBIR Phase I award. Phase II proposal for pilot-scale demonstration is under consideration by NSF. These technologies have been accepted in EPA's Superfund Innovation Technology Evaluation (SITE-E07) program.

Source of Information: Vendor

Company Name/POC	M. L. Energia, Inc./Dr. Moshe Lavid P.O. Box 470 Princeton, New Jersey 08542		
E-Mail Address			
Product/Service	Reductive Photo-Dehalogenation (RPD)(TM)	Phone Number	609 799-7970
Process Type	Chemical Reduction	Fax Number	609 799-0312

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

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.

Product/Service Maturity: Pilot plant testing

Performance History: The technology has been successfully demonstrated at bench-top scale for chlorocarbons, PCBs, halons and freons. Treated compounds include 1,1,1-trichloroethane; trichloroethylene; dichloroethylene; chloroform; carbon tetrachloride; dichloromethane; PCBs; CFC-12, 113, 114, and Halons 1211, and 1301.

Comments: There are two major advantages of this technology over other chlorocarbon treatment technologies. Unlike granular activated carbon adsorption and membrane separation, the process de-toxifies waste streams rather than merely adsorbing 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. It can effectively treat individual contaminants as well as multi-species ("cocktail"). Cost estimates are \$1.00 - 2.50 per pound of treated compounds, depending on the nature of the contaminants. "Other" contaminants are identified as CFCs and Halons.

Source of Information: Vendor

Company Name/POC	Magneox Electric/Dr. R. Clayton Littlebrook Complex Littlebrook Manorway Dartford Kent DA1 5PY, UK		
E-Mail Address			
Product/Service	Radioactive Waste Treatment - Slurry Dewatering	Phone Number	44 1322 282800
Process Type	Filtration	Fax Number	44 1322 282819

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service Maturity: Pilot plant testing

Performance History: After detailed review of available technology, crossflow filtration was chosen. Magnox Electric, formerly part of 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 Magnox 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: Vendor

Company Name/POC	Maple Environmental Services Ltd./John Haanstra 201 County Court Blvd Suite 600 Brampton, Ontario 16W 4L2		
E-Mail Address			
Product/Service	Biological Groundwater Treatment (Biopur)	Phone Number	905 457-6444
Process Type	Bioreactors	Fax Number	905 457-2498

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: Biological treatment of contaminated groundwater and soil vapor in a fixed film bioreactor.

Product/Service 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: Vendor

Company Name/POC	Matrix Photocatalytic, Inc. (formerly NuTech)/Bob Henderson 22 Pegler St. London, Ontario, Canada N5W 4C8		
E-Mail Address			
Product/Service	Titanium Dioxide Photocatalytic Treatment Systems	Phone Number	519 660-8669
Process Type	Ultraviolet Oxidation	Fax Number	519 660-8525

Contaminants

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

Media

☒ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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 1.5 CFM; 5.5 kW system.

Typical VOC removal in water - BTEX destruction nominally 50 ppm/minute retention time.

Product/Service Maturity: Field demo complete

Performance History: 40 units produced to date

Specific customer information is proprietary (contact Matrix Photocatalytic, Inc.)

Successful pilot test at Savannah River for soil vapor extraction, Oak Ridge K-25

Superfund demonstration in water phase

Comments: Limitations include (1) Flood rates greater than: air 2000 CFM, water 1000 GPM; (2) certain organic compounds are refractory and take longer time to break down; therefore faster than other field-ready technologies.

Equipment is very simple and easy to install (one man, 4 hours setup)

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: Vendor

Company Name/POC Maxymillian Technologies, Inc./Neal Maxymillian (Boston)/John Anthony (HQ)
1801 East St.
Pittsfield, Massachusetts 01201

E-Mail Address

Product/Service Thermal Desorption System

Phone Number 413 499-3050

Process Type High Temperature Thermal Desorption

Fax Number 413 443-0511

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: Use of thermal treatment 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.

Product/Service Maturity: Commercial use experience

Performance History: Performance data are available.

The system has processed over 285,000 tons of petroleum contaminated soils, many with heavy clays and high moisture content. The system has processed PAH and VOC-contaminated soils at a coal tar site and a Superfund site. The system can process soil with high tar content.

Comments: Boston contact number: 617-557-6077

Source of Information: Vendor

Company Name/POC	MBI International/Mahendra K. Jain 3900 Collins Road P.O. Box 27609 Lansing, Michigan 48909-0609		
E-Mail Address	jain@mbi.org		
Product/Service	PCB - Dechlorinating Anaerobic Microbial Granules	Phone Number	517 336-4626
Process Type	Biodegradation (In Situ)	Fax Number	517 337-2122

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone)

Brief Description: MBI has designed and evaluated a dechlorination technology utilizing self-immobilized anaerobic microbial granules as a delivery system to treat PCB-contaminated lake and river sediments. These anaerobic granules are composed of facultative bacteria and anaerobic hydrolytic-fermentative, acetogenic, sulfate-reducing, and methanogenic bacteria. The granular structure helps to protect the anaerobic bacteria from unfavorable environmental conditions such as changes in pH and exposure to oxygen. It is proposed that lake and river sediments contaminated with PCBs can be "seeded" with our granules to carry out dechlorination "in situ".

The key to the success of our anaerobic granules is that they can carry out selective dechlorination of highly chlorinated PCB mixtures, dechlorinating at the meta, para, and ortho positions. The anaerobic dechlorinating granules are tolerant of transient exposure to oxygen, are mass producible, and maintain their dechlorinating activities for long periods of time. We have also shown an appreciable amount of dechlorination at environmentally relevant temperatures.

Our dechlorination technology is unique in that it offers complete destruction of PCBs "in situ" to acceptable levels without the need to dredge the sediments from the river or lake system. These granules also can be used in an on-site slurry reactor to treat PCB-contaminated sediments and soils.

Product/Service Maturity: Bench scale testing only

Performance History: MBI's anaerobic microbial consortia are capable of dechlorinating PCBs present in soils, sludges, and sediments to environmentally acceptable concentrations. We have shown the capability to dechlorinate Aroclors 1242, 1254, and 1260 in sediments at concentrations as high as 2,000 ppm with little accumulation of mono- and dichlorobiphenyls.

This dechlorination technology proposes the mass production of dechlorinating granules followed by seeding of the contaminated sediments. The cost of this process can be much lower than other technologies because it does not require costly dredging of the contaminated sediments followed by secondary treatment and disposal or delivering oxygen to sediments.

MBI's dechlorinating anaerobic granules have been demonstrated successfully at bench-scale utilizing four liter reaction vessels containing two liters of actual contaminated sediment. Anaerobic granules have been mass

January 1997

T 312

Environmental Cleanup Privatization
Products and Services Directory

produced in a 34-liter upflow anaerobic reactor while maintaining the dechlorinating activity. A pilot-scale 1.4 cubic meter reactor is now under operation.

MBI is currently seeking a partner to test this PCB-dechlorinating technology at field scale.

Comments: MBI's dechlorinating granules may be affected by extremely high levels of heavy metals or secondary organic pollutants, but they are not affected when concentrations of these contaminants are low. Bioavailability of PCBs in contaminated sediments that are high in organic matter such as oil and grease may slow the dechlorination rate, causing longer reaction times for complete dechlorination of the PCBs.

Source of Information: Vendor

Company Name/POC	Membrane Technology & Research, Inc./Marc Jacobs 1360 Willow Road Suite 103 Menlo Park, California 94025-1516		
E-Mail Address			
Product/Service	Membrane Vapor Separation	Phone Number	415 328-2228
Process Type	Membrane Separation	Fax Number	415 328-6580

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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, CHCl₃.

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: Vendor

Company Name/POC	Mercury Recovery Services, Inc./Michael V. Rose 700 Fifth Avenue New Brighton, Pennsylvania 15066		
E-Mail Address			
Product/Service	Mobile and Fixed-Site Mercury Removal/Recovery Process (MRS)		Phone Number 412 835-6111
Process Type	Low Temperature Thermal Desorption	Fax Number	412 843-5353

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On site

Brief Description: This technology reduces residual total Hg to <1 ppm regardless of the form and amount of Hg contamination of the treated material. The process meets or exceeds all Federal, State and OSHA air standards, produces only clean treated solids, metallic mercury and clean air so that everything is recyclable and the liability chain regarding hazardous waste disposal is broken. EPA has designated the process as Best Demonstrated Available Technology for treating Hg-contaminated material.

The process consists of contaminated soil mixed with an environmentally safe additive to facilitate decomposition of specific mercury compounds and/or reduce the content of gaseous sulfur and chlorine compounds in the process effluent; material is then heated in a contained, low-volume, low-velocity air stream in two stages: 1) low-temperature stage during which low-temperature volatiles (i.e., water vapor) are vaporized without vaporizing significant quantities of mercury and 2) a second stage at temperature sufficient to vaporize the mercury from the dry material. Exhaust gases from first-stage passes through gas purification system formulated to remove all traces of mercury and other impurities. Second stage mercury vapor condensed to metallic mercury suitable for refining and recycling. Exhaust gas from second stage passes through gas purification system.

Product/Service Maturity: Commercial use experience

Performance History: First full-size commercial mobile unit began operation in New Mexico during July 1994. Over 5000 tons of soil were processed, 2000 lbs. of pure (99%) metallic mercury recovered. Total mercury content of treated soil has averaged 0.8 ppm.

Comments: Process system is modular and self-contained making shipping and setup easy. The process is amenable to a variety of waste with very low levels of mercury in final product. The process is not skilled-labor intensive. System needs include:

- Self-contained processing system: mobile units, 1 or 2 over-the-road trailers
- Electrical power: (Avg) 2.16MW for six furnace modules - Average 35MW/furnace module

*Environmental Cleanup Privatization
Products and Services Directory*

January 1997
T 315

Treatment

- Logistics support: Removal/staging of contaminated soil/material for treatment
State and Federal (EPA) departments have classified the MRS process as "recycling" rather than "waste treatment" and the process is exempt from air and solid waste permitting requirements in New Mexico and Pennsylvania.

Feed rate potential for mobile units is 4-15 t/day. For fixed site units up to 110 t/day.

Source of Information: Vendor

Company Name/POC	MES/ACT Environmental, Inc./Jack Sheldon 11270 Aurora Avenue Des Moines, Iowa 50322	
E-Mail Address		
Product/Service	In Situ Groundwater Bioremediation	Phone Number 515 276-3434
Process Type	Biodegradation (In Situ)	Fax Number 515 276-0246

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Company Name/POC MES/ACT Environmental, Inc./Jack Sheldon
11270 Aurora Avenue
Des Moines, Iowa 50322

E-Mail Address**Product/Service**

Bioreactor

Phone Number 515 276-3434**Process Type**

Bioreactors

Fax Number 515 276-0246**Contaminants**

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC	Metcalf and Eddy, Inc./Pier Mantovani 30 Harvard Mill Square Wakefield, Massachusetts 01880	
E-Mail Address		
Product/Service	Hydraulic Soil Washing (HYDROSEP)	Phone Number 617 246-5200
Process Type	Soil Washing	Fax Number 617 245-6293

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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

Treatment

Company Name/POC Metcalf and Eddy, Inc./Pier Mantovani
30 Harvard Mill Square
Wakefield, Massachusetts 01880

E-Mail Address

Product/Service Metals Extraction (METALEX)

Phone Number 617 246-5200

Process Type Chemical Extraction

Fax Number 617 245-6293

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service 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

Company Name/POC	Millgard Environmental Corporation/D. Colman 12822 Stark Road Livonia, Michigan 48151		
E-Mail Address			
Product/Service	In-situ soil mixing using MecTool	Phone Number	313 261-9760
Process Type	Solidification/Stabilization (In Situ)	Fax Number	313-425 -0624

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service 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: Vendor

Company Name/POC Misonix Inc./Christopher J. Thomas 1938 New Highway Farmingdale, New York 11735	
E-Mail Address	
Product/Service Mystaire Scrubbers	Phone Number 516 694-9555
Process Type Other	Fax Number 516 694-9412

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On site

Brief Description: Misonix Inc. is a supplier of state of the art Wet Scrubbing Systems, specifically for the removal of water soluble vapor phase contaminants. In many cases our scrubbers are used in conjunction with other treatment devices, such as incinerators, to affect total treatment of the targeted contaminants.

Typical contaminants treated by Misonix wet scrubbers include all inorganic acids and bases, aldehydes, some ketones, most amines, alcohols, odorous compounds such as H₂S and mercaptans, submicron and micron particulates (TiO₂, SiO₂, B₂O₄), reactive gases such as TiCl₄ and BCl₃, by-products of incomplete combustion, mists and fumes, and radio active contaminants, such as tritium.

Misonix specializes in small gas flow rates down to the liter per minute range. We have a complete line of portable gas scrubbers from 25 CFM to 500 CFM. In addition, we manufacture large systems for gas flow rates up to 50,000 CFM. Custom designs are available to meet specific application requirements.

Product/Service Maturity: Commercial use experience

Performance History: Contact vendor for performance data.

Comments: Misonix has been supplying wet scrubbers to industry and government facilities for over 35 years. We utilize a unique scrubber packing material known as the Waterweb Mesh which is a co-current wetted mesh packing with a surface area of 1,300 ft²/ft³ having an order of magnitude greater surface area than normal random dumped packing. This allows very high removal efficiencies in a smaller scrubber.

Source of Information: Vendor

Company Name/POC	Molten Metal Technology, Inc./Michele Perry 51 Sawyer Road Waltham, Massachusetts 02154		
E-Mail Address			
Product/Service	Catalytic Extraction Processing	Phone Number	617 487-9700
Process Type	Recycle	Fax Number	617 487-7870

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On 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.

Status = Commercially Available: Two commercial facilities operating in Oak Ridge, TN. processing low-level radioactive waste and mixed radioactive and hazardous waste.

Product/Service Maturity: Field demo complete

Performance History: Wastes processed on a commercial scale include: polystyrene/graphite; chlorotoluene/heavy organics; dimethyl; acetamide/heavy organics; industrial biosolid; waste/graphite; spent electronic componentry; K019/K020/chlorobenzene/fuel oil; K027; F024/fuel oil/chlorotoluene.

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;

Ease of Use: little up-front characterization required, minimal feed pretreatment/separation, product 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: Vendor

Company Name/POC	MSE Technology Application, Inc./Robert Trout P.O. Box 4078 Butte, Montana 59702		
E-Mail Address			
Product/Service	Testing, Demonstration & Evaluation Services for Innovative Technologies		Phone Number 406 494-7100
Process Type	Other	Fax Number	406 494-7230

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Off site

Brief Description: Clients include the Department of Energy; the U.S. Army, the U.S. Navy, the U.S. Air Force, The National Aeronautics and Space Administration, the Environmental Protection Agency, Boeing, Lockheed-Martin, Foster-Wheeler, Bechtel, Atlantic Richfield Company, state agencies, counties and municipalities, and manufacturers.

Product/Service Maturity: Commercial use experience

Performance History: MSE provides testing, evaluation, development, and implementation of innovative technologies and approaches in the areas of waste management and remediation, energy production, and aerospace.

Areas of expertise include: civil, electrical, and chemical engineering/specialists in Environmental, Safety, and Health compliance; instrumentation and control; mining; high temperature kinetics; geology/hydrology; gas dynamics; physical, environmental, and chemical modeling; risk assessment and estimation; and materials science.

Comments: Typical projects have included:

- 1) Engineering design support for Lockheed Environmental Systems and Technologies (LESAT) Idaho National Engineering Laboratory Pit 9 Project...specializing in the thermal treatment system and offgas treatment subsystem.
- 2) Operation of the thermal treatment system for LESAT at Pit 9.
- 3) Demonstration and evaluation of an innovative groundwater barrier technology at a remote mine site in Montana.
- 4) Design, fabrication, and evaluation of biotechnologies for the treatment of mining wastes.

Treatment

5) Application of probabilistic risk assessment methods to support a no-action Record of Decision for a mixed waste Comprehensive Environmental Response, Compensation, and Liability Act.

Source of Information: Vendor

Company Name/POC	MWR, Inc., Division of Envirogen, Inc./Frederick C. Payne, PhD 7707 Rickle Road Lansing, Michigan 48917		
E-Mail Address			
Product/Service	VaporTech	Phone Number	517 322-9311
Process Type	Bioventing	Fax Number	517 322-2936

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (vadose zone)

Brief Description: Soil vapor extraction and various enhancements performed by MWR/Envirogen 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.

Product/Service Maturity: Commercial use experience

Performance History: Total projects - 90 (36 closed)
Largest closed to health-based closure = 425,000 yds(3)

Comments: 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: Vendor
Environmental Cleanup Privatization
Products and Services Directory

January 1997
T 327

Company Name/POC	MWR, Inc., Division of Envirogen, Inc./Frederick C. Payne, PhD 7707 Rickle Road Lansing, Michigan 48917		
E-Mail Address			
Product/Service	VaporTech	Phone Number	517 322-9311
Process Type	Soil Vapor Extraction (In Situ)	Fax Number	517 322-2936

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (vadose zone)

Brief Description: Soil vapor extraction and various enhancements performed by MWR/Envirogen 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.

Product/Service Maturity: Commercial use experience

Performance History: Total projects - 90 (36 closed)
Largest closed to health-based closure = 425,000 yds(3)

Comments: 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: Vendor

Company Name/POC	MWR, Inc., Division of Envirogen, Inc./Frederick C. Payne, PhD 7707 Rickle Road Lansing, Michigan 48917		
E-Mail Address			
Product/Service	SparTech	Phone Number	517 322-9311
Process Type	Air Sparging	Fax Number	517 322-2936

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service 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: Vendor

Company Name/POC Mycotech Corp./Robert Kearns
P.O. Box 4109
Butte, Montana 59702

E-Mail Address

Product/Service Fungal Enzyme Degradation
Process Type White Rot Fungus

Phone Number 406 782-2386**Fax Number** 406 782-9912**Contaminants**

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

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.

Product/Service Maturity: Commercial use experience

Performance History: The technology has been demonstrated commercially at small scale (<6,000 cubic yards of soil). The primary soil contaminants were pentachlorophenol or nitro-aromatics (explosives). Other recalcitrant compounds have been degraded in laboratory settings or in small plot tests.

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: Vendor

Company Name/POC	National Seal Company/Peter Dytrych 1245 Corporate Blvd Suite 300 Aurora, Illinois 60545		
E-Mail Address	ldl.tml@ix.netcom.com		
Product/Service	Dura Seal/Friction Seal Membranes Bentofix GCLs		Phone Number 708 898-1161
Process Type	Containment		Fax Number 708 898-6566

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: On site

Brief Description: Geosynthetic barrier layers for liquid and solid waste containment.

Product/Service Maturity: Commercial use experience

Performance History: National Seal Company has been fabricating, manufacturing and installing environmental containment systems since 1979, worldwide.

Comments: None.

Source of Information: Vendor

Treatment

Company Name/POC	Newcon A/S/J. Mollekilde Ternevey 20 DK-4000 Roskilde		
E-Mail Address			
Product/Service	Biological Soil Treatment Plant	Phone Number	45 42353616
Process Type	Bioreactors	Fax Number	45 42351548

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service 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

Company Name/POC	Noell Aball- u. Energietechnik GmbH/Mr. Rockkelein HuttenstraBe 3 D-38642 Goslar, Germany		
E-Mail Address			
Product/Service	White Rot Fungus	Phone Number	05321 3372 15
Process Type	White Rot Fungus	Fax Number	05321 3372 55

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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

Company Name/POC	Non-Destructive Cleaning, Inc./Patrick J. Gillis, Jr. 1600 Providence Highway Walpole, Massachusetts 02081		
E-Mail Address			
Product/Service	Non-Destructive Cleaning (NDC)	Phone Number	508 660-3064
Process Type	Mechanical Surface Cleaning	Fax Number	508 660-3067

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC	Norwegian Geotechnical Institute/Tor Loken PO Box 3930, Ullevaal Hageby N 0806 Oslo, Norway		
E-Mail Address			
Product/Service	In Situ Bioremediation	Phone Number	47 22023000
Process Type	Biodegradation (In Situ)	Fax Number	47 22230448

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

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

Product/Service 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

Company Name/POC O'Brien & Gere Technical Services, Inc./Eric Neubauer
5000 Brittonfield Parkway
East Syracuse, New York 13057

E-Mail Address**Product/Service****Process Type**

Soda Blasting

Mechanical Surface Cleaning

Phone Number 315 437-6400**Fax Number** 315 437-9800**Contaminants**

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC	OEEL Ltd/ESU Ltd/ Lucian S. Gill 4 Cumberland House Greenide Land Lidget Green Bradford W.Yorkshire BD89TF England	
E-Mail Address		
Product/Service	Phytostabilized Bioremediation	Phone Number 1274 480033
Process Type	Biodegradation (In Situ)	Fax Number 1274 483003

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: In-situ (saturated zone) In-situ (vadose 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 rhizome 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, sulfur and phosphorous) are removed via soil processes.

Product/Service 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 adaptation 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

Company Name/POC	Ontario Hydro Technologies/Paul Gierszewski 2700 Lake Shore Drive Mississauga L5J1K3	
E-Mail Address		
Product/Service	Plasma Tritium Decontamination	Phone Number 905 855-4724
Process Type	Other	Fax Number 905 823-8020

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: A plasma is used to remove tritium bound on tool and equipment surfaces.

Product/Service 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: Surfaces to be cleaned are limited to sizes which fit inside the plasma chamber (30 cm diameter, 50 cm long for the current model). The technique requires a moderate vacuum, which is provided by the system. 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 tritiated gas which is recovered on either metal getters or mol sieve.

Source of Information: Vendor

Treatment

Company Name/POC Osprey Biotechnics/Hiren K. Trivedi
2530 B. Trailmate Drive
Sarasota, Florida 34243

E-Mail Address

Product/Service Munox
Process Type Bioaugmentation

Phone Number 941 755-7770

Fax Number 941 755-0626

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Débris	☒ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: Munox is a specific strain of bacteria which has been designed to degrade a wide variety of problem organics from industrial sources. Our advanced production technology of selective mating and blending of safe bacteria in our laboratory by skilled microbiologists results in a superior natural product.

Munox is comprised of patented bacteria that are naturally occurring and contain no pathogens. Since all of the bacteria were isolated from natural sources, there is no artificial mutation or genetic engineering involved.

Munox is prepared, "freeze-dried" and stored frozen before shipment. This unique manufacturing process holds the culture in suspended animation and assures that Munox is at 100% strength levels at time of application.

Product/Service Maturity: Commercial use experience Pilot plant testing Field demo complete

Performance History: Since 1982, Munox has been used successfully to degrade problem waste materials generated during industrial production. Munox has a proven record of success in a wide range of applications:

Comments: The pH is very important for microbial activity. The pH should be measured and adjusted within 6.0-8.0 if necessary.

Temperature is also a factor in determining the rate of degradation. Temperature of water should be between 55 to 95 degree Fahrenheit with optimum being 75 to 80 degrees Fahrenheit.

Munox is a mixture of aerobic bacteria. Dissolved Oxygen (D.O.) is a critical parameter to be monitored. The preferred D.O. in the system should be greater than 0.5 ppm all the time. Aeration is to be provided if needed. Aeration can also be used for complete mixing of the system.

Source of Information: Vendor

Company Name/POC	Paques, Inc./Andre de Vegt 486 Thomas Jones Way Suite 100 Exton, Pennsylvania 19341 USA	
E-Mail Address		
Product/Service	Biological Sulfate and Metal Removal	Phone Number 610 363-9564
Process Type	Slurry Phase Biological Treatment	Fax Number 610 363-9554

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: PAQUES is an environmental engineering company which for the past 10 years has been engaged in the development and installation of treatment systems based on biotechnological processes to remove sulfur compounds from water, air and gaseous streams. Metals and sulfate are removed from process and ground waters using a combination of biological and solid separation steps: 1) Conversion of sulfate to hydrogen sulfide (H₂S) by sulfate reducing bacteria in a reactor under oxygen-free, i.e. anaerobic conditions; 2) the H₂S reacts with the dissolved metals to form insoluble metal sulfide precipitates. An excess of H₂S is produced to insure complete metal precipitation; 3) Excess H₂S is converted to elemental sulfur by sulfide oxidizing bacteria in a reactor under carefully controlled aerobic, i.e. oxygen-present conditions; 4) The metal sulfide precipitates and elemental sulfur are removed from the water by gravity employing liquid/solid separators.

Product/Service Maturity: Commercial use experience

Performance History: PAQUES has designed and installed a groundwater treatment system for the Budelco zinc refinery in the Netherlands to remove sulfate and metals as described above. The system has been operating since May 1992 treating a flow of 5000 m³/d (1.3 MGD). Zinc and cadmium removal averages 99.7%. Typical zinc effluent concentrations are 0.05-0.15 mg/l and effluent sulfate concentration is well below the discharge limit of 200 mg/l.

A test program, utilizing a large scale pilot plant designed and build by PAQUES, started in November 1995 at a copper mine in the U.S.A. to remediate groundwater. In addition, PAQUES is working with the Bureau of Mines Pittsburgh Research Center on the biological treatment of mining waters, such as the Berkeley Pit, with special attention to metal recovery.

Comments: None.

Source of Information: Vendor

Treatment

Company Name/POC	Parsons Engineering-Science, Inc./Mr. Doug Downey 1700 Broadway Suite 900 Denver, Colorado 80290		
E-Mail Address			
Product/Service	Bioventing	Phone Number	303 831-8100
Process Type	Bioventing	Fax Number	303 831-8208

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Company Name/POC	PEGO Systems, Inc./Customer Service P.O. Box 90038 Long Beach, California 90809		
E-Mail Address	pego@pego.com		
Product/Service	Blower and Vacuum Packages	Phone Number	310 426-1321
Process Type	Vacuum Vapor Extraction	Fax Number	310 490-0633

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Vapor extraction systems with carbon drum adsorption.
Vapor extraction systems with thermal oxidizers.

I.C. Engine vapor extraction. Engine utilizes vapors for fuel and destroys them simultaneously.

Product/Service Maturity: Commercial use experience Pilot plant testing

Performance History: Building systems since 1981 for the oil companies, large contractors and industrial end users.

Comments: Can also build systems to suit customer designs and specifications. Can build and design to meet system requirements.

Source of Information: Vendor

Company Name/POC	PENTEK, Inc./Nancy Moore 1026 Fourth Avenue Coropolis, Pennsylvania 15108-1659		
E-Mail Address	pentekusa@usa.com		
Product/Service	Remotely Operated Scrubber-MOOSE	Phone Number	412 262-0725
Process Type	Mechanical Surface Cleaning	Fax Number	412 262-0731

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC	PENTEK, Inc./Nancy Moore 1026 Fourth Avenue Coropolis, Pennsylvania 15108-1659		
E-Mail Address	pentekusa@usa.com		
Product/Service	Pentek-600	Phone Number	412 262-0725
Process Type	Chemical Surface Cleaning	Fax Number	412 262-0731

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Treatment

Company Name/POC	Pet-Con Soil Remediation, Inc./Tom LaBudde P.O. Box 205 Spring Green, Wisconsin 53588		
E-Mail Address			
Product/Service	Thermal Desorption	Phone Number	608 588-7365
Process Type	Low Temperature Thermal Desorption	Fax Number	608 588-7606

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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 channeled 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.

Product/Service Maturity: Commercial use experience

Performance History: Performance data are available.

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.

Comments: 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: Vendor

Company Name/POC	Petrol Rem, Inc./John Opsasnick 2275 Swallow Hill Road Bldg. 2500 Second Floor Pittsburgh, Pennsylvania 15220	
E-Mail Address		
Product/Service	PRP (R) Petroleum Remediation Product	Phone Number 412 279-9745
Process Type	Bioremediation	Fax Number 412 279-1367

Contaminants

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

Media

☒ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: On site

Brief Description: PRP (R) is an all natural product which contains hydrocarbon degrading bacteria and nutrients. Upon contact with the spilled hydrocarbon, the fuel is bound by the PRP (R) and the remediation process begins. Because the PRP (R) is hydrophobic, it will keep the hydrocarbon afloat while it is being degraded. Eventually, the hydrocarbon and the PRP (R) itself is degraded. The best application for PRP (R) is on open water spills, especially around sensitive areas such as marshlands. PRP (R) can be applied remotely and left in place to degrade.

Product/Service Maturity: Field demo complete

Performance History: A field demonstration and detailed study was performed by the National Environmental Technology Application Corporation (NETAC). NETAC was originally formed by the US EPA and the University of Pittsburgh in 1989. Their mission is to evaluate the efficacy of various new biological technologies. See attached sheet for details.

Comments: None.

Source of Information: Vendor

Company Name/POC	Pittsburgh Activated Carbon Services, Inc./Henry Nowicki Ph.D/MBA	
	409 Meadi Drive	
	Coraopolis, Pennsylvania 15108	
E-Mail Address		
Product/Service	Activated Carbon Regeneration	Phone Number 412 457-6576
Process Type	Filtration	Fax Number 412 457-1214

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Off site On site

Brief Description: Activated carbon filter water/air to capture contaminants. We have a new liquid-phase regeneration, to make the activated carbon like new and recover the adsorbents.

Product/Service Maturity: Bench scale testing only

Performance History: Demonstrated with hydrocarbon spent activated carbon.

Comments: Many possible uses. We are expecting samples of spent activated carbon to test how our new regeneration works on real-world spent activated carbon samples.

Source of Information: Vendor

Company Name/POC	Pittsburgh Activated Carbon Services, Inc./Henry Nowicki Ph.D/MBA 409 Meadi Drive Coraopolis, Pennsylvania 15108		
E-Mail Address			
Product/Service	Activated Carbon Regeneration	Phone Number	412 457-6576
Process Type	Recycle	Fax Number	412 457-1214

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Off site On site

Brief Description: Activated carbon filter water/air to capture contaminants. We have a new liquid-phase regeneration, to make the activated carbon like new and recover the adsorbents.

Product/Service Maturity: Bench scale testing only

Performance History: Demonstrated with hydrocarbon spent activated carbon.

Comments: Many possible uses. We are expecting samples of spent activated carbon to test how our new regeneration works on real-world spent activated carbon samples.

Source of Information: Vendor

Company Name/POC	Pittsburgh Activated Carbon Services, Inc./Henry Nowicki Ph.D/MBA		
	409 Meadi Drive		
	Coraopolis, Pennsylvania 15108		
E-Mail Address			
Product/Service	Activated Carbon Regeneration	Phone Number	412 457-6576
Process Type	Chemical Extraction	Fax Number	412 457-1214

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Off site On site

Brief Description: Activated carbon filter water/air to capture contaminants. We have a new liquid-phase regeneration, to make the activated carbon like new and recover the adsorbents.

Product/Service Maturity: Bench scale testing only

Performance History: Demonstrated with hydrocarbon spent activated carbon.

Comments: Many possible uses. We are expecting samples of spent activated carbon to test how our new regeneration works on real-world spent activated carbon samples.

Source of Information: Vendor

Company Name/POC	Pittsburgh Mineral & Environmental Tech/William F. Sutton 700 Fifth Avenue New Brighton, Pennsylvania 15066		
E-Mail Address	mrs@ccia.com		
Product/Service	Mercury Recovery Services (MRS)	Phone Number	412 843-5000
Process Type	High Temperature Thermal Desorption	Fax Number	412 843-5353

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC	Plastronics Inc./Customer Service P.O. Box 580404 Houston, TX 77058		
E-Mail Address			
Product/Service	Containment	Phone Number	713 335-1318
Process Type	Containment	Fax Number	713 335-1408

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application:

Brief Description: Large FRP tanks; ductwork fiberglass; pipe fiberglass.

Product/Service Maturity: Commercial use experience.

Performance History: 30 years of product history. Contact vendor for performance data.

Comments: None.

Source of Information: Vendor

Company Name/POC	Polygon Industries, Inc./Charles A Chenes 665 Third Street Suite 315 San Francisco, California 94107		
E-Mail Address	polygon@polygon1.com		
Product/Service	Flashlamp StarBoldt (TM)	Phone Number	415 357-3690
Process Type	Mechanical Surface Cleaning	Fax Number	415 357-3695

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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 D in. 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 StarBolt 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 StarBolt 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: Vendor

Company Name/POC	Portec, Inc./Jim Lincoln 700 West 21st Street P.O. Box 20 Yankton, South Dakota 57078-0220		
E-Mail Address			
Product/Service	Ex Situ Soil Remediation Equipment	Phone Number	605 665-8770
Process Type	Other	Fax Number	605 665-8858

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

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.

Product/Service 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. In 1995 Portec Pagewells were on site throughout the U.S., Canada, and Mexico on remediation, encapsulation and bioremediation projects including PCB's, hydrocarbons, copper and heavy metals.

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: Vendor

Company Name/POC	Power Fluidics/Paul Murray 13245 Reese Blvd West Campbell Bldg Suite 100 Hunterville, North Carolina 28078	
E-Mail Address		
Product/Service	Power Fluidic Stripper	Phone Number 704 875-9573
Process Type	Air Stripping	Fax Number 704 875-8114

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC	Praxair, Inc./Gary E. Storms 39 Old Ridgeburg Rd. Danbury, Connecticut 06810-5113		
E-Mail Address	gary_storms@praxair.com		
Product/Service	Mixflo (TM)	Phone Number	1 800 772-9247
Process Type	Biodegradation (In Situ)	Fax Number	203 837-2505

Contaminants

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

Media

☒ Surface Impoundment	☐ Soil	☐ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: Praxair's MIXFLO (TM) 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.

Product/Service 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 (TM) 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: Vendor

Treatment

Company Name/POC	Pressure Systems Inc./John Theis 1900 Randolph Road, SE Suite A Albuquerque, New Mexico 87106		
E-Mail Address			
Product/Service	Phoenix Ash Technology	Phone Number	505 248-1191
Process Type	Solidification/Stabilization (Ex Situ)	Fax Number	505 248-1196

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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 stabilize a wide variety of potential waste streams. The Phoenix Ash 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 of high structural integrity which result in a volume reduction. 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 inexpensive fly ash, and produces a block configuration with high leach resistance and structural strength. The bricks have short cure times of and have an advantage in not requiring special containers for storage.

Product/Service 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, 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, Dr. Karl Standhammer, 505-667-9333. Dr. Bruce King NETAC, 412-826-5511, EPA study 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. Additional testing may identify additional materials that can be treated using this technology. 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 understood and established process noted for their long term stability. The Phoenix Ash Technology 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 Phoenix Ash 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 unit 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 PSI.

Source of Information: Vendor

Treatment

Company Name/POC	Process Technologies, Inc./Michael Swan P.O. Box 476 Boise, Idaho 83701		
E-Mail Address	mswan@rmci.net		
Product/Service	Photolytic Destruction Technology	Phone Number	208 385-0900
Process Type	Ultraviolet Oxidation	Fax Number	208 385-0994

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: Photolytic Destruction is a non-thermal, low temperature, process for destroying vapor-phase halogenated VOCs. The proprietary technology uses UV light to oxidize the target chemistry. The resulting by-products are chemically reacted with a solid reagent to form non-hazardous salts.

Product/Service Maturity: Commercial use experience Field demo complete

Performance History: The company has performed two pilot-scale and two commercial-scale field demonstrations of the technology. Two pilot-scale demonstrations were performed at McClellan AFB, in 1994 and 1995, to evaluate the efficiency and cost of PTI's process in treating a mixture of chlorinated and non-chlorinated VOCs in the SVE off-gas. An average DRE of 95% and an on-line availability in excess of 90%. A successful six-month study was performed at Hill AFB in 1995. The study focused on the destruction of off-gas from four 1800-gallon chemical storage tanks. The primary contaminants were 1,1,1 TCA, TCE, PCE and MeC1 at total concentrations of 20,000 ppmv. The company has installed a commercial unit at the site for long-term operations.

The company recently completed (March-April 1996) a commercial-scale treatability study at Aerojet General Corporation. The purpose of this study was to evaluate the efficiency and cost of destroying high levels of TCE known to be in the soil. The TCE was removed from the soil with an SVE system, then concentrated with a fluid-bed concentrator prior to treatment with PTI's Photolytic Destruction process. Results were not available at the time of writing.

Comments: Equipment design and sizing is volume dependent. Significant cost savings can be realized if the use of a concentrator to pretreat the gas stream is possible. The process is capable of treating gas concentrations to 50,000 ppmv.

The system uses no moving parts and is therefore simple to start-up, operate and maintain. On-line availability is typically >90%.

The solid reagent typically captures in excess of 98% of the acidic by-products created in the oxidation process. A back-up scrubber may be required when treating highly halogenated gas streams. The reagent material is replaced when fully utilized.

January 1997
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Environmental Cleanup Privatization
Products and Services Directory

Source of Information: Vendor

Treatment

Company Name/POC	Promeco B.V./ A.J. M. Broeders P.O. Box 94 5741 OAB Beek En Donk, The Netherlands
E-Mail Address	
Product/Service	Optimizing Separation
Process Type	Soil Washing
	Phone Number 31 492 463903 Fax Number 31 492 465025

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC	Quaternary Investigations, Inc. (QI)/Tony Morgan 300 W. Olive St. Suite A Colton, California 92324		
E-Mail Address			
Product/Service	Air Sparging	Phone Number	909 423-0740
Process Type	Air Sparging	Fax Number	909 423-0743

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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 biodegradating microorganism population and increasing in situ bioremediation of contaminants. No emissions result from this system.

Product/Service 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: Vendor

Company Name/POC	Quaternary Investigations, Inc. (QI)/Tony Morgan		
	300 W. Olive St.		
	Suite A		
	Colton, California 92324		
E-Mail Address			
Product/Service	Bioventing	Phone Number	909 423-0740
Process Type	Bioventing	Fax Number	909 423-0743

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Company Name/POC	R. Mazur/Rick Mazur 360 So. Reynolds Rd. Toledo, Ohio 43615		
E-Mail Address			
Product/Service	Bioventing	Phone Number	419 537-6000
Process Type	Bioventing	Fax Number	419 537-8774

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Company Name/POC Radian Corporation/Joe Milanowski
10150 West National Ave.
Milwaukee, Wisconsin 53227

E-Mail Address

Product/Service Integrated Steam Stripping/Condensation
Process Type Hot Water or Steam Flushing/Stripping

Phone Number 414 327-9955

Fax Number 414 327-2129

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: Integrated treatment system would reinject treated off-gases to increase subsurface gradients and augment removal. Condensation produces concentrated liquid organic phase.

Product/Service 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: Vendor

Company Name/POC	Radian Corporation/Joe Milanowski 10150 West National Ave. Milwaukee, Wisconsin 53227		
E-Mail Address			
Product/Service	In-Situ Fixation	Phone Number	414 327-9955
Process Type	Solidification/Stabilization (In Situ)	Fax Number	414 327-2129

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service Maturity: Field demo complete

Performance History: Contact Radian Corporation for performance data.

Comments: Limitations include: subsurface obstructions; depths over 150 feet.

Source of Information: Vendor

Treatment

Company Name/POC	Radian International/Darrell Mauller 9801 Westheimer Houston, Texas 77042	
E-Mail Address		
Product/Service	Sorbathene/Solvent Vapor Recovery Unit	Phone Number 713 914-6508
Process Type	Other	Fax Number 713 789-8404

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service Maturity: Commercial use experience

Performance History: More than 30 units in operation as of September 1996. 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 (PPG 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: Vendor

Company Name/POC	Radian International/Darrell Mauller 9801 Westheimer Houston, Texas 77042	
E-Mail Address		
Product/Service	AQUADETOX/SVE Integrated System	Phone Number 713 914-6508
Process Type	Hot Water or Steam Flushing/Stripping	Fax Number 713 789-8404

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Product/Service Maturity: Commercial use experience

Performance History: Performance data are available.

Approximately 45 to 50 units are in operation as of September 1996 ranging in size from 5 to 9,000 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.

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 Radian International along with detailed manuals of operation. The training is minimal and no unusual personnel skills are required.

Radian International (formerly DOW Environmental and Radian Corporation).

Source of Information: Vendor

Company Name/POC	Radiation Science Inc./Thomas P. Bracke 10 South River Road Suite 1005 Cranburg, New Jersey 08512	
E-Mail Address		
Product/Service	In-Situ Oxidation of Organic Contamination in Groundwater	Phone Number 609 395-1466
Process Type	Chemical Reduction	Fax Number 609 395-1178

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Treatment

Company Name/POC	Radiological Services Inc./James McCleer 31 Shaw Street New London, Connecticut 06320		
E-Mail Address			
Product/Service	LVS Series Radiological Pipe Crawler (Crawler)	Phone Number	860 443-4944
Process Type	Mechanical Surface Cleaning	Fax Number	860 444-6110

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (vadose zone)

Brief Description: The purpose of the technology is radiological decontamination and free release survey of internal piping surfaces. Following assessment of candidate piping, a four-step process begins without disturbing site grounds or buildings: 1) High-pressure water-cleaning of pipe surfaces with self-contained collection, processing and recycling of cleaning water. 2) Complete video inspection of all interior surfaces to verify cleanliness, dryness and integrity prior to survey. 3) Free release surveys using the patented LVS crawlers. 4) Thorough documentation for all pipe runs including encoded videotape records, survey unit release records, and comprehensive data tables.

Product/Service Maturity: Commercial use experience

Performance History: Over 15,000 lb of piping has been decontaminated and surveyed for free release to the public at commercial facilities. The following pipe diameters have been decontaminated and surveyed to date: 12", 10", 8", 6", 4", 3", and 2". All survey work verified by NRC. Contacts:

Fred Petschauer, Brookhaven National Lab - 516 282-7498

Arthur Bortz, New York Power Authority - 914 736-8133

Steve Masciulli, ABB Combustion Engineering - 203 285-2121

Comments: All necessary equipment, personnel and utilities services are available through RSI for remote deployment.

All work described has been successfully performed in total in the field. Equipment is flexible and has been applied to a wide variety of piping sizes and configurations, including multiple 90 and 45-degree turns.

Source of Information: Vendor

Company Name/POC	Ranator AB/Torgny A. Mellin Roslagsvagen 101, hus 15, S-104 05 Stockholm, Sweden	
E-Mail Address		
Product/Service	Ranator Detoxification Process (RDP)	Phone Number 46 8 153880
Process Type	Soil Washing	Fax Number 46 8 159717

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service Maturity: Pilot plant testing

Performance History: RDP was successfully tested on full pilot plant scale in 1995. An industrial mobile RDP plant is scheduled to commence commercial operations in early 1997.

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.
Pilot plant testing: Full Scale.

Source of Information: Vendor

Treatment

Company Name/POC Recycling Sciences International Inc./William C. Meenan
175 West Jackson Blvd.
Suite A1934
Chicago, Illinois 60604

E-Mail Address

Product/Service Desorption and Vapor Extraction (DAVE) System **Phone Number** 312 663-4242
Process Type Low Temperature Thermal Desorption **Fax Number** 312 663-4269

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC	Regenesis Bioremediation Products/Amber M. Healy/John B. Griffiths 27130A Paseo Espada Suite 1407 San Juan Capistrano, CA 92675	
E-Mail Address		
Product/Service	Oxygen Release Compound - ORC (R)	Phone Number 714 443-3136
Process Type	Biodegradation (In Situ)	Fax Number 714 443-3140

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ In-situ (saturated zone) In-situ (vadose zone) On site Non-intrusive

Brief Description: Oxygen Release Compound [ORC (R)] passively and cost-effectively enhances in-situ aerobic bioremediation of dissolved phase hydrocarbons. ORC is a patented formulation of magnesium peroxide that releases oxygen slowly when contacted with water. The product will release oxygen between six months to one year, depending on site conditions. Microbes flourish with the steady oxygen supply and biodegrade the contaminants. In ground water application, ORC powder is inserted into a well (in filter socks) or boreholes (as a slurry) through the length of the contaminated saturated zone where contact with groundwater initiates the release of oxygen. ORC can also be mixed with the clean backfill in the bottom of an excavated UST pit to prevent recontamination by a rising water table. The by-products of the OR reaction with water are oxygen and ordinary magnesium hydroxide, which make ORC environmentally safe to use.

Product/Service Maturity: Commercial use experience Pilot plant testing Field demo complete

Performance History: ORC has been proven to significantly increase dissolved oxygen levels (15-25ppm in contaminated aquifers) which supports aerobic bioremediation. Performance data are available. Since its introduction to the environmental markets in February 1995, ORC is now being used for groundwater and soil remediations on over 650 sites in 40 states and Canada by over 150 Engineering/Consulting firms. ORC can be used to meet a variety of remediation objectives, including source treatment for early site closure, plume containment, and risk reduction.

Data are available demonstrating the reduction of dissolved phase hydrocarbons, specifically BTEX; however ORC may be used to remediate any aerobically degradable contaminants.

Comments: ORC is a simple, cost-effective technology designed to close sites early at substantial savings compared to other remediation methods. Once ORC is installed, there is no need for continuous mechanical operation or maintenance. ORC will also deliver higher levels of dissolved oxygen than possible with air; the

release of oxygen from the ORC particle is independently continuous and does not require constant injection or pumping.

Source of Information: Vendor

Company Name/POC	Remediation Service International/Michael J. Joy 2060 Knoll Drive Suite 200 Ventura, California 93003		
E-Mail Address	rsi@west.net		
Product/Service	S.A.V.E. (TM) System	Phone Number	805 644-5892
Process Type	Biodegradation (In Situ)	Fax Number	805 654-0720

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: The S.A.V.E. (TM) system is a unique and innovative approach to soil and groundwater remediation. It was designed to simultaneously extract hydrocarbon contamination from soil and remove benzene and MTBE from impacted groundwater while abating the off gasses created from both processes. RSI's equipment has been used successfully for soil venting, (hot) air injection, bioslurping, air stripping and abating off gasses with compressive thermal-catalytic oxidation.

Product/Service Maturity: Commercial use experience

Performance History: Remediation Service International (RSI) has produced over 150 remediation systems for the environmental industry during the past 9 years. RSI's systems have been used by the U.S. Air Force and Navy for soil venting, bioventing, bioslurping and bioremediation at various projects. Our technology has been used by IT Corporation to increase yield from a shallow aquifer using enhanced vacuum recovery. Still others have used our spray aeration to remove VOC (halogenated and nonhalogenated), MTBE, and other contaminants from extracted groundwater. In most cases RSI was also required to abate off gasses created from the processes to meet local air pollution control district guidelines. In some instances, we have treated condensate from land fill soil venting systems and/or abated methane from the soil venting process itself. Many consultants have applied the S.A.V.E. (TM) system successfully on many projects.

Comments: RSI has developed the Phoenix 1000 Auto Air Fuel Controller which is a fully automated operating system for the above mentioned systems. We generate our own necessary power and have no need for outside electrical power. We manufacture systems for sale, lease, or rent. Installation costs are minimal.

Source of Information: Vendor

Company Name/POC	Remediation Service International/Michael J. Joy 2060 Knoll Drive Suite 200 Ventura, California 93003		
E-Mail Address	rsi@west.net		
Product/Service	S.A.V.E. (TM) System	Phone Number	805 644-5892
Process Type	Soil Vapor Extraction (In Situ)	Fax Number	805 654-0720

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: The S.A.V.E. (TM) system is a unique and innovative approach to soil and groundwater remediation. It was designed to simultaneously extract hydrocarbon contamination from soil and remove benzene and MTBE from impacted groundwater while abating the off gasses created from both processes. RSI's equipment has been used successfully for soil venting, (hot) air injection, bioslurping, air stripping and abating off gasses with compressive thermal-catalytic oxidation.

Product/Service Maturity: Commercial use experience

Performance History: Remediation Service International (RSI) has produced over 150 remediation systems for the environmental industry during the past 9 years. RSI's systems have been used by the U.S. Air Force and Navy for soil venting, bioventing, bioslurping and bioremediation at various projects. Our technology has been used by IT Corporation to increase yield from a shallow aquifer using enhanced vacuum recovery. Still others have used our spray aeration to remove VOC (halogenated and nonhalogenated), MTBE, and other contaminants from extracted groundwater. In most cases RSI was also required to abate off gasses created from the processes to meet local air pollution control district guidelines. In some instances, we have treated condensate from land fill soil venting systems and/or abated methane from the soil venting process itself. Many consultants have applied the S.A.V.E. (TM) system successfully on many projects.

Comments: RSI has developed the Phoenix 1000 Auto Air Fuel Controller which is a fully automated operating system for the above mentioned systems. We generate our own necessary power and have no need for outside electrical power. We manufacture systems for sale, lease, or rent. Installation costs are minimal.

Source of Information: Vendor

Company Name/POC	Remediation Service International/Michael J. Joy 2060 Knoll Drive Suite 200 Ventura, California 93003		
E-Mail Address	rsi@west.net		
Product/Service	S.A.V.E. (TM) System	Phone Number	805 644-5892
Process Type	Oxygen Enhancement with Air Sparging	Fax Number	805 654-0720

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: The S.A.V.E. (TM) system is a unique and innovative approach to soil and groundwater remediation. It was designed to simultaneously extract hydrocarbon contamination from soil and remove benzene and MTBE from impacted groundwater while abating the off gasses created from both processes. RSI's equipment has been used successfully for soil venting, (hot) air injection, bioslurping, air stripping and abating off gasses with compressive thermal-catalytic oxidation.

Product/Service Maturity: Commercial use experience

Performance History: Remediation Service International (RSI) has produced over 150 remediation systems for the environmental industry during the past 9 years. RSI's systems have been used by the U.S. Air Force and Navy for soil venting, bioventing, bioslurping and bioremediation at various projects. Our technology has been used by IT Corporation to increase yield from a shallow aquifer using enhanced vacuum recovery. Still others have used our spray aeration to remove VOC (halogenated and nonhalogenated), MTBE, and other contaminants from extracted groundwater. In most cases RSI was also required to abate off gasses created from the processes to meet local air pollution control district guidelines. In some instances, we have treated condensate from land fill soil venting systems and/or abated methane from the soil venting process itself. Many consultants have applied the S.A.V.E. (TM) system successfully on many projects.

Comments: RSI has developed the Phoenix 1000 Auto Air Fuel Controller which is a fully automated operating system for the above mentioned systems. We generate our own necessary power and have no need for outside electrical power. We manufacture systems for sale, lease, or rent. Installation costs are minimal.

Source of Information: Vendor

Company Name/POC	Remediation Service International/Michael J. Joy 2060 Knoll Drive Suite 200 Ventura, California 93003		
E-Mail Address	rsi@west.net	Phone Number	805 644-5892
Product/Service	S.A.V.E. (TM) System	Fax Number	805 654-0720
Process Type	Air Sparging		

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: The S.A.V.E. (TM) system is a unique and innovative approach to soil and groundwater remediation. It was designed to simultaneously extract hydrocarbon contamination from soil and remove benzene and MTBE from impacted groundwater while abating the off gasses created from both processes. RSI's equipment has been used successfully for soil venting, (hot) air injection, bioslurping, air stripping and abating off gasses with compressive thermal-catalytic oxidation.

Product/Service Maturity: Commercial use experience

Performance History: Remediation Service International (RSI) has produced over 150 remediation systems for the environmental industry during the past 9 years. RSI's systems have been used by the U.S. Air Force and Navy for soil venting, bioventing, bioslurping and bioremediation at various projects. Our technology has been used by IT Corporation to increase yield from a shallow aquifer using enhanced vacuum recovery. Still others have used our spray aeration to remove VOC (halogenated and nonhalogenated), MTBE, and other contaminants from extracted groundwater. In most cases RSI was also required to abate off gasses created from the processes to meet local air pollution control district guidelines. In some instances, we have treated condensate from land fill soil venting systems and/or abated methane from the soil venting process itself. Many consultants have applied the S.A.V.E. (TM) system successfully on many projects.

Comments: RSI has developed the Phoenix 1000 Auto Air Fuel Controller which is a fully automated operating system for the above mentioned systems. We generate our own necessary power and have no need for outside electrical power. We manufacture systems for sale, lease, or rent. Installation costs are minimal.

Source of Information: Vendor

Company Name/POC	Remediation Service International/Michael J. Joy 2060 Knoll Drive Suite 200 Ventura, California 93003		
E-Mail Address	rsi@west.net	Phone Number	805 644-5892
Product/Service	S.A.V.E. (TM) System	Fax Number	805 654-0720
Process Type	Bioventing		

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: The S.A.V.E. (TM) system is a unique and innovative approach to soil and groundwater remediation. It was designed to simultaneously extract hydrocarbon contamination from soil and remove benzene and MTBE from impacted groundwater while abating the off gasses created from both processes. RSI's equipment has been used successfully for soil venting, (hot) air injection, bioslurping, air stripping and abating-off gasses with compressive thermal-catalytic oxidation.

Product/Service Maturity: Commercial use experience

Performance History: Remediation Service International (RSI) has produced over 150 remediation systems for the environmental industry during the past 9 years. RSI's systems have been used by the U.S. Air Force and Navy for soil venting, bioventing, bioslurping and bioremediation at various projects. Our technology has been used by IT Corporation to increase yield from a shallow aquifer using enhanced vacuum recovery. Still others have used our spray aeration to remove VOC (halogenated and nonhalogenated), MTBE, and other contaminants from extracted groundwater. In most cases RSI was also required to abate off gasses created from the processes to meet local air pollution control district guidelines. In some instances, we have treated condensate from land fill soil venting systems and/or abated methane from the soil venting process itself. Many consultants have applied the S.A.V.E. (TM) system successfully on many projects.

Comments: RSI has developed the Phoenix 1000 Auto Air Fuel Controller which is a fully automated operating system for the above mentioned systems. We generate our own necessary power and have no need for outside electrical power. We manufacture systems for sale, lease, or rent. Installation costs are minimal.

Source of Information: Vendor

Company Name/POC	Remediation Service International/Michael J. Joy 2060 Knoll Drive Suite 200 Ventura, California 93003		
E-Mail Address	rsi@west.net		
Product/Service	S.A.V.E. (TM) System	Phone Number	805 644-5892
Process Type	Hot Water or Steam Flushing/Stripping	Fax Number	805 654-0720

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: The S.A.V.E. (TM) system is a unique and innovative approach to soil and groundwater remediation. It was designed to simultaneously extract hydrocarbon contamination from soil and remove benzene and MTBE from impacted groundwater while abating the off gasses created from both processes. RSI's equipment has been used successfully for soil venting, (hot) air injection, bioslurping, air stripping and abating off gasses with compressive thermal-catalytic oxidation.

Product/Service Maturity: Commercial use experience

Performance History: Remediation Service International (RSI) has produced over 150 remediation systems for the environmental industry during the past 9 years. RSI's systems have been used by the U.S. Air Force and Navy for soil venting, bioventing, bioslurping and bioremediation at various projects. Our technology has been used by IT Corporation to increase yield from a shallow aquifer using enhanced vacuum recovery. Still others have used our spray aeration to remove VOC (halogenated and nonhalogenated), MTBE, and other contaminants from extracted groundwater. In most cases RSI was also required to abate off gasses created from the processes to meet local air pollution control district guidelines. In some instances, we have treated condensate from land fill soil venting systems and/or abated methane from the soil venting process itself. Many consultants have applied the S.A.V.E. (TM) system successfully on many projects.

Comments: RSI has developed the Phoenix 1000 Auto Air Fuel Controller which is a fully automated operating system for the above-mentioned systems. We generate our own necessary power and have no need for outside electrical power. We manufacture systems for sale, lease, or rent. Installation costs are minimal.

Source of Information: Vendor

Company Name/POC	Remediation Service International/Michael J. Joy 2060 Knoll Drive Suite 200 Ventura, California 93003		
E-Mail Address	rsi@west.net		
Product/Service	S.A.V.E. (TM) System	Phone Number	805 644-5892
Process Type	Vacuum Vapor Extraction	Fax Number	805 654-0720

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: The S.A.V.E. (TM) system is a unique and innovative approach to soil and groundwater remediation. It was designed to simultaneously extract hydrocarbon contamination from soil and remove benzene and MTBE from impacted groundwater while abating the off gasses created from both processes. RSI's equipment has been used successfully for soil venting, (hot) air injection, bioslurping, air stripping and abating off gasses with compressive thermal-catalytic oxidation.

Product/Service Maturity: Commercial use experience

Performance History: Remediation Service International (RSI) has produced over 150 remediation systems for the environmental industry during the past 9 years. RSI's systems have been used by the U.S. Air Force and Navy for soil venting, bioventing, bioslurping and bioremediation at various projects. Our technology has been used by IT Corporation to increase yield from a shallow aquifer using enhanced vacuum recovery. Still others have used our spray aeration to remove VOC (halogenated and nonhalogenated), MTBE, and other contaminants from extracted groundwater. In most cases RSI was also required to abate off gasses created from the processes to meet local air pollution control district guidelines. In some instances, we have treated condensate from land fill soil venting systems and/or abated methane from the soil venting process itself. Many consultants have applied the S.A.V.E. (TM) system successfully on many projects.

Comments: RSI has developed the Phoenix 1000 Auto Air Fuel Controller which is a fully automated operating system for the above mentioned systems. We generate our own necessary power and have no need for outside electrical power. We manufacture systems for sale, lease, or rent. Installation costs are minimal.

Source of Information: Vendor

Company Name/POC	Remediation Service International/Michael J. Joy 2060 Knoll Drive Suite 200 Ventura, California 93003		
E-Mail Address	rsi@west.net	Phone Number	805 644-5892
Product/Service	S.A.V.E. (TM) System	Fax Number	805 654-0720
Process Type	Oxidation		

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: The S.A.V.E. (TM) system is a unique and innovative approach to soil and groundwater remediation. It was designed to simultaneously extract hydrocarbon contamination from soil and remove benzene and MTBE from impacted groundwater while abating the off gases created from both processes. RSI's equipment has been used successfully for soil venting, (hot) air injection, bioslurping, air stripping and abating off gases with compressive thermal-catalytic oxidation.

Product/Service Maturity: Commercial use experience

Performance History: Remediation Service International (RSI) has produced over 150 remediation systems for the environmental industry during the past 9 years. RSI's systems have been used by the U.S. Air Force and Navy for soil venting, bioventing, bioslurping and bioremediation at various projects. Our technology has been used by IT Corporation to increase yield from a shallow aquifer using enhanced vacuum recovery. Still others have used our spray aeration to remove VOC (halogenated and nonhalogenated), MTBE, and other contaminants from extracted groundwater. In most cases RSI was also required to abate off gases created from the processes to meet local air pollution control district guidelines. In some instances, we have treated condensate from land fill soil venting systems and/or abated methane from the soil venting process itself. Many consultants have applied the S.A.V.E. (TM) system successfully on many projects.

Comments: RSI has developed the Phoenix 1000 Auto Air Fuel Controller which is a fully automated operating system for the above mentioned systems. We generate our own necessary power and have no need for outside electrical power. We manufacture systems for sale, lease, or rent. Installation costs are minimal.

Source of Information: Vendor

Company Name/POC	Remediation Service International/Michael J. Joy 2060 Knoll Drive Suite 200 Ventura, California 93003	
E-Mail Address	rsi@west.net	
Product/Service	S.A.V.E. (TM) System	Phone Number 805 644-5892
Process Type	Dual Phase Extraction	Fax Number 805 654-0720

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: The S.A.V.E. (TM) system is a unique and innovative approach to soil and groundwater remediation. It was designed to simultaneously extract hydrocarbon contamination from soil and remove benzene and MTBE from impacted groundwater while abating the off gasses created from both processes. RSI's equipment has been used successfully for soil venting, (hot) air injection, bioslurping, air stripping and abating off gasses with compressive thermal-catalytic oxidation.

Product/Service Maturity: Commercial use experience

Performance History: Remediation Service International (RSI) has produced over 150 remediation systems for the environmental industry during the past 9 years. RSI's systems have been used by the U.S. Air Force and Navy for soil venting, bioventing, bioslurping and bioremediation at various projects. Our technology has been used by IT Corporation to increase yield from a shallow aquifer using enhanced vacuum recovery. Still others have used our spray aeration to remove VOC (halogenated and nonhalogenated), MTBE, and other contaminants from extracted groundwater. In most cases RSI was also required to abate off gasses created from the processes to meet local air pollution control district guidelines. In some instances, we have treated condensate from land fill soil venting systems and/or abated methane from the soil venting process itself. Many consultants have applied the S.A.V.E. (TM) system successfully on many projects.

Comments: RSI has developed the Phoenix 1000 Auto Air Fuel Controller which is a fully automated operating system for the above mentioned systems. We generate our own necessary power and have no need for outside electrical power. We manufacture systems for sale, lease, or rent. Installation costs are minimal.

Source of Information: Vendor

Company Name/POC	Resource Conservation Company/Lanny Weimer 3630 Cornus Lane Ellicott City, Maryland 21042	
E-Mail Address	lweiner@softaid.net	
Product/Service	RCC Solvent Extraction	Phone Number 410 750-0626
Process Type	Chemical Extraction	Fax Number 410 465-2887

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC	Resource Management and Recovery/Mike Hosea 4980 Baylor Canyon Road Las Cruces, New Mexico 88011		
E-Mail Address			
Product/Service	Ion Exchange Treatment of Water	Phone Number	505 382-9228
Process Type	Ion Exchange	Fax Number	505 382-9228

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On site

Brief Description: Ion exchange units from Resource Management and Recovery include specialty adsorbents that selectively remove heavy metals, including radionuclides, from water (including soil-washing water). The adsorbents can be regenerated, removing the metal ions and restoring adsorptive capacity. This technique is an alternative to precipitation and to membrane-based methods.

Product/Service Maturity: Commercial use experience

Performance History: RMR has developed more than 40 systems for removal of heavy metals from water, varying from <1gpm to over 100 gpm.

Comments: Feed water must be free of particulates, oil and grease before entering ion exchange columns. Systems are easy to use, largely automatic, needing occasional attention by non-degreed operators with about a week of on-site training.

The metals removed from the wash water are concentrated to ~1% w/t (more can be done, using evaporators). The fate of this concentrate depends on the metals present; they may be electroplated from the solution or precipitated; or the solution may be disposed of without further treatment.

Source of Information: Vendor

Company Name/POC Richard Buchen GmpH/Dr. Jorg Unk
Gawerbering 4 - 8
76149 Karlsruhe
Germany

E-Mail Address

Product/Service Decontamination of Metal by Decontgel

Phone Number 011 49 7247 20311

Process Type Chemical Surface Cleaning

Fax Number 011 49 7247 21893

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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

Company Name/POC	Riso National Laboratory/Jorn Roed Environmental Science and Technology Department P.O. Box 49 DK-4000 Roskilde, Denmark	
E-Mail Address		
Product/Service	High Pressure KEW Unit with Turbo Nozzle and Sandblasting Equipment	Phone Number 454677 4186
Process Type	Mechanical Surface Cleaning	Fax Number 454237 0025

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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

Company Name/POC	RKK, Ltd./Ron Krieg or Doug Orkney 16404 Smokey Point Boulevard Suite 303 Arlington, Washington 98223		
E-Mail Address			
Product/Service	CRYOSWEEP (TM)	Phone Number	360 653-4844
Process Type	Other	Fax Number	360 653-7456

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: CRYOSWEEP (TM) is an in-situ soil remediation technology which removes all known types of impurities, including radioactive, ionic, or organic solutes. Based on a thermomolecular effect associated with the melting of a solid at an interface, CRYOSWEEP (TM) is designed to control the movement of contaminants in groundwater to the extent of separating, steering, and concentrating them in a zone of safe collection.

Freeze pipes are installed in an array configured to match the waste geometry and most effective clean-up scenario, in either rows or concentric circles. As a freeze front develops along a pipe row, or circle, contamination is forced ahead of the front and is then picked up and swept along the next circle of pipes. The contaminants are separated and forced into a collection zone in the center of this circular installation where they can be extracted for treatment or removed from the melt water. Installations using the pipe row configuration force contaminants towards one end of the rectangular installation.

A Thermodynamic Modeling program incorporates all site characteristics into a three dimensional model, which is used to design installations to ISO 14000 standards, and estimate site remediation costs. After installation, this program's model data is compared with on-site monitoring systems data, such as electromagnetic imaging and ground penetrating radar, to develop a real-time computer image of remediation progress throughout CRYOSWEEP (TM) installation's remediation life-cycle. Thermal control of the installation is regulated via this same system.

This steering and concentration process can be used to enhance other remediation and capture technologies. CRYOSWEEP (TM) can effectively guide and concentrate contaminants within the optimum zone of influence for various contaminate specific remediation processes.

Product/Service Maturity: Field demo complete

Performance History: Continual Bench-Scale Testing of CRYOSWEEP (TM) technology at the University of Washington's Low Temperature Physics Laboratory. CRYOSWEEP (TM) designs have been submitted and are currently under review as cost effective solutions to many remediation scenarios.

Comments: CRYOSWEEP (TM) can operate on all types of impurities in aqueous solutions; radioactive, ionic, or organic, with no theoretical lower limit to clean-up level. This translates to remediation efficiency. By containing the subject site as the first step, chemicals and additives can be added to dissolve contaminants bonded to site soils. CRYOSWEEP (TM) can then effectively remove site contaminants. When compared to pump-and-treat methods which may fail to separate a hazardous substance bound to sediment even after 60-80 flushes, inefficiency comes to mind. Inefficiency translates to increased remediation cost and unsatisfactory results. CRYOSWEEP (TM) technology is site specific, and can be engineered to remove hazardous substances from under buildings or structures without removal or damage. CRYOSWEEP (TM) can be scaled for small, intermediate, and large hazardous substance removal projects.

Source of Information: Vendor

Company Name/POC	RKK, Ltd./Ron Krieg or Doug Orkney 16404 Smokey Point Boulevard Suite 303 Arlington, Washington 98223		
E-Mail Address			
Product/Service	ISOCELL (TM)	Phone Number	360 653-4844
Process Type	Containment	Fax Number	360 653-7456

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: ISOCELL (TM) provides complete containment, isolation, and mobilization of mixed or high level radioactive waste, including exploded or unexploded ordnances, rusting drums, or gas cylinders. The ISOCELL (TM) process was specifically designed to protect the health and safety of workers, the environment, and the public. The ISOCELL (TM) process involves the installation of freeze pipes around hazardous substances or an area of subsurface contamination with lifting brackets inserted before freeze down. Standard installations provide frustrum shaped soil parcels 8'x 8'x10' in size, but can be sized up to 20' to 30' in length. Parcel size is determined by soil conditions, mitigation specifications, and transportation requirements where required. To lift the blocks, their vertical boundaries are loosened by selective thawing. Thermal influencing pipes installed before freezedown create a thinly thawed boundary between a frozen parcel and the surrounding soil, allowing separation. Once the initial lift has been accomplished, the boundary layer is refrozen, and parcels are mobilized according to one of RKK's site specific options. Once extracted, blocks can be transported offsite or processed onsite through vitrification, incineration, or another acceptable remediation process. The primary benefit of the ISOCELL (TM) system is both exposure to airborne contaminants, and the mixing of wastes during the recovery process, is eliminated. Waste mixing is a factor of great concern when dealing with unknown hazardous substances or plutonium waste, the contact of two or more parts in sufficient quantities could attain a critical state.

Product/Service Maturity: Field demo complete

Performance History: ISOCELL (TM) barriers have been installed at: RKK Demonstration Project, Carnation, Washington fro U.S. DOE
ISOCELL (TM) designs have been submitted and are currently under review in may U.S. DOE and DOD sites, as well as sites in the private sector market.

Comments: ISOCELL (TM) provides a tremendous cost reduction to clients, especially in mixed waste sites. Present cleanup practices are unable to separate various waste types, resulting in a cleanup cost based on the most hazardous material present. A parcel of hazardous substances stabilized and mobilized by the ISOCELL

(TM) process can be scanned and inventoried, providing waste classification. This equates to baseline volume waste reduction and a decreased site cleanup cost. ISOCELL (TM) is the only method permitting the proper technology and/or mitigation technique to be applied to the various hazardous substance classification at any given site. ISOCELL (TM) engineering is specific to the hazardous substance being mobilized at a site, with designs incorporating ISO 14000 standards.

Source of Information: Vendor

Treatment

Company Name/POC	RKK, Ltd./Ron Krieg or Doug Orkney 16404 Smokey Point Boulevard Suite 303 Arlington, Washington 98223		
E-Mail Address	rkklimited@aol.com		
Product/Service	CRYOCELL (R)	Phone Number	360 653-4844
Process Type	Containment	Fax Number	360 653-7456

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: CRYOCELL (R) is a containment system which provides real time monitorable, earthquake resistant, brownout proof, diffusion free full containment and isolation, that is removable and repairable in situ. The system involves the formation of a flow-impervious, removable ice barrier which can fully circumscribe hazardous substances underground, provide diversionary boundaries for groundwater or waste streams, and can also be used in conjunction with all next step in-situ remediation technologies. CRYOCELL (R) design involves drilling parallel arrays of 4" to 6" freeze pipes outside and below a contaminated zone, completely surrounding the contaminated source or groundwater plume, much like the ribs of a canoe. Once installed, the array of freeze pipes is connected to freeze plants by a distributive manifold and supplied with colled brine at -20 degrees Celcius to -40 degrees Celcius to freeze the volume of soil between the pipes and the entire inner volume of earth between the pipe rows, resulting in a barrier 35'-75' thick (thickness varies with site design). The depth of an installation can be in excess of 500'.

CRYOCELL (R) engineering is site specific, with designs incorporating ISO 14000 standards. RKK, Ltd.'s proprietary Thermodynamic Modeling/Monitoring program incorporates all characteristics into a three dimensional model, which RKK uses to design installations and estimate site costs. After barrier installation, this program's model data is compared with on-site monitoring systems data, such as flow and temperature systems, electromagnetic imaging and ground penetrating radar, to develop a real-time computer image of barrier status throughout its life-cycle. Barrier control is regulated via this same system.

Product/Service Maturity: Field demo complete

Performance History: Ground freezing has been used in civil engineering to provide groundwater control and structural excavation support for over 100 years. Subsurface in-situ CRYOCELL (R) barriers have been installed at:

SEG/RKK CRYOCELL (R) Demonstration Project, Oak Ridge, Tennessee for U.S. DOE

RKK Demonstration Project, Carnation, Washington

CRYOCELL (R) Installation, Public Service Electric and Gas Co., Patterson, N.J. (commercial)

Bench Scale CRYOCELL (R) Testing, Project # 175

January 1997

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Environmental Cleanup Privatization
Products and Services Directory

Comments: CRYOCELL (R) technology provides the highest design and performance standards of any containment technology today, with the lowest overall long-term or short-term cost.

Source of Information: Vendor

Treatment

Company Name/POC	RMT, Inc./Christopher Rehmann 744 Heartland Trail Madison, Wisconsin 53717-1934		
E-Mail Address	chrisr@rmtmsn.rmtinc.com		
Product/Service	MTT - Metals Treatment Technology	Phone Number	608 831-4444
Process Type	Solidification/Stabilization (In Situ)	Fax Number	608 831-3334

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: RMT's heavy metal treatment process has been utilized on over 200 bench-scale treatability studies, and successfully implemented on 20 full-scale projects, including one Superfund site. USEPA and State agency approval has been obtained on each of these projects, many times with permission to leave the treated soil on-site.

Examples include City of Wisconsin Rapids, Wisconsin (3,500 cy of land contaminated soil); Laidlan Environmental Services Battery Recycling Superfund Site (38,000 tons of land-contaminated soil); and Gopher Smelting & Refining Co., Eagan, Minnesota (in situ treatment of 2,650 tons of lead-contaminated soil).

Product/Service Maturity: Commercial use experience

Performance History: RMT has developed four processes for ex situ and in situ treatment of heavy metals. These proprietary chemistries and methods focus on lead, cadmium, chromium, arsenic, copper, and zinc. The process involves the use of a buffering agent with phosphate compounds to render lead- and cadmium-bearing waste, soil, and contaminated media nonhazardous metals into forms of the metals which are less hazardous and more stable in the environment.

Some metals, such as lead, exhibit amphoteric solubility characteristics; that is, they become very soluble at low and high pHs.

To avoid the high pH caused by Portland cement or lime, RMT uses buffering agents which do not raise the pH as high as lime does. These buffers are used in combination with an acid or salt containing an anion that chemically bonds with and forms substantially nonleachable forms of metals.

Typical doses of treatment chemicals are in the 5 to 10 percent range, resulting in considerable less bulking as compared to conventional treatment methods.

Comments: RMT has been developing chemical treatment solutions for heavy metal problems since the early 1980s, and has patented some of the most effective ones. The current technologies can reduce the leaching of lead, cadmium, zinc, copper, arsenic, and chrome when present in soil, sludge, ash, slag or some mixture of the above items.

January 1997
T 396

*Environmental Cleanup Privatization
Products and Services Directory*

Treatment

This chemical treatment process is not a traditional solidification/stabilization process. The treated material does not harden and retains its original mechanical properties. Metals are actually converted into compounds which are less soluble in the environment.

Source of Information: Vendor

Treatment

Company Name/POC	RMT, Inc./Christopher Rehmann 744 Heartland Trail Madison, Wisconsin 53717-1934	
E-Mail Address	chrisr@rmtmsn.rmtinc.com	
Product/Service	MTT - Metals Treatment Technology	Phone Number 608 831-4444
Process Type	Solidification/Stabilization (Ex Situ)	Fax Number 608 831-3334

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: RMT's heavy metal treatment process has been utilized on over 200 bench-scale treatability studies, and successfully implemented on 20 full-scale projects, including one Superfund site. USEPA and State agency approval has been obtained on each of these projects, many times with permission to leave the treated soil on-site.

Examples include City of Wisconsin Rapids, Wisconsin (3,500 cy of land contaminated soil); Laidlan Environmental Services Battery Recycling Superfund Site (38,000 tons of land-contaminated soil); and Gopher Smelting & Retiring Co., Eagan, Minnesota (in situ treatment of 2,650 tons of lead-contaminated soil).

Product/Service Maturity: Commercial use experience

Performance History: RMT has developed four processes for ex situ and in situ treatment of heavy metals. These proprietary chemistries and methods focus on lead, cadmium, chromium, arsenic, copper, and zinc. The process involves the use of a buffering agent with phosphate compounds to render lead- and cadmium-bearing waste, soil, and contaminated media nonhazardous metals into forms of the metals which are less hazardous and more stable in the environment.

Some metals, such as lead, exhibit amphoteric solubility characteristics; that is, they become very soluble at low and high pHs.

To avoid the high pH caused by Portland cement or lime, RMT uses buffering agents which do not raise the pH as high as lime does. These buffers are used in combination with an acid or salt containing an anion that chemically bonds with and forms substantially nonleachable forms of metals.

Typical doses of treatment chemicals are in the 5 to 10 percent range, resulting in considerable less bulking as compared to conventional treatment methods.

Comments: RMT has been developing chemical treatment solutions for heavy metal problems since the early 1980s, and has patented some of the most effective ones. The current technologies can reduce the leaching of lead, cadmium, zinc, copper, arsenic, and chrome when present in soil, sludge, ash, slag or some mixture of the above items.

Treatment

This chemical treatment process is not a traditional solidification/stabilization process. The treated material does not harden and retains its original mechanical properties. Metals are actually converted into compounds which are less soluble in the environment.

Source of Information: Vendor

Treatment

Company Name/POC	Robertson Barrier Systems Corporation/Rhino Rohrs 640 Hornby St. Vancouver, B.C. V6C 3B6		
E-Mail Address			
Product/Service	Robertson Barrier Liner	Phone Number	604 684-8072
Process Type	Containment	Fax Number	604 681-4166

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service 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: Vendor

Treatment

Company Name/POC	Roy F. Weston, Inc./Michael G. Cosmos 1 Weston Way West Chester, Pennsylvania 19380	
E-Mail Address		
Product/Service	Low Temperature Thermal Treatment	Phone Number 610 701-7423
Process Type	Low Temperature Thermal Desorption	Fax Number 610 701-5035

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service 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: Vendor

Company Name/POC	S.S. Papadopoulos & Associates, Inc./Jim L. Lolcama 7944 Wisconsin Ave. Bethesda, Maryland 20814		
E-Mail Address	chemjim@sspa.com	Phone Number	301 718-8900
Product/Service	DENAPLs	Fax Number	301 718-8909
Process Type	Other		

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone)

Brief Description: Non-toxic biodegradable surfactant compounds are employed to enhance the solubility and dissolved-phase mobility of Non-Aqueous Phase Liquids (NAPL's) in the subsurface, such as chlorinated solvents, PCB's and BTEX compounds. Computer modeling is used to optimize the delivery rate of injectate, and identifying the most beneficial location(s) for extracting the well(s). NAPL is removed from the recovered groundwater by filtration, separation or activated carbon.

Product/Service Maturity: Commercial use experience Field demo complete

Performance History: SSP&A has successfully completed one field scale evaluation and one (RARA/TSCA) clean-up operation. The mobility of PCB's present in the subsurface at a contaminated site in Pennsylvania was significantly enhanced such that the recovered PCB mass increased by several orders of magnitude during the duration of surfactant flushing. Recovered surfactant was degraded on-site using acclimated microbes, and PCB was removed using activated carbon filtration units.

Comments: The DENAPL's methodology shows considerable potential for reducing clean-up times in the subsurface for a number of commonly occurring compounds. Commercial application experience supports the field-scale suitability of the method for a variety of contaminants. SSP&A offers the full range of supporting expertise required to apply this methodology.

Source of Information: Vendor

Treatment

Company Name/POC	SBP Technologies, Inc./Dr. James Mueller, Ph.D. One Sabine Island Drive Gulf Breeze, Florida 32561-3999	
E-Mail Address		
Product/Service	Solid Phase - Bioremediation	Phone Number 904 934-9282
Process Type	Solid Phase Biological Treatment	Fax Number 904 934-2420

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Treatment

Company Name/POC	SBP Technologies, Inc./Dr. James Mueller, Ph.D. One Sabine Island Drive Gulf Breeze, Florida 32561-3999		
E-Mail Address			
Product/Service	Slurry Phase Bioremediation	Phone Number	904 934-9282
Process Type	Slurry Phase Biological Treatment	Fax Number	904 934-2420

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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. A two-stage, sequential bioreactor system was recently patented for creosote and related wastes.

Product/Service Maturity: Field demo complete

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. Full scale operations in Europe have been combined with soil/sediment washing to achieve volume reduction.

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: Vendor

Company Name/POC	SBP Technologies, Inc./Dr. James Mueller, Ph.D. One Sabine Island Drive Gulf Breeze, Florida 32561-3999		
E-Mail Address			
Product/Service	Vertical Groundwater Circulation	Phone Number	904 934-9282
Process Type	Biodegradation (In Situ)	Fax Number	904 934-2420

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone) In-situ (vadose 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 in conjunction with UVB (TM) vertical groundwater circulation cell technology yields 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.

Product/Service Maturity: Field demo complete

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. From operations initiated in 1992, clean closures in 29 sites in Europe and 3 sites in U.S.

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.
Product/Service Maturity: Full scale (57 sites on-line in U.S. and Over 350 sites on-line in Europe).

Source of Information: Vendor

Company Name/POC	SC&A/Charles R. Phillips 1000 Monticello Court Montgomery, Alabama 36117		
E-Mail Address			
Product/Service	Radioactive Soil Washing and Particle Separation (RSWAPS)	Phone Number	334 272-2234
Process Type	Soil Washing	Fax Number	334 213-0407

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service 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.

Treatment

Company Name/POC Seaman Corporation/F.R. Wilson
1000 Venture Blvd
Wooster, Ohio 44691

E-Mail Address

Product/Service XR-5 Geomembrane
Process Type Containment

Phone Number 423 691-9476

Fax Number 423 539-8294

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ

Brief Description: UV resistant geomembrane prefabricated into single sheets up to 17,000 S.F. petroleum resistant.

Product/Service Maturity: Commercial use experience

Performance History: In use in North America since 1976. Installations at Oak Ridge, Paducah West Valley, Los Alamos, and Hanford.

Comments: None.

Source of Information: Vendor

Company Name/POC	Selentec/Neil Swift 8601 Dunwoody Pl. Suite 302 Atlanta, Georgia 30350		
E-Mail Address			
Product/Service	Soil Extraction	Phone Number	770 640-7059
Process Type	Other	Fax Number	770 640-9305

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ

Brief Description: Chemical extraction of radionuclides in soil; carbonate and magnetic separation to <35 pCi/g uranium and 25 pCi/g plutonium.

Product/Service Maturity: Pilot plant testing

Performance History: Lab testing program successful in treating clay contaminated soil. Field demonstrations scheduled for Summer 1996.

Comments: Uses standard equipment. Field testing, and proof of efficiency on clay soils is needed. Pilot demo complete.

Source of Information: Vendor

Company Name/POC Selentec/Steve Weldon
8601 Dunwoody Pl.
Suite 302
Atlanta, Georgia 30350

E-Mail Address

Product/Service EIX, Electrochemical Ion Exchange

Phone Number 770 640-7059

Process Type Other

Fax Number 770 640-9305

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ

Brief Description: Electrochemical Ion Exchange (EIX) is a technology that selectively removes nitrates from water, leaving all other non-hazardous ions unaffected. The nitrates are then electrochemically destroyed, leaving no waste product. There is no chemical pre-treatment required, only filtering, and since the resins are regenerated and the nitrates destroyed, there are no disposal concerns.

Product/Service Maturity: Pilot plant testing

Performance History: The EIX process was evaluated against 20 competing technologies by the Mine Waste Technology Pilot Program (MWTPP) and was selected as the lowest cost option for treating nitrates in mine waste water. The MWTPP recently completed a field test that compares the costs of ion exchange, EIX, and biodegradation, and the results of that testing will be documented in an upcoming MWTPP report. Based on very preliminary data from that testing, the costs for EIX are estimated as less than 1 mil per gallon of water. The demonstration was successful in reducing nitrates to Drinking Water Standards. Also, the concentrations of the nitrates in the tests were approximately as follows:

Concentration of Nitrate, influent - 71 ppm expressed as N

Concentration of Nitrate, effluent - 4 ppm expressed as N

Higher concentrations of nitrates are capable of being treated using this technology. Decontamination factors (ratio of nitrate in the influent to the effluent) of 50 to 100 are typically achievable.

Comments: Selentec's EIX technology was selected as one of the 100 Most Technologically Significant New Products of 1991, by the R&D trade publication.

"Other Contaminants" identified as nitrates.

Source of Information: Vendor

Company Name/POC	Selentec/Steve Weldon 8601 Dunwoody Pl. Suite 302 Atlanta, Georgia 30350		
E-Mail Address			
Product/Service	MAG*SEP (SM)	Phone Number	770 640-7059
Process Type	Chemical Surface Cleaning	Fax Number	770 640-9305

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: The MAG*SEP (SM) process is designed to remove target contaminants from groundwater, surface water, washed soils, or process streams by applying ion exchange principles. The target contaminants are absorbed onto the resin-coated magnetic particles. Then, the particles are captured magnetically, and the contaminants are removed (eluted off with acid). Lastly, the particles are recycled for reuse.

Product/Service Maturity: Pilot plant testing

Performance History: A prototype scale demonstration test of the MAG*SEP (SM) technology at Savannah River has shown that the process is capable of removal of heavy metal contaminants in the presence of significant concentrations of competing ions. For example, nickel ion concentrations were reduced from approximately 1000 ppb to less than 100 ppb in the presence of significant concentrations of competing ions (i.e., aluminum @ 50 ppm, magnesium @ 40 ppm, and calcium @ 60 ppm). For the lab-scale optimization of the MAG*SEP (SM) process for treatment of acid mine drainage, the results show actual removal efficiency of iron of 99% (vs. target removal efficiency of 85%) and an actual removal efficiency of copper of 98% (vs. target removal efficiency of 85%). Also, based on early results it appears the process was capable of reducing the metals in the water to below Gold Book standards for drinking water.

Comments: MAG*SEP (SM) particles have been developed for the selective treatment of the following contaminants: titanium, copper, cadmium, arsenic, cobalt, molybdenum, platinum, selenium, chromium, zinc, gold, iodine, manganese, technetium, mercury, strontium, iron, ruthenium, thallium, cesium, cobalt, palladium lead, radium, nickel, silver, bismuth, thallium, antimony, zirconium, palladium, radium, cerium, and ALL ACTINIDES. Pilot Plant Testing is completed and a field demonstration at Savannah River is underway. Separately, Selentec is awaiting a contract from the Ukraine for the first commercial application of MAG*SEP (SM). This application of MAG*SEP (SM) will entail the decontamination of milk that resulted from the Chernobyl nuclear catastrophe, in order to get the milk to World Health Organization standards for human consumption.

Treatment

Source of Information: Vendor

Company Name/POC	Selentec/Steve Weldon 8601 Dunwoody Pl. Suite 302 Atlanta, Georgia 30350	
E-Mail Address		
Product/Service	ACT*DE*CON/MAG SEP (SM)	Phone Number 770 640-7059
Process Type	Soil Washing	Fax Number 770 640-9305

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: ACT*DE*CON (SM) 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 (SM) process. The MAG*SEP (SM) 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 soil remediation demonstration.

Product/Service Maturity: Pilot plant testing

Performance History: Currently being implemented for the soil treatment demonstration at the Mound site (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.

Field testing scheduled for Summer 1996.

Pilot demo complete.

Source of Information: Vendor

Company Name/POC	Selion Technologies, Inc./Jukka Rautakallio 871 Ethan Allen Hwy. Suite 104 Ridgefield, Connecticut 06877		
E-Mail Address	rkallio@aol.com		
Product/Service	Cesium Removal from Liquid Waste and Selective Ion Exchange Media called CsTreat	Phone Number	203 894-1854
Process Type	Ion Exchange	Fax Number	203 431-0296

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: Cesium is selectively removed by inorganic granular (grain size 0.25-0.85 mm) ion exchange media called CsTreat. Typically liquids are purified with Decontamination Factors of 1,000-10,000 with associated Volume Reductions of 1,000-50,000. CsTreat can be used in pH 1-13, but in high salt liquids, even higher pH is possible.

Product/Service Maturity: Commercial use experience

Performance History: The full-scale application of CsTreat has been in operation at the Loviisa NPP in Finland for five years. 2.8 cu.ft. of media has successfully treated 185,000 gallons of high salt evaporator concentrates, corresponding to 66,000 gal/cu.ft. A transportable system to treat low salt liquid waste (with a capacity of 474,000 gal/cu.ft) was in operation at the Paldiski Naval Base in Estonia. A full-scale system has been designed for use at the Paks NPP in Hungary. A system has been designed to treat the reprocessing liquids at JAERI in Japan.

Comments: pH range 1-13.
CsTreat can be used under difficult conditions, where ion exchange is not normally possible.
CsTreat is suitable for both small column and large bed operations.

Source of Information: Vendor

Company Name/POC	Selion Technologies, Inc./Jukka Rautakallio 871 Ethan Allen Hwy. Suite 104 Ridgefield, Connecticut 06877		
E-Mail Address	rkallio@aol.com		
Product/Service	Filtering of Particles	Phone Number	203 894-1854
Process Type	Filtration	Fax Number	203 431-0296

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service 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: Vendor

Company Name/POC	Selion Technologies, Inc./Jukka Rautakallio 871 Ethan Allen Hwy. Suite 104 Ridgefield, Connecticut 06877		
E-Mail Address	rkallio@aol.com		
Product/Service	Strontium Removal from Liquid Waste with Selective Ion Exchange Media called SrTreat	Phone Number	203 894-1854
Process Type	Ion Exchange	Fax Number	203 431-0296

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: Strontium is selectively removed by an inorganic granular (grain size 0.25-0.85 mm) ion exchange media called SrTreat. Typically liquids are purified with Decontamination Factors of 500 - 2,000. SrTreat can be used in pH 10-13.

Product/Service Maturity: Commercial use experience

Performance History: A system has been designed to treat the reprocessing liquids at JAERI in Japan.

Comments: pH range 10 - 13, normally max. temperature 122F.
SrTreat is suitable for both small column and large bed operations.

Source of Information: Vendor

Company Name/POC	Sensible Environmental Solutions/Laura Cummins 454 Main Street #1 Grand Junction, Colorado 81501		
E-Mail Address	ses@wic.net		
Product/Service	Environmental Consulting	Phone Number	970 256-0102
Process Type	Other	Fax Number	970 256-0108

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Other Application

Brief Description: SES is a non profit corporation promoting common sense solutions to environmental problems. The mission of SES is:

To provide an independent, third party perspective for designing and implementing sound solutions to environmental problems.

To broaden the appreciation and understanding of science in our everyday lives and reach a diverse community through the promotion and funding of educational opportunities.

Product/Service Maturity:

Performance History: The principals at SES have worked on projects that include:
the development of innovative strategies for environmental cleanup at a major federal facility.
coordination of groups of experts to perform technical peer reviews.
regulatory analysis of new environmental cleanup technologies.
programmatic review and analysis of a major federal cleanup program.

Comments: Products and services provided by SES include:

- program and policy analysis to ensure adequate consideration of environmental concerns
- enhancing the acceptability of innovative environmental technologies
- facilitation of peer reviews and negotiations
- promotion of science in education through the development of hands-on learning programs
- environmental regulatory analysis and interpretation to streamline projects
- development of partnerships between diverse parties for achievement of common goals

Source of Information: Vendor

Treatment

Company Name/POC	Separation and Recovery Systems, Inc./Chris Hebble 1762 McGaw Avenue Irvine, California 92714-4962	
E-Mail Address		
Product/Service	SAREX MX-1500 & MX-2000/2500 Thermal Processors	Phone Number 714 261-8860
Process Type	High Temperature Thermal Desorption	Fax Number 714 261-6010

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service Maturity: Commercial use experience

Performance History: 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. Contact vendor for additional specific information.

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: Vendor

Treatment

Company Name/POC	Separation and Recovery Systems, Inc./Chris Hebble 1762 McGaw Avenue Irvine, California 92714-4962		
E-Mail Address			
Product/Service	SAREX MX-1500 & MX-2000/2500 Thermal Processors	Phone Number	714 261-8860
Process Type	Low Temperature Thermal Desorption	Fax Number	714 261-6010

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service Maturity: Commercial use experience

Performance History: 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. Contact vendor for additional specific information.

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: Vendor

Company Name/POC Serengeti Products Company/David Reel
8130 Westglen
Suite 200
Houston, Texas 77053

E-Mail Address**Product/Service** OilSnapper (TM)**Phone Number** 713 266-4300**Process Type** Solid Phase Biological Treatment**Fax Number** 713 266-4339**Contaminants**

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: OilSnapper is soils conditioner, designed to stimulate the bioremediation of hydrocarbon contaminated soil. It will perform well with either natural or commercial microbe strains. The product also improved the aeration and moisture retention properties of the soil.

Product/Service Maturity: Pilot plant testing

Performance History: OilSnapper has been used by a pipeline company as a maintenance tool to absorb and hold small leaks and spills on to soil, which are then allowed to bioremediate in place, or are collected to a central treatment area. A large oil company has used in product in producing oil field to bioremediate hydrocarbon contaminated soil around production facilities.

Comments: The product is easy to apply and immediately improves the appearance of the soil. Bioremediation is encouraged by maintaining acceptable oxygen, moisture, and pH levels in the soil. Serengeti can also make available to clients bioremediation consulting, project management, and training.

Source of Information: Vendor

Company Name/POC	Serengeti Products Company/David Reel 8130 Westglen Suite 200 Houston, Texas 77053		
E-Mail Address			
Product/Service	BugChow (TM)	Phone Number	713 266-4300
Process Type	Solid Phase Biological Treatment	Fax Number	713 266-4339

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: BugChow (TM) is a nutrient formulation, designed to stimulate bioremediation of hydrocarbon contaminated soil. It functions well with natural and commercial microbe strains. One cubic yard of the product has sufficient nutrient to remediate 30 cubic yards of soil at 10,000 ppm (TPH). BugChow is based upon "Enhanced Urea Technology (TM)."

Product/Service Maturity: Commercial use experience

Performance History: Product has been used in projects involving soil contaminated with crude oil, diesel, turbine oil and hydraulic oil. Contamination reduction of 95 to 99% has been achieved in 30 to 120 days. Laboratory test plots, using West Texas crude oil achieved 99.5% reduction in contamination level in 49 days.

Comments: The product is light weight (one pound per cubic foot) and requires special handling to prevent product loss. It is designed for the professional or consultant, who will use the product as part of a well designed and well maintained bioremediation project.

Source of Information: Vendor

Company Name/POC

Sevenson Environmental Service/Philip R. DeLuca
2749 Lockport Road
Niagara Falls, NY 14302-0396

E-Mail Address**Product/Service**

Stabilization/Solidification

Phone Number 716 284-0431

Process Type

Solidification/Stabilization (Ex Situ)

Fax Number 716 284-1796

Contaminants

- ☐ Pesticides/Herbicides
☐ Petroleum Hydrocarbons
☐ Nonhalogenated VOC

- ☒ Heavy Metals
☒ Radionuclides
☐ Halogenated VOC

- ☐ PCB
☐ SVOC
☐ N/A

- ☐ Explosives/Propellants
☐ Other Contaminant

Media

- ☐ Surface Impoundment
☐ Construction Materials/Debris
☐ Sediments in Water
☒ Process Wastes and Sludge

- ☒ Soil
☐ Landfills
☐ Vapor Phase

- ☐ Process Water
☐ Drums/Tanks/Piping
☐ Free Product

- ☐ Surface Water
☐ Containers/Equipment
☐ Ground Water

Application: Ex-situ On site

Brief Description: Sevenson (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.

Product/Service 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: Vendor

Company Name/POC	Shields Environmental Corporation/Jim Steel 19800 Mac Arthur Blvd Suite 510A Irvine, California 92715		
E-Mail Address			
Product/Service	Mobile Reuse Center	Phone Number	714 260-3880
Process Type	Containment	Fax Number	714 260-2200

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Off site On site

Brief Description: Mobile modular environmental control system for hazardous materials.

Product/Service Maturity: Commercial use experience

Performance History: Proven cost savings systems by US Navy and Northrup Grumman.

Comments: None.

Source of Information: Vendor

Company Name/POC	SIEMPELKAMP GIESSEREI Gmbh & CO./Dr. Manfred Sappok Siempelkampstrasse 45 D-47803 Krefeld, Germany	
E-Mail Address		
Product/Service	Melting and Recycling of Radioactively and/or Chemically Contaminated Scrap	Phone Number 49 0 2151 894205
Process Type	Recycle	Fax Number 49 0 2151 894455

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service 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: Vendor

Company Name/POC	Sive Services/Douglas K. Dieter, P.E. 555 Rossi Drive Dixon, California 95620		
E-Mail Address			
Product/Service	Steam Flushing/Stripping	Phone Number	916 678-8358
Process Type	Hot Water or Steam Flushing/Stripping	Fax Number	916 678-2202

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Steam injection to enhance in situ contaminant extraction and biodegradation.

Product/Service Maturity: Commercial use experience

Performance History: Field use since 1988. Contact vendor for performance data.

Comments: Applicable to remediate sites contaminated with fuels, solvents, and oils. Effective for floating layers on groundwater, as well as for DNAPLs.

Source of Information: Vendor

Company Name/POC Slaggrödukt/Hans Larsson
Box 244
30104 Halmstad, Sweden

E-Mail Address

Product/Service Magnetic Separation

Process Type Other

Phone Number 4660 122072

Fax Number 4660 121062

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: The technology removes magnetic objects from shooting ranges.

Product/Service Maturity:

Performance History: Contact company for performance data.

Comments: None.

Source of Information: International TechCon

Company Name/POC	Smith Environmental Technologies Corp./Dave Ettlers 304 Inverness Way South Suite 200 Englewood, Colorado 80112		
E-Mail Address			
Product/Service	Soil Washing	Phone Number	303 790-1747
Process Type	Soil Washing	Fax Number	303 799-0186

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC	Smith Environmental Technologies Corp./Dave Ettlers 304 Inverness Way South Suite 200 Englewood, Colorado 80112	
E-Mail Address		
Product/Service	Battery Waste Treatment Process (BWTP)	Phone Number 303 790-1747
Process Type	Recycle	Fax Number 303 799-0186

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC Soil Solutions, Inc./Jonathan Ransom
1703 Vargrave Street,
Winston-Salem, North Carolina 27107

E-Mail Address**Product/Service**

Steam Flushing/Stripping

Phone Number 910 725-5844**Process Type**

Hot Water or Steam Flushing/Stripping

Fax Number 910 725-6244**Contaminants**

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On site

Brief Description: The CleanSoil (R) Process is a patented process designed to clean sites contaminated with organic compounds such as gasoline, diesel fuel, kerosene, jet fuel, naphtha, and solvents.

The CleanSoil (R) unit is mounted on a standard with forty foot trailer, which is mobilized to the project site. After mobilizing to the site, the contaminated soil is processed, and the remediated soil is left on site or removed as required.

The boiler generates steam which is supplied to the processor. The steam, by virtue of the proprietary design of the processor, passes through the soil matrix and mobilizes the contaminants. Contaminates in the vapor phase are trapped by the carbon filter media before exiting the process. Contaminates in the liquid phase (and water) accumulate in a condensation tank and are pumped through a four stage particulate and oilphillic filter system. The filtered water then flows to a feed tank, where it is fed back to the boiler in a closed loop. No discharge of contaminated liquid occurs. Contaminated carbon and filters are removed from the unit, packaged in 55 gallon drums and sent for disposal.

Product/Service Maturity: Commercial use experience

Performance History: Soil Solutions, Inc. has successfully remediated hazardous waste soil on-site by using the CleanSoil steam distillation process. Soil Solutions, Inc. operates in full compliance with RCRA regulations, which allow for on-site treatment of environmental media (soil, groundwater, and sediment) without obtaining a "permit" to treat hazardous waste. Such remediation eliminates the costly and lengthy permitting process generally required to treat hazardous waste.

Comments: Samples of cleaned soil are collected according to state guidelines and are sent to an independent, state certified laboratory for analysis. After confirmation that the soil has been remediated to below action limits, the undamaged soil can be used on-site as fill or cover. After completion of the project, Soil

Treatment

Solutions, Inc. supplies the customer with a detailed remediation report. This report includes batch logs, laboratory certifications and a certificate of remediation.

Operating in states throughout the southeast, southwest and midwest, Soil Solutions, Inc. (SSI) uses the CleanSoil process to decontaminate contaminated soils and groundwater at the generator's site. SSI operates in strict compliance with all RCRA guidelines, and only OSHA trained personnel handle and treat the hazardous waste.

Source of Information: Vendor

Company Name/POC	Soiltech ATP Systems, Inc./Dave Ettlers 304 Inverness Way South Suite 200 Englewood, Colorado 80112	
E-Mail Address		
Product/Service	Soiltech ATP System	Phone Number 303 790-1747
Process Type	High Temperature Thermal Desorption	Fax Number 303 799-0186

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On site

Brief Description: The SoilTech ATP System 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 cooked 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.

Product/Service 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

The following information was obtained from the VISITT 3.0 database. The information is presented in a tabular format. The first column lists the company name, and the second column lists the address. The third column lists the phone number, and the fourth column lists the fax number. The fifth column lists the email address, and the sixth column lists the website address. The seventh column lists the type of service provided, and the eighth column lists the years of operation.

Company Name: [Faint text]
Address: [Faint text]
Phone: [Faint text]
Fax: [Faint text]
Email: [Faint text]
Website: [Faint text]
Service: [Faint text]
Years of Operation: [Faint text]

Company Name: [Faint text]
Address: [Faint text]
Phone: [Faint text]
Fax: [Faint text]
Email: [Faint text]
Website: [Faint text]
Service: [Faint text]
Years of Operation: [Faint text]

Company Name: [Faint text]
Address: [Faint text]
Phone: [Faint text]
Fax: [Faint text]
Email: [Faint text]
Website: [Faint text]
Service: [Faint text]
Years of Operation: [Faint text]

Company Name: [Faint text]
Address: [Faint text]
Phone: [Faint text]
Fax: [Faint text]
Email: [Faint text]
Website: [Faint text]
Service: [Faint text]
Years of Operation: [Faint text]

Company Name: [Faint text]
Address: [Faint text]
Phone: [Faint text]
Fax: [Faint text]
Email: [Faint text]
Website: [Faint text]
Service: [Faint text]
Years of Operation: [Faint text]

Company Name/POC	Solarchem Environmental Systems/Kathy Bealor 301 S. Perimeter Park Drive Suite 100 Nashville, Tennessee 37211		
E-Mail Address			
Product/Service	Rayox	Phone Number	615 781-4367
Process Type	Ultraviolet Oxidation	Fax Number	615 781-4362

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC Solucorp Industries/Michael DeLuca
520 Victor Street
Saddle Brook, New Jersey 07663

E-Mail Address**Product/Service**

Molecular Bonding System

Phone Number 201 368-7902**Process Type**

Solidification/Stabilization (Ex Situ)

Fax Number 201 368-8522**Contaminants**

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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. This is done using sulfides. The MBS reagents are added to excavated soil or sludge in a pugmill operation. Moisture is added to catalyze the reagents and create a homogeneous mixture. Curing is immediate and the soil is either returned to the site or disposed of off-site a Subtitle "D" or municipal waste landfill as fill or cover material.

Product/Service 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 levels. Depending on the size of the equipment, the system can treat from 20-150 tons/hr. All equipment is mobile. The process works on all RCRA metals as well as other constituent metals. The process also treats multiple metals concurrently.

Comments: The MBS equipment requires an area of 100 ft x 100 ft to operate. This includes the needed area for loaders and other equipment to move around the site. Two workers and one supervisor are required to operate the system. Treated material can be returned to the site in basically the same form. Material is easily transported since the handling characteristics are not changed.

Source of Information: Vendor

Company Name/POC	Someus & Partners Unlimited/G. Edward Someus Int. Technology Transfer Centre P.O. Box 4575 New Delhi 110 016 India	
E-Mail Address		
Product/Service	Product Control Someus (PCS) Thermal Desorption	Phone Number 91-11 685 6276
Process Type	High Temperature Thermal Desorption	Fax Number 91-11 685 6274

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On site

Brief Description: Indirect thermal decomposition (thermal desorption, 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.

Product/Service 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. Field demonstration 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. Field demonstration plant testing; full scale plant available.

Source of Information: Vendor

Company Name/POC SONOSEP BioTech Inc./John Poppleton
120 - 13511 Commerce Parkway
Richmond, B.C., Canada V6V 2L1

E-Mail Address**Product/Service****Process Type**

Ultrasound Particle Separation (SONOSEP)

Other

Phone Number 604 244-7654**Fax Number** 604 279-2047**Contaminants**

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service Maturity: Field demo complete

Performance History: First product released May 1996. Over 6 years of applied research has been performed. Equipment is available for batch and continuous-flow separations.

Comments: This is a non-fouling separation system. 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: Vendor

Company Name/POC	SPI/ASTEC/Wendell R. Feltman, P.E. P.O. Box 72787 Chattanooga, Tennessee 37407	
E-Mail Address		
Product/Service	LTTD With Heat Recovery	Phone Number 423 867-4210
Process Type	Low Temperature Thermal Desorption	Fax Number 423 827-1550

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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 or quench chamber, baghouse, induced draft fan, stack and stack monitor. Dry or wet scrubbers are utilized where needed.

Product/Service Maturity: Commercial use experience

Performance History: Performance data are available.
40 systems constructed.

Comments: 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: Vendor

Treatment

Company Name/POC SRE, Inc./Sam Sofer
P.O. Box 251
PineBrook, New Jersey 07058

E-Mail Address

Product/Service BioOx (R) and Solv-Ex

Phone Number 201 661-5192

Process Type Bioreactors

Fax Number 201 661-3713

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: SRE, Inc. uses activated sludge bacteria attached to a biosupport in a cartridge to solubilize oils and other pollutants and oxidizes them largely to carbon dioxide and water. BioOx in situ cleans soils without excavation. BioOx with multistage mechanical washer and biodispersant clean excavated or dredged solids. Solve-Ex in a solvent extraction delivers high purity oil, cleaned solids and water.

Product/Service Maturity: Commercial use experience Field demo complete

Performance History: Successfully completed field demonstrations at approximately 10 test locations.

Comments: Marketing products not a priority because SRE (on proprietary basis) is still collecting data for patenting. Products are now available for testing. Estimated in six months available for sale.

Source of Information: Vendor

Company Name/POC	STC Omega, Inc./Greg Maupin 7650 E. Redfield Road Suite D5 Scottsdale, Arizona 85260		
E-Mail Address			
Product/Service	Stabilization/Solidification	Phone Number	602 948-7100
Process Type	Solidification/Stabilization (In Situ)	Fax Number	602 991-3173

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

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

Product/Service 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: Vendor

Treatment

Company Name/POC	STC Omega, Inc./Greg Maupin 7650 E. Redfield Road Suite D5 Scottsdale, Arizona 85260		
E-Mail Address			
Product/Service	Stabilization/Solidification	Phone Number	602 948-7100
Process Type	Solidification/Stabilization (Ex Situ)	Fax Number	602 991-3173

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site

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.

Product/Service 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: Vendor

Company Name/POC	Stord, Inc./Bruce Low 309 Regional Road South Greensboro, North Carolina 27409-9674		
E-Mail Address			
Product/Service	Stord ROTADISC Processor	Phone Number	910 668-7727
Process Type	High Temperature Thermal Desorption	Fax Number	910 668-0537

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On site

Brief Description: Thermal dewatering/desorption of compounds volatile within the operating temperature range of the ROTADISC Processor.

Product/Service Maturity: Commercial use experience Pilot plant testing Field demo complete

Performance History: Performance data are available.

Comments: None.

Source of Information: Vendor

Company Name/POC: Stord, Inc./Bruce Low
309 Regional Road South
Greensboro, North Carolina 27409-9674

E-Mail Address:

Product/Service: Stord ROTADISC Processor
Process Type: Low Temperature Thermal Desorption

Phone Number: 910 668-7727
Fax Number: 910 668-0537

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On site

Brief Description: Thermal dewatering/desorption of compounds volatile within the operating temperature range of the ROTADISC Processor.

Product/Service Maturity: Commercial use experience Pilot plant testing Field demo complete

Performance History: Performance data are available.

Comments: None.

Source of Information: Vendor

Company Name/POC	Studsvik RadWaste AB/Sten-Olof Andersson S-611 82 NYKOPING Sweden		
E-Mail Address			
Product/Service	LLW Incineration	Phone Number	46 155 22 15 20
Process Type	Incineration	Fax Number	46 155 26 31 17

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On site

Brief Description: Advanced controlled air incinerator. Operate under excess air conditions for low heating value waste or under starved air conditions for high heating value waste. Over 90% in volume and weight reduction of waste as plastics, cloths, wood, paper, rubber and other. The very low releases of both radioactive and non radioactive material can, to a large extent, be ascribed to the relatively cleaner off-gas of controlled air incineration system.

Product/Service Maturity: Commercial use experience

Performance History: Over 6,000 tons incinerated waste up to date, delivered incineration plants to SEG (USA) and CILVA (Belgium). Performance data are available.

Comments: None.

Source of Information: Vendor

Company Name/POC Studsvik RadWaste AB/Sten-Olof Andersson
S-611 82 NYKOPING
Sweden

E-Mail Address

Product/Service Ion Exchange Resin Pyrolysis (Radflash)

Phone Number 46 155 22 15 20

Process Type Pyrolysis

Fax Number 46 155 26 31 17

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site

Brief Description: Ion Exchange Resin Pyrolysis is basically the thermal decomposition of polymers in absence of the oxygen. The process has been developed and proved by experiment to comply with waste volume reduction by a factor of 10, and a biological and geochemical inert end product mainly carbon. The process excludes or severely limits the amounts of radioactive secondary waste. The system is environmentally safe and fulfill US requirements for radioactive and non-radioactive emissions.

Product/Service 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: None.

Source of Information: Vendor

Company Name/POC	Studsvik RadWaste AB/Sten-Olof Andersson S-611 82 NYKOPING Sweden		
E-Mail Address			
Product/Service	Studsvik Metal Melter	Phone Number	46 155 22 15 20
Process Type	Other	Fax Number	46 155 26 31 17

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site

Brief Description: An induction melting furnace for steel with a capacity of 1500 kg/h and a crucible furnace for aluminum and brass with a capacity of 250 kg/h. Segmentation and melting of voluminous equipment such as heat exchangers and steam generators. After the melting, the radioactivity can be exactly determined from samples. The ingots can be released for restricted or unrestricted reuse or stored for decay to the appropriate limits.

Product/Service Maturity: Commercial use experience

Performance History: Over 23,000 tons melted components since 1989, 610 tons free released metals. Our main customers are Swedish and German NPP:s. Performance data are available.

Comments: None.

Source of Information: Vendor

Company Name/POC Studsvik RadWaste AB/Sten-Olof Andersson
S-611 82 NYKOPING
Sweden

E-Mail Address

Product/Service Strong Ozone Decontamination Process (SODP) **Phone Number** 46 155 22 15 20

Process Type Chemical Surface Cleaning **Fax Number** 46 155 26 31 17

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: SODP was developed for decontamination of scrap for free release of the decontaminated material. Very low activity levels achieved owing to effective removal of oxides and some microns of the based material. The process is a single step method and can be applied at room temperature. SODP is a patented method based on the use of ozone and cerium in a nitric acid solution.

Product/Service 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: Vendor

Company Name/POC	Surface Combustion/T.J. Schultz P.O. Box 428 1700 Indian Wood Circle Maumee, Ohio 43537		
E-Mail Address			
Product/Service	Pyro Batch	Phone Number	419 891-7150
Process Type	Recycle	Fax Number	419 891-7151

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Off site On site

Brief Description: Totally contained batch furnace and afterburner. Material heated in primary chamber, afterburner and pollution control system clean-up off gases.

Product/Service Maturity: Commercial use experience

Performance History: Have operating units treating drummed waste.

Comments: Can include low NOx. Afterburner and/or energy recovery.

Source of Information: Vendor

Treatment

Company Name/POC Surface Combustion/T.J. Schultz
P.O. Box 428
1700 Indian Wood Circle
Maumee, Ohio 43537

E-Mail Address

Product/Service Rich Rume Incinerator

Phone Number 419 891-7150

Process Type Incineration

Fax Number 419 891-7151

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ

Brief Description: Incinerator/oxides gas streams with low oxygen content. Often used as afterburners for other processes.

Product/Service Maturity: Commercial use experience

Performance History: Offered commercially for more than twenty years. Demonstrated ability, EPA approved.

Comments: Can incinerate liquids simultaneously with gas stream.

Source of Information: Vendor

Company Name/POC	Surface Combustion/T.J. Schultz P.O. Box 428 1700 Indian Wood Circle Maumee, Ohio 43537		
E-Mail Address			
Product/Service	Rich Rume Incinerator	Phone Number	419 891-7150
Process Type	Oxidation	Fax Number	419 891-7151

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ

Brief Description: Incinerator/oxides gas streams with low oxygen content. Often used as afterburners for other processes.

Product/Service Maturity: Commercial use experience

Performance History: Offered commercially for more than twenty years. Demonstrated ability, EPA approved.

Comments: Can incinerate liquids simultaneously with gas stream.

Source of Information: Vendor

Company Name/POC Surface Combustion/T.J. Schultz
P.O. Box 428
1700 Indian Wood Circle
Maumee, Ohio 43537

E-Mail Address

Product/Service Pyro Batch

Phone Number 419 891-7150

Process Type Pyrolysis

Fax Number 419 891-7151

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Off site On site

Brief Description: Totally contained batch furnace and afterburner. Material heated in primary chamber, afterburner and pollution control system clean-up off gases.

Product/Service Maturity: Commercial use experience

Performance History: Have operating units treating drummed waste.

Comments: Can include low NOx. Afterburner and/or energy recovery.

Source of Information: Vendor

Company Name/POC	Surface Combustion/T.J. Schultz P.O. Box 428 1700 Indian Wood Circle Maumee, Ohio 43537		
E-Mail Address			
Product/Service	Pyro Batch	Phone Number	419 891-7150
Process Type	Incineration	Fax Number	419 891-7151

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Off site On site

Brief Description: Totally contained batch furnace and afterburner. Material heated in primary chamber, afterburner and pollution control system clean-up off gases.

Product/Service Maturity: Commercial use experience

Performance History: Have operating units treating drummed waste.

Comments: Can include low NOx. Afterburner and/or energy recovery.

Source of Information: Vendor

Company Name/POC Surface Combustion/T.J. Schultz
P.O. Box 428
1700 Indian Wood Circle
Maumee, Ohio 43537

E-Mail Address

Product/Service Pyro Batch

Phone Number 419 891-7150

Process Type Oxidation

Fax Number 419 891-7151

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Off site On site

Brief Description: Totally contained batch furnace and afterburner. Material heated in primary chamber, afterburner and pollution control system clean-up off gases.

Product/Service Maturity: Commercial use experience

Performance History: Have operating units treating drummed waste.

Comments: Can include low NOx. Afterburner and/or energy recovery.

Source of Information: Vendor

Company Name/POC	Tauw Milieu/ H.B.R. J. Van Vree Handelskade 11 P.O. Box 133 7400 AC Deventer, Netherlands		
E-Mail Address			
Product/Service	BioPur	Phone Number	31 57 0699911
Process Type	Biofiltration	Fax Number	31 57 0699666

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: Biopur (R) is a static biofilm system, in which water and air are led through a special packing material. This packing material is made of polyurethane (PUR) with a high specific contact area. Due to this high biomass concentrations are feasible i.e. high reaction rates at short retention times. The Biopur (R) reactor can also be used to treat soil vapor and groundwater simultaneously. In the Biopur (R) the contaminated soil vapor is treated by means of a combination of scrubbing and biological degradation. Volatilization of the contaminants hardly ever takes place. The Biopur (R) system is therefore particularly suitable for applications in combination with "in situ" soil remediation. A patent has been obtained for the system in America and Europe.

Product/Service Maturity: Commercial use experience

Performance History: Efficiencies of more than 99% for aromatic compounds (BTEX) were attained. No detectable amounts of aromatics were present (<0.5 ug/l) in the treated groundwater. Air emissions no longer contained detectable amounts of contaminants (<0.1 ppm).

Comments: Easy to use. Trailer-mounted. Currently being developed for chlorinated hydrocarbons and PCB's. Tauw owns basic patent to this biofilter system. Must be licensed before use.

Source of Information: Vendor

Company Name/POC Technology Scientific Ltd./Dr. Richard Petela
152 Ranch Estates Drive
NW Calgary AB T3G 1K4

E-Mail Address

Product/Service Flow Consecutor Technology

Phone Number 403 239-1239

Process Type Soil Washing

Fax Number 403 239-1239

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ

Brief Description: Technology Scientific Ltd has developed the innovative Flow Consecutor Technology (FCT) which implements the intensively acting tube agitator, named Flow Consecutor (FC) (patented in Canada), to replace any traditional agitator (e.g. a stirred tank) for processing multi-phase mixtures.

FC can be applied for adsorption of heavy metals from contaminated water on carbonaceous particles, solvent extraction of oil contaminant from soil, and so forth.

FC is usually combined with process of separation. Flotation is usually used to separate coal agglomerates.

Traditional screening or/and sedimentation can be used to separate solids, in such processes like de-ionization or solvent extraction.

If flotation is applied to separate the agglomerates from cleaned soil and water, then the FC can be combined with a patentable new intensive flotation apparatus (IFA). The IFA is a device that creates swirling horizontal forces: The centrifugal forces created determine the separation of the agglomerates at rates 50 times higher than in traditional gravitational flotation devices.

Combination of intensive both FC and IFA makes the total unit very compact which is an important factor when a mobile unit is considered.

Product/Service Maturity: Bench scale testing only.

Performance History: The FC process has been demonstrated on the bench scale at the Alberta Research Council and at the University of British Columbia. The 130 kg/h sand cleaning capacity bench scale plant was set up and tested. Successful results have been obtained for coal agglomeration, diesel fuel and engine oil contaminated sands cleaning, clean-up of water contaminated with oil and Cu, Pb and Zn ions. For example, the amount of contaminants in sands were reduced from the initial above classification level, 50,000 ppm (5.00%) to less than class B, 380 ppm in case of diesel fuel and to less than class C, 2,600 ppm (0.26%) in case of engine oil. Initial concentration of ions of 525 to 378 ppm was reduced to 1ppm.

Comments: The process requires pulverized coal or other carbonaceous material to be added to processed slurry. In result of the process, oiled coal (or other carbonaceous material) leaving the plant can be utilized as an enriched fuel.

January 1997

T 460

Environmental Cleanup Privatization
Products and Services Directory

For a new application initial pilot tests are required in order to determine specific formulation. The FCT reviews variables and situations on a "case by case" basis and the optimal configurations are recommended or alternative technologies suggested.

The operating cost of remediation per one ton of soil is estimated from \$20 to 20 t/h to \$60 at 5 t/h plant capacity. The plant would be based mostly on the commercially available components and its capital cost requirement would be ~\$500,000.

Source of Information: Vendor

Treatment

Company Name/POC	Technotreat Corporation/Richard J. Bigda 5800 W. 68th Street Tulsa, Oklahoma 74131		
E-Mail Address			
Product/Service	Fenton's Chemistry (Fe catalyzed H ₂ O ₂)	Phone Number	918 445-0996
Process Type	Chemical Reduction	Fax Number	918 445-0994

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC	Tekno Associates Inc./Gunter Brox 3466 South Westwood Drive Salt Lake City, Utah 84109		
E-Mail Address			
Product/Service	Biolift Reactor	Phone Number	801 272-2288
Process Type	Slurry Phase Biological Treatment	Fax Number	801 272-2288

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC	Terra Vac/Bruce Bosshard 356 Fortaleza St. P.O. Box 1591 San Juan, P.R. 00902-1591	
E-Mail Address		
Product/Service	Entrainment Vapor Extraction	Phone Number 809 723-9171
Process Type	Soil Vapor Extraction (In Situ)	Fax Number

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service 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

January 1997

T 464

Environmental Cleanup Privatization
Products and Services Directory

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

Company Name/POC	Terra Vac/James Malot/Bruce Bosshard 356 Fortaleza St., P.O. Box 1591 San Juan, P.R. 00902-1591		
E-Mail Address			
Product/Service	Air-Sparging Vapor Extraction	Phone Number	809 723-9171
Process Type	Air Sparging	Fax Number	

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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

Company Name/POC	Terra Vac/James Malot/Bruce Bosshard 356 Fortaleza St., P.O. Box 1591 San Juan, P.R. 00902-1591		
E-Mail Address			
Product/Service	Biological Vapor Extraction	Phone Number	809 723-9171
Process Type	Bioventing	Fax Number	

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service 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

Treatment

Company Name/POC	Terra Vac/James Malot/Bruce Bosshard	
	356 Fortaleza St., P.O. Box 1591	
	San Juan, P.R. 00902-1591	
E-Mail Address		
Product/Service	Dual Vapor Extraction	Phone Number 809 723-9171
Process Type	Soil Vapor Extraction (In Situ)	Fax Number

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service 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

January 1997

T 470

Environmental Cleanup Privatization
Products and Services Directory

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

Company Name/POC	Terra Vac/Steven Thompson, Bruce Bosshard	
	356 Fortaleza St.	
	P.O. Box 1591	
	San Juan, P.R. 00902-1591	
E-Mail Address		
Product/Service	Vapor Extraction	Phone Number 809 723-9171
Process Type	Vacuum Vapor Extraction	Fax Number

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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

Company Name/POC	Tetronics Limited/Charles Heanley 5 Lechlade Road Faringdon, Oxfordshire, SN7 9AJ		
E-Mail Address			
Product/Service	Tetronics Plasma System	Phone Number	44 1367 240224
Process Type	Vitrification (Ex Situ)	Fax Number	44 1367 241445

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On site

Brief Description: Variety of plasma systems including twin torch, single torch, twin graphite and single graphite together with furnace and rest of system for treating mixed waste, organic waste, ashes, asbestos, slags and metals.

Product/Service Maturity: Commercial use experience

Performance History: First commercial plant start up in 1984. Systems operating in Europe, Far East and in the USA. Most experience with metallurgical recycling and incinerator ash vitrification. Systems sized from 500 KW to 7 MW and 500 lbs to 8000 lbs an hour.

Comments: Wide Experience of treating range of slags, glasses and organics.

Source of Information: Vendor

Company Name/POC Texarome, Inc./Gueric R. Boucard
 1.5 Miles East Highway 337
 P.O. Box 157
 Leaky, Texas 78873

E-Mail Address

Product/Service Mobile Solid Waste Desorption
Process Type Low Temperature Thermal Desorption

Phone Number 210 232-6079**Fax Number** 210 232-5716**Contaminants**

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC	Texilla Environmental, Inc./Dr. Irfran Toor 4570 Westgrove Drive Suite 140 Dallas, Texas 75248		
E-Mail Address			
Product/Service	Soils Stabilization	Phone Number	214 733-3378
Process Type	Solidification/Stabilization (Ex Situ)	Fax Number	214 733-0366

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: The company has extensive experience in stabilization of heavy metals or petroleum contaminated soils. Also provide environmental services in Remedial Investigations/Feasibility Study, Risk Assessment, subsurface plume delineation and remediation using in situ or ex situ treatment systems.

Product/Service Maturity: Commercial use experience Pilot plant testing

Performance History: A special metal stabilization technology SMITE has been successfully applied at bench scale. Waste loadings as high as 53% As have been effectively treated to withstand multiple TCLP extractions.

Comments: None.

Source of Information: Vendor

Company Name/POC ThermoChem, Inc./Gary Voelker
10220-H Old Columbia Road
Columbia, Maryland 21046

E-Mail Address TC60000@aol.com

Product/Service Steam Foaming

Phone Number 410 312-6300

Process Type Chemical Reduction

Fax Number 410 312-6303

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On site Non-intrusive

Brief Description: The ThermoChem patented steam reforming system separates inorganics including radionuclides and heavy metals into a final waste form and destroys the hazardous organic compounds with greater than 99.99% DRE for a very wide variety of contaminated waste streams. The first stage of this high throughput system consists of an indirectly heated fluidized bed steam reformer. The first stage steam reformer operates at approximately 1000 degrees Fahrenheit. The organics are partially steam reformed and vaporized and inorganics remain with the glass frit bed material. The solid bed material is then either vitrified or separated for final disposal depending on the desired final waste form. The organic gases are then reformed at a significantly higher temperature to achieve full destruction.

Product/Service Maturity: Field demo complete.

Performance History: This technology is being commercially applied in the processing of caustic black liquor in the paper industry at the 15 ton per hour scale. ThermoChem has a contract with the DOE to demonstrate the ability to isolate and vitrify radionuclides and to destroy a wide range of hazardous halogenated and non-halogenated compounds at a ton per day scale.

Comments: None.

Source of Information: Vendor

Company Name/POC	ThermoChem, Inc./Gary Voelker 10220-H Old Columbia Road Columbia, Maryland 21046		
E-Mail Address	TC60000@aol.com	Phone Number	410 312-6300
Product/Service	Steam Foaming	Fax Number	410 312-6303
Process Type	Other		

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On site Non-intrusive

Brief Description: The ThermoChem patented steam reforming system separates inorganics including radionuclides and heavy metals into a final waste form and destroys the hazardous organic compounds with greater than 99.99% DRE for a very wide variety of contaminated waste streams. The first stage of this high throughput system consists of an indirectly heated fluidized bed steam reformer. The first stage steam reformer operates at approximately 1000 degrees Fahrenheit. The organics are partially steam reformed and vaporized and inorganics remain with the glass frit bed material. The solid bed material is then either vitrified or separated for final disposal depending on the desired final waste form. The organic gases are then reformed at a significantly higher temperature to achieve full destruction.

Product/Service Maturity: Field demo complete

Performance History: This technology is being commercially applied in the processing of caustic black liquor in the paper industry at the 15 ton per hour scale. ThermoChem has a contract with the DOE to demonstrate the ability to isolate and vitrify radionuclides and to destroy a wide range of hazardous halogenated and non-halogenated compounds at a ton per day scale.

Comments: None.

Source of Information: Vendor

Company Name/POC	ThermoChem, Inc./Gary Voelker 10220-H Old Columbia Road Columbia, Maryland 21046		
E-Mail Address	TC60000@aol.com		
Product/Service	Steam Foaming	Phone Number	410 312-6300
Process Type	Chemical Oxidation	Fax Number	410 312-6303

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On site Non-intrusive

Brief Description: The ThermoChem patented steam reforming system separates inorganics including radionuclides and heavy metals into a final waste form and destroys the hazardous organic compounds with greater than 99.99% DRE for a very wide variety of contaminated waste streams. The first stage of this high throughput system consists of an indirectly heated fluidized bed steam reformer. The first stage steam reformer operates at approximately 1000 degrees Fahrenheit. The organics are partially steam reformed and vaporized and inorganics remain with the glass frit bed material. The solid bed material is then either vitrified or separated for final disposal depending on the desired final waste form. The organic gases are then reformed at a significantly higher temperature to achieve full destruction.

Product/Service Maturity: Field demo complete

Performance History: This technology is being commercially applied in the processing of caustic black liquor in the paper industry at the 15 ton per hour scale. ThermoChem has a contract with the DOE to demonstrate the ability to isolate and vitrify radionuclides and to destroy a wide range of hazardous halogenated and non-halogenated compounds at a ton per day scale.

Comments: None.

Source of Information: Vendor

Company Name/POC	Trisep Corporation/Peter Knappe 93 South La Patera Lane Goleta, California 93117		
E-Mail Address	TRISEP@TRISEP.COM		
Product/Service	Membrane Separation Products	Phone Number	805 964-8003
Process Type	Membrane Separation	Fax Number	805 964-1235

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On site

Brief Description: Trisep manufactures micro, nano, and ultra filtration spiral wound elements as well as reverse osmosis.

Product/Service Maturity: Commercial use experience

Performance History: Contact vendor for performance data.

Comments: None.

Source of Information: Vendor

Company Name/POC TVIES, Inc./W. R. (Randy) Hall
 440 Bennar
 Suite 2250
 Houston, Texas 77060

E-Mail Address

Product/Service Soil Washing

Phone Number 713 447-5544

Process Type Soil Washing

Fax Number 713 447-6669

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service 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: Vendor

Company Name/POC	U.S. Filter-Recovery Services/Dan Crear 2430 Rose Place Roseville, Minnesota 55113		
E-Mail Address			
Product/Service	Process Waste Water Ion-Exchange and Treatment	Phone Number	800 732-3226
Process Type	Ion Exchange	Fax Number	612 633-5074

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On site

Brief Description: Ion exchange for the removal of heavy metals in low concentration. Also able to take drum and bulk waste that is inorganic in nature.

Product/Service Maturity: Commercial use experience Pilot plant testing

Performance History: RCRA facility with CTRF designation in business for 9 years, with 20-25% growth each year. Started as regional facility, now working nationwide on small and large systems.

Comments: None.

Source of Information: Vendor

Company Name/POC	U.S. Filter-Zimpro/Bill Himebaugh 7755 Center Ave. Suite 1119 Huntington Beach, California 92648	
E-Mail Address		
Product/Service	UV/Oxidation Water Treatment	Phone Number 714 545 5557
Process Type	Ultraviolet Oxidation	Fax Number 714 557-5396

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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). The technology is very attractive for use with mixed wastes (groundwater or wastewater with organics and radioactivity). The process destroys organics in the water phase without creating a radioactive waste side stream or adsorbent bed.

Source of Information: Vendor

Company Name/POC	Umweltschutz Nord GmbH & Co./Hans-Peter Ratzke Industriepark 6, D-27767 Ganderkesee Germany		
E-Mail Address			
Product/Service	AQUAFERM (R)	Phone Number	49 4222 47 106
Process Type	Bioreactors	Fax Number	49 4222 47 203

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC Umweltschutz Nord GmbH & Co./Hans-Peter Ratzke
Industriepark 6, D-27767 Ganderkesee
Germany

E-Mail Address

Product/Service AEROFORM (R) - Biofilter

Phone Number 49 4222 47 106

Process Type Biofiltration

Fax Number 49 4222 47 203

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service Maturity: Commercial use experience.

Performance History: Contact company for performance history.

Comments: Maximal concentration of contaminants 1 gm/cu m. Aeroform (R) as a basic biological treatment technology that needs an adaptation period of a few weeks. Aeroform (R) is an exhausting air treatment technology.

Source of Information: Vendor

Company Name/POC	Umweltschutz Nord GmbH & Co./Hans-Peter Ratzke Industriepark 6, D-27767 Ganderkesee Germany		
E-Mail Address			
Product/Service	Tongues Jointing for Excavation Pit and Covered Excavation	Phone Number	49 4222 47 106
Process Type	Containment	Fax Number	49 4222 47 203

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service Maturity: Commercial use experience

Performance History: Umweltshcutz Nord GmHH & 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: Vendor

Treatment

Company Name/POC	Umweltschutz Nord GmbH & Co./Hans-Peter Ratzke Industriepark 6, D-27767 Ganderkesee Germany		
E-Mail Address			
Product/Service	Terra Ferm	Phone Number	49 4222 47 106
Process Type	Composting	Fax Number	49 4222 47 203

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service 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: Vendor

Company Name/POC	URT Umwelttechnik GmbH/Gerd Braun 50354 Hurth Siemensstr. 1 Germany	
E-Mail Address		
Product/Service	Water Treatment Process	Phone Number 02233 7994 0
Process Type	Ion Exchange	Fax Number 02233 78199

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service Maturity: Commercial use experience

Performance History: Contact company for performance history.

Comments: This process targets uranium mill tailings.

Source of Information: Vendor

Company Name/POC	Va-Tran Systems, Inc./James Sloan 677 Anita St. Suite A Chula Vista, CA 91911	
E-Mail Address		
Product/Service	Cleaning with Dry Ice	Phone Number 619 423-4555
Process Type	Mechanical Surface Cleaning	Fax Number 619 423-4604

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On-site

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.

Product/Service 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: Vendor

Company Name/POC	Vert LTD./Keith McNeill Unit 7, Stadium Court Parkgate, Rotherham S62 6EW, UK	
E-Mail Address		
Product/Service	McNeill Vitrification Process	Phone Number 1709 720651
Process Type	Vitrification (Ex Situ)	Fax Number 1709 720851

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On 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 tons/day the technology has been proven to be completely successful in the destruction of wastes, both organic & nonorganic.

Product/Service Maturity: Commercial use experience

Performance History: First Mobile 20T/Day Plant will commence late spring on site in Nurnberg, Germany. The technology has been tested at all levels from bench top to 240 tons/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 a 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 tons/day.

Source of Information: Vendor

Company Name/POC	Viking Industries/Don T. Pearson 3441 Adams Rd. Murfreesboro, Tennessee 37130	
E-Mail Address		
Product/Service	Recycle of Metal and Cyanide Ions	Phone Number 615 890-1018
Process Type	Recycle	Fax Number 615 890-9932

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service Maturity: Pilot plant testing

Performance History: Separation of metal cautions 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: Vendor

Company Name/POC VKI Water Quality Institute/Bjorn Jensen
 Agern Alle 11
 DK 2970 Hoersholm, Denmark

E-Mail Address

Product/Service In Situ Venting of Soil and Groundwater

Phone Number 45 42 86 52 11

Process Type Bioventing

Fax Number 45 42 86 72 73

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service 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: Vendor

Company Name/POC	VKI Water Quality Institute/Bjorn Jensen Agern Alle 11 DK 2970 Hoersholm, Denmark	
E-Mail Address		
Product/Service	On-site Biological Treatment of Leachate	Phone Number 45 42 86 52 11
Process Type	Bioreactors	Fax Number 45 42 86 72 73

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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 modeled.

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: Vendor

Company Name/POC W.E.S. Environmental Division/Anthony DeLoach
6389 Tower Lane
Sarasota, Florida 34240

E-Mail Address

Product/Service

Process Type

VACU-POINT

Vacuum Vapor Extraction

Phone Number 941 371-7617

Fax Number 941 378-5218

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Product/Service 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 - 4 projects, 1-100 GPM no problems. Randy Coil 305 738-2725

Chevron USA - 55 GPM, no problems. John Machen 404 984-3192

Comments: This technology works well in a wide range of lithologies. Water disposal after treatment is required. For use where both groundwater and 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: Vendor

Company Name/POC	W.E.S. Environmental Division/Anthony DeLoach 6389 Tower Lane Sarasota, Florida 34240		
E-Mail Address			
Product/Service	BIO-WASH	Phone Number	941 371-7617
Process Type	Bioreactors	Fax Number	941 378-5218

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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 development 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, or recycle waste and process effluent.

Product/Service 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: Vendor

Treatment

Company Name/POC	Walsh & Associates/Dr. Bill Mahaffey 4888 Pearl East Circle Suite 108 Boulder, Colorado 80301-2975		
E-Mail Address			
Product/Service	Biological Treatment of Chlorinated Solvents	Phone Number	303 670-2875
Process Type	Co-Metabolic Processes	Fax Number	303 443-0367

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Company Name/POC	Waste Minimization and Containment Corp./Jim Becker 2140 Scranton Road Cleveland, Ohio 44113		
E-Mail Address			
Product/Service	Cryogeneis	Phone Number	216 696 8797
Process Type	Mechanical Surface Cleaning	Fax Number	216 696-8794

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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 or compressed air supply hose is required to operate the system. Cryogenesis Model 1350-3 weighs only 350 pounds when empty (500 pounds when filled with dry ice). The dimensions 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. Cryogenesis is an extremely easy system to use. The system is reliable, maintainable, easily serviceable, and user-friendly.

Source of Information: Vendor

Treatment

Company Name/POC Waste Technologies Industries (WTI)/Heidi J. Dugan
1250 Saint George St.
East Liverpool, Ohio 43920

E-Mail Address

Product/Service

Incineration

Phone Number 330 385-7337

Process Type

Incineration

Fax Number 330 386-2167

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Off site

Brief Description: Waste Technologies Industries' (WTI) high temperature rotary kiln is rated at 97.8 million BTU/hour for a practical capacity of 60,000 tons of waste per year. The kiln has successfully demonstrated a destruction removal efficiency greater than 99.99 percent.

WTI accepts waste in a variety of forms including bulk solids, bulk liquids, containerized solids and containerized liquids. Typical waste streams include high BTU liquids, organic liquids, aqueous waste, organic sludge, contaminated solids and soils, reactives, isocyanates, mercaptans, lithium and magnesium batteries, pesticides and herbicides.

Product/Service Maturity: Commercial use experience

Performance History: WTI's RCRA-authorized treatment facility, which is also CERCLA approved, began operations in December 1992. The facility features an advanced computer system that, for instance, allows state and local environmental regulators to review key operational data via modem 24 hours a day. The system also tracks waste from the moment it enters the facility to the point of final destruction.

WTI's performance already exceeds all the requirements of the promulgated rules of the Clean Air Act. For example, the facility, which is the first of its kind in America to accept a permit limit for dioxin, controls emissions of these compounds to significantly lower levels than the limit that has been proposed. In addition to leading the way in terms of environmental protection, WTI has generated exemplary records for safety and regulatory compliance. The company completed 1995 without experiencing a single lost-time accident, and without incurring a notice of violation based on thousands of man-hours of inspections by regulators.

Comments: WTI's parent company is Swiss-based Von Roll. For more than sixty years, the company has designed and constructed hundreds of waste treatment facilities worldwide. This proven experience is at work in WTI's rotary kiln with state of the art pollution control systems.

WTI strives for complete customer satisfaction with advanced, environmental technology. The company is proud of the leading role it plays in the safe responsible treatment of industrial waste.

Source of Information: Vendor

Company Name/POC	WASTECHEM Ltd/Dr. M.G. Down Earl Road Stanley Green Wilnslow Cheshire, SR93RL, UK	
E-Mail Address		
Product/Service	Electrolytic Decontamination to Free Release Levels	Phone Number 161 485 8231
Process Type	Electrical Separation	Fax Number 161 482 8137

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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 tons of reactor waste at a UK nuclear site.

Product/Service Maturity: Commercial use experience

Performance History: Commercial scale demonstration on 14 tons of steel under contract to UKAEA. Successfully decontaminated to free release levels.

Comments: WasteChem 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 tons 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: Vendor

Company Name/POC	Water Protection International/Ron Kreig 16404 Smokey Point Boulevard Suite 303 Arlington, Washington 98223	
E-Mail Address	rkklimited@aol.com	
Product/Service	CRYOCELL (R)	Phone Number 360 653-4844
Process Type	Containment	Fax Number 360 653-7456

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: CRYOCELL (R) is a containment system which provides real time monitorable, earthquake resistant, brownout proof, diffusion free full containment and isolation, that is removable and repairable in situ. The system involves the formation of a flow-impervious, removable ice barrier which can fully circumscribe hazardous substances underground, provide diversionary boundaries for groundwater or waste streams, and can also be used in conjunction with all next step in-situ remediation technologies. CRYOCELL (R) design involves drilling parallel arrays of 4" to 6" freeze pipes outside and below a contaminated zone, completely surrounding the contaminated source or groundwater plume, much like the ribs of a canoe. Once installed, the array of freeze pipes is connected to freeze plants by a distributive manifold and supplied with colled brine at -20 degrees Celcius to -40 degrees Celcius to freeze the volume of soil between the pipes and the entire inner volume of earth between the pipe rows, resulting in a barrier 35'-75' thick (thickness varies with site design). The depth of an installation can be in excess of 500'.

CRYOCELL (R) engineering is site specific, with designs incorporating ISO 14000 standards. RKK, Ltd.'s proprietary Thermodynamic Modeling/Monitoring program incorporates all characteristics into a three dimensional model, which RKK uses to design installations and estimate site costs. After barrier installation, this program's model data is compared with on-site monitoring systems data, such as flow and temperature systems, electromagnetic imaging and ground penetrating radar, to develop a real-time computer image of barrier status throughout its life-cycle. Barrier control is regulated via this same system.

Product/Service Maturity: Field demo complete

Performance History: Ground freezing has been used in civil engineering to provide groundwater control and structural excavation support for over 100 years. Subsurface in-situ CRYOCELL (R) barriers have been installed at:

SEG/RKK CRYOCELL (R) Demonstration Project, Oak Ridge, Tennessee for U.S. DOE
RKK Demonstration Project, Carnation, Washington

CRYOCELL (R) Installation, Public Service Electric and Gas Co., Patterson, N.J. (commercial)
Bench Scale CRYOCELL (R) Testing, Project # 175

Comments: CRYOCELL (R) technology provides the highest design and performance standards of any containment technology today, with the lowest overall long-term or short-term cost.

Additional contact: Jeff Barrow--1202 Kentucky Ave, Woodland, CA 95776 (916) 662-2829, Fax (916) 662-1592.

Source of Information: Vendor

Company Name/POC	Water Protection International/Ron Kreig 16404 Smokey Point Boulevard Suite 303 Arlington, Washington 98223		
E-Mail Address			
Product/Service	ISOCELL (TM)	Phone Number	360 653-4844
Process Type	Containment	Fax Number	360 653-7456

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: ISOCELL (TM) provides complete containment, isolation, and mobilization of mixed or high level radioactive waste, including exploded or unexploded ordnances, rusting drums, or gas cylinders. The ISOCELL (TM) process was specifically designed to protect the health and safety of workers, the environment, and the public. The ISOCELL (TM) process involves the installation of freeze pipes around hazardous substances or an area of subsurface contamination with lifting brackets inserted before freeze down. Standard installations provide frustrum shaped soil parcels 8'x 8'x10' in size, but can be sized up to 20' to 30' in length. Parcel size is determined by soil conditions, mitigation specifications, and transportation requirements where required. To lift the blocks, their vertical boundaries are loosened by selective thawing. Thermal influencing pipes installed before freezedown create a thinly thawed boundary between a frozen parcel and the surrounding soil, allowing separation. Once the initial lift has been accomplished, the boundary layer is refrozen, and parcels are mobilized according to one of RKK's site specific options. Once extracted, blocks can be transported offsite or processed onsite through vitrification, incineration, or another acceptable remediation process. The primary benefit of the ISOCELL (TM) system is both exposure to airborne contaminants, and the mixing of wastes during the recovery process, is eliminated. Waste mixing is a factor of great concern when dealing with unknown hazardous substances or plutonium waste, the contact of two or more parts in sufficient quantities could attain a critical state.

Product/Service Maturity: Field demo complete

Performance History: ISOCELL (TM) barriers have been installed at: RKK Demonstration Project, Carnation, Washington for U.S. DOE. ISOCELL (TM) designs have been submitted and are currently under review in many U.S. DOE and DOD sites, as well as sites in the private sector market.

Comments: ISOCELL (TM) provides a tremendous cost reduction to clients, especially in mixed waste sites. Present cleanup practices are unable to separate various waste types, resulting in a cleanup cost based on the most hazardous material present. A parcel of hazardous substances stabilized and mobilized by the ISOCELL (TM) process can be scanned and inventoried, providing waste classification. This equates to baseline volume waste reduction and a decreased site cleanup cost. ISOCELL (TM) is the only method permitting the proper technology and/or mitigation technique to be applied to the various hazardous substance classification at any given site. ISOCELL (TM) engineering is specific to the hazardous substance being mobilized at a site, with designs incorporating ISO 14000 standards.

Source of Information: Vendor

Company Name/POC	Water Protection International/Ron Kreig 16404 Smokey Point Boulevard Suite 303 Arlington, Washington 98223		
E-Mail Address			
Product/Service	CRYOSWEEP (TM)	Phone Number	360 653-4844
Process Type	Other	Fax Number	360 653-7456

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: CRYOSWEEP (TM) is an in-situ soil remediation technology which removes all known types of impurities, including radioactive, ionic, or organic solutes. Based on a thermomolecular effect associated with the melting of a solid at an interface, CRYOSWEEP (TM) is designed to control the movement of contaminants in groundwater to the extent of separating, steering, and concentrating them in a zone of safe collection.

Freeze pipes are installed in an array configured to match the waste geometry and most effective clean-up scenario, in either rows or concentric circles. As a freeze front develops along a pipe row, or circle, contamination is forced ahead of the front and is then picked up and swept along the next circle of pipes. The contaminants are separated and forced into a collection zone in the center of this circular installation where they can be extracted for treatment or removed from the melt water. Installations using the pipe row configuration force contaminants towards one end of the rectangular installation.

A Thermodynamic Modeling program incorporates all site characteristics into a three dimensional model, which is used to design installations to ISO 14000 standards, and estimate site remediation costs. After installation, this program's model data is compared with on-site monitoring systems data, such as electromagnetic imaging and ground penetrating radar, to develop a real-time computer image of remediation progress throughout CRYOSWEEP (TM) installation's remediation life-cycle. Thermal control of the installation is regulated via this same system.

This steering and concentration process can be used to enhance other remediation and capture technologies. CRYOSWEEP (TM) can effectively guide and concentrate contaminants within the optimum zone of influence for various contaminate specific remediation processes.

Product/Service Maturity: Field demo complete

Performance History: Continual Bench-Scale Testing of CRYOSWEEP (TM) technology at the University of Washington's Low Temperature Physics Laboratory. CRYOSWEEP (TM) designs have been submitted and are currently under review as cost effective solutions to many remediation scenarios.

Comments: CRYOSWEEP (TM) can operate on all types of impurities in aqueous solutions; radioactive, ionic, or organic, with no theoretical lower limit to clean-up level. This translates to remediation efficiency. By containing the subject site as the first step, chemicals and additives can be added to dissolve contaminants bonded to site soils. CRYOSWEEP (TM) can then effectively remove site contaminants. When compared to pump-and-treat methods which may fail to separate a hazardous substance bound to sediment even after 60-80 flushes, inefficiency comes to mind. Inefficiency translates to increased remediation cost and unsatisfactory results. CRYOSWEEP (TM) technology is site specific, and can be engineered to remove hazardous substances from under buildings or structures without removal or damage. CRYOSWEEP (TM) can be scaled for small, intermediate, and large hazardous substance removal projects.

Source of Information: Vendor

Company Name/POC	Water Technology Int. Corp./Wastewater Technology Centre/Deonarine Phagoo 867 Lakeshore Road P.O. Box 5068 Burlington, Ontario, Canada L7R 4L7		
E-Mail Address	Julia.Stegemann@CCIW.ca		
Product/Service	Auto-Heating Thermophilic Aerobic Reactor (ATAR)	Phone Number	905 336-6478
Process Type	Slurry Phase Biological Treatment	Fax Number	- 905 336-4765

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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 Harbor 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: Vendor

Company Name/POC	Water Technology Int. Corp./Wastewater Technology Centre/Kevin Hosler		
	867 Lakeshore Road		
	P.O. Box 5068		
	Burlington, Ontario, Canada L7R 4L7		
E-Mail Address	Julia.Stegemann@CCIW.ca		
Product/Service	Enhanced Bioremediation	Phone Number	905 336-6478
Process Type	Biodegradation (In Situ)	Fax Number	905 336-4765

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Company Name/POC	Water Technology Int. Corp./Wastewater Technology Centre/Kevin Hosler 867 Lakeshore Road P.O. Box 5068 Burlington, Ontario, Canada L7R 4L7		
E-Mail Address	Julia.Stegemann@CCIW.ca		
Product/Service	Slurry-Phase Bioremediation	Phone Number	905 336-6478
Process Type	Slurry Phase Biological Treatment	Fax Number	905 336-4765

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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

Product/Service 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: Vendor

Company Name/POC	Water Technology International Corporation/Julia Stegemann		
	867 Lakeshore Rd.		
	P.O. Box 5068		
	Burlington, Ontario, L7R 4L7, Canada		
E-Mail Address	Julia.Stegemann@CCIW.ca		
Product/Service	Stabilization/Solidification	Phone Number	905 336-4738
Process Type	Solidification/Stabilization (Ex Situ)	Fax Number	905 336-4765

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: Use of generic low-cost cementing additives to produce monolithic stabilized waste forms of residual leachability.

Product/Service 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: WTI has extensive information development capability. Would need to work with contractor for full-scale application.

Source of Information: Vendor

Company Name/POC	Water Technology International Corporation/Julia Stegemann 867 Lakeshare Rd. P.O. Box 5068 Burlington, Ontario, L7R 4L7, Canada		
E-Mail Address	Julia.Stegemann@CCIW.ca		
Product/Service	Self-Sealing/Self-Healing Barrier	Phone Number	905 336-4738
Process Type	Containment	Fax Number	905 336-4765

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Water Technology International Corporation is licensed by Environment Canada to develop and commercialize a patented Self-Sealing/Self-Healing Barrier system for containment of wastes which is jointly owned with the Netherlands Energy Research Foundation. The Self-Sealing/Self-Healing Barrier is intended for use as either a liner or cover for waste landfills, contaminated sites, secondary containment areas, etc., in the industrial, chemical, mining and municipal sectors, and also as a barrier to hydraulic flow for the transportation and construction industry.

The Self-Sealing/Self-Healing Barrier concept functions on the principle that two reactive materials placed in layers will react at their interface to form an insoluble precipitate. This precipitate constitutes a seamless impermeable seal, which will prevent transmission of leachate and contaminants.

Product/Service Maturity: Field demo complete

Performance History: No current applications in the U.S.

Comments: Self-Sealing/Self-Healing Barriers for mining wastes consistently exhibit an early hydraulic conductivity ranging from 10 (-9) to 10 (-13) m/s, which decreases by a factor of 10 over a period of several weeks. These measurements meet or exceed the recommended hydraulic conductivity required by the United States Environmental Protection Agency for soil liners (<1x10 [-9] m/s) used in landfills and hazardous waste sites. Water Technology International Corporation is seeking to develop working relationships with companies interested in either 1) field application of the Self-Sealing/Self-Healing barrier technology developed for mining wastes, or 2) development of other customized Self-Sealing/Self-Healing Barrier formulations for specific waste management scenarios.

Source of Information: Vendor

Company Name/POC Waterjet Technology, Inc./David Lierman
21414 68th Avenue South,
Kent, Washington 98032

E-Mail Address

Product/Service Cleaner/Scarifier System
Process Type Mechanical Surface Cleaning

Phone Number 206 872-1925

Fax Number 206 872-0690

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service Maturity: Field demo complete

Performance History: Contact the company for performance history data.

Comments: Formerly, Quest Integrated, Inc.

Source of Information: Vendor

Company Name/POC	Westar Resources, Inc. (Formerly Analytical Development Corp)/Duane Churchwell 6732 W. Coal Mine Ave. #419 Littleton, Colorado 80123		
E-Mail Address			
Product/Service	Potassium Ferrate/TRU/Clear	Phone Number	303 973-9693
Process Type	Precipitation	Fax Number	303 933-7100

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: Potassium Ferrate (Iron VI) --- Strong oxidant and excellent coagulant. Destroys low level organic, cyanide, sulfide, propellant and bacterial contaminants. Removes uranium, plutonium, americium and RCRA metals from water. Oxidation through degradation of Iron VI from +6 to +3 valence. Coagulation through charge neutralization, agglomeration, coagulation and precipitation. Decontamination to below regulatory requirements while generating 2-10 times less dewaterable sludge for recovery.

Product/Service Maturity: Commercial use experience

Performance History: Performance data are available.

Comments: Uses current wastewater treatment equipment or new in line injection. Mobile unit designed using in-line injection, baffled mixing, incline settler and direct filtration. Can operate at 0-150 gpm. Unit utilizes all of the best features of the chemistry to provide simplicity.

Source of Information: Vendor

Company Name/POC Western Research Institute/Lyle Johnson Jr.
365 N. 9th
Laramie, Wyoming 82070

E-Mail Address

Product/Service Contained Recovery of Oily Waste (CROW)

Phone Number 307 721-2281

Process Type Hot Water or Steam Flushing/Stripping

Fax Number 307 721-2233

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone)

Brief Description: The process is 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 extraction wells. The surrounding area is isolated laterally by the hydraulic gradients produced by the extraction and injection wells. Vertical containment of potential vapor emission is accomplished by a cold-water cap. Removal rates vary with waste and site characteristics and can be as high as the mid 90% range.

Product/Service 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. Full-scale remediation at an active wood treatment facility also 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: Vendor

Company Name/POC	Westinghouse Communications/D.L. Keairns 1310 Beulah Rd. Pittsburgh, Pennsylvania 15235	
E-Mail Address		
Product/Service	RF Driven Thermal Processing	Phone Number 412 256 1954
Process Type	Low Temperature Thermal Desorption	Fax Number 412 256-1348

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On site

Brief Description: Thermal desorption unit can be used to dewater sludges and precipitates, and to remove organics by devolatilization.

Product/Service 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: Vendor

Company Name/POC	Westinghouse Remediation Services, Inc./William E. Norton, P.E.	
	675 Park North Boulevard	
	Building F	
	Suite 100	
	Clarkston, Georgia 30021	
E-Mail Address		
Product/Service	Westinghouse Soil Washing System	Phone Number 404 299-4736
Process Type	Soil Washing	Fax Number 404 296-9752

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC	Wheelabrator Technologies, Inc./Mark Lyons 4 Liberty Lane West Hampton, New Hampshire 03842	
E-Mail Address		
Product/Service	Waste-to-Energy/Ash Stabilization (WESPHIX)	Phone Number 800 682-0026
Process Type	Solidification/Stabilization (Ex Situ)	Fax Number 603 929-3123

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ

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.

Product/Service 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: Vendor

Company Name/POC	Wheelabrator Water Technologies, Inc., Memtek Division/Nicole Kavecki 28 Cook Street, Billerica, Massachusetts 01821	
E-Mail Address		
Product/Service	Membrane Filtration of Soil Washing Water	Phone Number 508 667-2828
Process Type	Filtration	Fax Number 508 667-1731

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC	Zapit Technology, Inc./Scott Hartung 2880 Lakeside Drive Suite 320 Santa Clara, California 95054	
E-Mail Address		
Product/Service	Off-Gas Treatment	Phone Number 408 986-1700
Process Type	Electron Beam	Fax Number 408 986-0222

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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

1941

1942

1943

1944

1945

1946

1947

1948

Characterization

Characterization

Company Name Index

A

Advanced Analytical Products & Services, 1
Advanced Concepts & Design (AC&D), Inc., 2
AEA Technology, 3, 5
AECL Research, 7, 9, 11
AES International Corporation, 12
Air Instruments and Measurements, Inc., 13, 14
Alba Industrie Umweltschutz Service GmbH, 15, 16
Ames Laboratory, 17
Aqua Tech Environmental Laboratories Inc., 19
Argonne National Laboratory, 20
Ariano Technologies, Inc., 22
Atlantic Screen & Manufacturing, 23

B

Barnebey and Sutcliffe Corporation, 24
Bay Geophysical Associates, Inc., 25
Bio-Genesis Technologies, Inc., 26
Biorenewal Technologies, Inc., 27, 29, 31, 33
Bioscience, Inc., 35
Biovir Laboratories, Inc., 36
British Columbia Research Corporation, 37
Brueel and Kjaer Innova, 38
Bruker Instruments, Inc., 39
BW Research & Technologies Ltd., 41

C

CEM Corporation, 43, 44
Chemrad Tennessee Corporation, 45
Chromatofast, Inc., 47
Computalog, 49

D

D'Appolonia Environmental Service, Inc., 50
Daimler-Benz Aerospace Ag. Valx, 51
Danish Geotechnical Institute, 52, 53
Delft Geotechnics, 54
Delta Research Corporation, 55
Dexsil Corporation, 57, 59, 60, 61, 62, 64

E

EA Technology Ltd., 65
EAS Laboratories, 66
EFA Technologies, Inc., 67
EM Science, 69
Energy Laboratories, 70
EnSys Environmental Products, Inc., 71
Environmental Biodetection Products Inc., 72
Environmental Education Enterprises, Inc., 74
Environmental Technologies Group, Inc., 75
EnviroSurv, Inc., 76, 78
ES Industries, 80

Exploranium G.S. Limited, 81

F

FCI Environmental, Inc., 82
FPM Space Sensor GmbH, 83

G

Gartner Lee Limited, 84
General Electric, Corp. R&D, 85
GEO-CENTERS, Inc., 86, 88, 89
Geo-Infometric, 90
Geomega - SARL, 92
Geophex, Ltd, 93
Geoprobe Systems, 94
Geosys GmbH, 95
Geotech Environmental, 96, 97, 98
GeoTrans, 99, 100, 101, 102
Gotting KG, 103
Groundwater & Environmental Services, Inc. (GES), 104
Group 206 Technologies, Inc., 105

H

H2O Waste-Tec, 107
High Plains Consortium, Inc., 108, 109
HNU Systems Inc., 110, 111, 112, 113, 114
hydroGEOPHYSICS, 115, 116

I

IHS Environmental Information, Inc., 117
Industrial Scientific Corp, 119
In-Situ Inc., 118
INTERA, Inc., 120

J

J. Dittrich Elektronik, 122

K

Kampsax Geodan, 123, 124, 126
KEMA Nederland B.V., 127, 128
Kinetic Sciences Inc., 129

L

Landauer, Inc., 131
Logic Beach Inc., 133
Loral Defense Systems - Eagan, 135
Los Alamos National Laboratory, 136
Lynx Geosystems Inc., 137

M

Magnox Electric, 138
Meta MESSTECHNIK, 139

Company Name Index (continued)

M (continued)

Microsensor Systems, Inc., 140
Microsensor Technology Inc. Analytical
Instruments, 141
Mount Sopris Instrument Company Inc., 142

N

New Mexico State University, 143
NIS Ingenieurgesellschaft mbH, 145, 146
Northeast Research Institute, Inc., 147
Northwest Environmental Services, Testing and
Training, 149

O

ORS Environmental Systems, 150, 151
Oxford Instruments, 154
Oxford Instruments UK Ltd., 152

P

PCP, Inc., 157
Promeco B.V., 158
P-Squared Technologies, Inc., 155
Pylon Electronics Inc., 159, 161, 162

Q

Quadrel Services, Inc., 163
Quantum Engineering Corporation, 164
Questron Corporation, 165

R

Range Vision Inc., 166
RKK, Ltd., 167

S

Sage Earth Science, 169
Sensidyne, Inc., 171, 173, 174
Sensor Electronics Corporation, 175
Sensors & Software Inc., 177
Siemens Environmental Systems Ltd., 178
SiteView Software, Inc., 180
SiteWorks, Inc., 181
Skinstrument A/S Pollution Control, 183
Soil Technology, 185, 186, 187
Solomat/Neotronics, 188
Steins Laboratorium A/S, 189
SVS Environmental Systems, 190

T

Teledyne Electronic Technologies, 191, 193
Telog Instruments, Inc., 195
Testwell Craig Laboratories, 196
Thermo NUtech, 197
TN Technologies/Spectrace Instruments, 199

Triangle Laboratories, Inc., 201
Triumpf, 202
Troxler Electronic Laboratories, 203
TSI Incorporated, 205

U

U.S. Filter/Enviroscan, 206
Uranium Resources Inc. (URI), 208

V

Viking Instruments Corporation, 209

W

WASTECHEM Ltd, 210
Water Protection International, 211
Westbay Instruments Inc., 213
WISMUT GmbH, 215, 217, 218

Process Type Index

Decision Support Tools, 3, 55, 64, 83, 89, 98, 99, 100, 101, 116, 126, 136, 145, 154, 157, 178, 188, 213
Drilling, 123, 165, 208
Geophysics/Hydrogeologic Measurements, 11, 25, 50, 87, 88, 91, 92, 94, 114, 115, 117, 122, 141, 142, 148, 167, 175, 193, 214
Laboratory Analysis, 5, 19, 24, 27, 33, 35, 36, 44, 47, 53, 65, 69, 163, 183, 184, 185, 191, 194, 199, 200
Other, 15, 20, 23, 73
Physical Sampling, 2, 7, 52, 75, 93, 97, 103, 106, 107, 210
Remote Sensing, 12, 14, 95, 102, 128, 164, 201, 205
Sensors/Field Analysis Equipment, 1, 9, 13, 16, 17, 22, 26, 29, 31, 37, 38, 39, 41, 43, 45, 49, 51, 54, 57, 59, 60, 61, 62, 63, 66, 68, 70, 71, 74, 77, 79, 80, 81, 82, 84, 85, 96, 104, 108, 109, 110, 111, 112, 113, 118, 119, 121, 125, 127, 130, 132, 134, 135, 137, 138, 139, 140, 144, 146, 149, 150, 151, 153, 156, 158, 159, 160, 161, 162, 169, 171, 172, 173, 176, 179, 181, 186, 187, 189, 195, 197, 203, 204, 206, 207, 211

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Company Name/POC	Advanced Analytical Products & Services/Jim Wrigley 1753 Cape Aston Court San Jose, California 95133-1128		
E-Mail Address			
Product/Service	Energy Dispersive X-Ray Fluorescence - Thin Film	Phone Number	408 926-4057
Process Type	Sensors/Field Analysis Equipment	Fax Number	408 926-4057

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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.

Product/Service 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 chromate's 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: Vendor

Company Name/POC Advanced Concepts & Design (AC&D), Inc./Scott R. Somers
77 Symons Street
Richland, Washington 99352

E-Mail Address

Product/Service Liquid/Drum Sampler

Phone Number 509 943-1431

Process Type Physical Sampling

Fax Number 509 943-1431

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: The Liquid/Drum Sampler is a patented device that collects liquid samples with improved data quality, operator ease and safety. The device transfers the material directly into the sample jar, unlike traditional products (Drum Thief and COLIWASA). To use, place sampler into container, engage plunger mechanism, retracting the plunger transfers the sample directly into a prealigned sample jar.

Product/Service Maturity: Commercial use experience

Performance History: The Liquid/Drum Sampler has been reviewed by EPA, DoD and DOE, with tentative review from NIST and ASTM. A recent study by Pacific Northwest National Lab (PNNL) has indicated improved safety and data quality over traditional devices. User community includes industry and government. The device can be used in any level of PPE or other controls.

Comments: This sampler is available in 250 and 1000-mLs, constructed of HDPE, and can be disposed or reused. Has been used in drums, tanks, and lagoons.

Source of Information: Vendor

Company Name/POC	AEA Technology/Dr. Mark Neville Building 429 Harwell Laboratory Near Didcot Oxon, OX11 0RA, UK	
E-Mail Address	mark.neville@AEAT.Co.UK	
Product/Service	Characterization for Physical Separation (Soil Washing)	Phone Number 44 1235 432252
Process Type	Decision Support Tools	Fax Number 44 1235 432278

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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 harbor 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

Characterization

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: Vendor

Company Name/POC	AECL Research/C. A. McDowall Whiteshell Laboratories Pinawa, Manitoba, R0 E1L0, Canada		
E-Mail Address			
Product/Service	Soil Gas Tracking System	Phone Number	204 753-2311
Process Type	Physical Sampling	Fax Number	204 753-2922

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone) In-situ (vadose 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. SpectraSmart has been used successfully, in the laboratory, to detect VOCs in groundwater samples.

Product/Service 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

Company Name/POC	AECL Research/C. A. McDowall Whiteshell Laboratories Pinawa, Manitoba, R0 E1L0, Canada		
E-Mail Address			
Product/Service	Sediment Probe	Phone Number	204 753-2311
Process Type	Sensors/Field Analysis Equipment	Fax Number	204 753-2922

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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

Company Name/POC	AECL Research/C. A. McDowall Whiteshell Laboratories Pinawa, Manitoba, R0 E1L0, Canada		
E-Mail Address			
Product/Service	Crosshole Seismic Scanning System	Phone Number	204 753-2311
Process Type	Geophysics/Hydrogeologic Measurements	Fax Number	204 753-2922

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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

Characterization

Company Name/POC AES International Corporation/Lance Robert
2900 FinFeather Road
Bryan, Texas 77801

E-Mail Address

Product/Service Airborne Ground Penetrating Radar

Phone Number 409 775-0765

Process Type Remote Sensing

Fax Number 409 775-0928

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Non-intrusive

Brief Description: Operation of airborne ground penetrating radar that can detect and map subsurface hydrocarbon plumes, UXOs, buried drums, and certain leachates associated with dump sites and landfills. Also use GPS and video to obtain location and aerial photos of areas where anomalies are present.

Product/Service Maturity: Commercial use experience

Performance History: Operating for >10 years with majority of jobs at military sites in desert southwest (base closure studies). Clients are US Corps of Engineers and Navy Explosive Ordnance Disposal Technology Division. Sites with most successes are in the western U.S. Objective of these job sites was locating buried debris; most of the sites were small landfills from the 60s to 80s. Contact Highland Morrow, US COE 916/557-6924.

Comments: Operating conditions and results are enhanced in areas where precipitation is minimal, and clay concentrations low.

Suitable for large areas and identification of buried material. Excellent screening tool which will require follow-on characterization such as trenching, boring, ground-based magnetometry, or ground-penetrating radar.

Source of Information: Vendor

Characterization

Company Name/POC	Air Instruments and Measurements, Inc./Harry C. Lord 13300 A Brooks Drive Baldwin Park, California 91706		
E-Mail Address	aim@aimanalysis.com		
Product/Service	Models 5000, 6000, and 7000	Phone Number	818 813-1460
Process Type	Sensors/Field Analysis Equipment	Fax Number	818 338-2585

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ In-situ (vadose zone) On site Non-intrusive

Brief Description: Gas and liquid analyzers to provide fenceline monitoring, area monitoring, vehicle emissions, leak and spill detection, etc.

Product/Service Maturity: Commercial use experience

Performance History: Available as a consulting service, lease or purchase.

Comments: None.

Source of Information: Vendor

Company Name/POC	Air Instruments and Measurements, Inc./Harry C. Lord 13300 A Brooks Drive Baldwin Park, California 91706		
E-Mail Address	aim@aimanalysis.com		
Product/Service	Model 5800 UV and Model 8000 IR	Phone Number	818 813-1460
Process Type	Remote Sensing	Fax Number	818 338-2585

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (vadose zone)

Brief Description: Open-path analyzer - multi component IR +/- UV analyzer for remote sensing, remote vehicle exhaust monitoring.

Product/Service Maturity: Commercial use experience

Performance History: Available as a consulting service, lease or purchase.

Comments: None.

Source of Information: Vendor

Company Name/POC	Alba Industrie Umweltschutz Service GmbH/Dr. K. Faber Rehrhoferweg 160 D29625 Munster Germany		
E-Mail Address			
Product/Service	Detection, Removal, Disassembling of Munitions (DRDM)	Phone Number	051 92 96 3212
Process Type	Other	Fax Number	051 92 96 3311

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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

Company Name/POC	Alba Industrie Umweltschutz Service GmbH/Dr..K. Faber Rehrhoferweg 160 D29625 Munster Germany	
E-Mail Address		
Product/Service	Mobile Laboratory for Chemical Weapons, Explosives and Propellants	Phone Number 051 92 96 3212
Process Type	Sensors/Field Analysis Equipment	Fax Number 051 92 96 3311

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: Mobile laboratory with all necessary chemical and physical equipment to detect and analyze chemical weapons, explosives, propellants and other toxic materials.

Product/Service 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

Company Name/POC	Ames Laboratory/US DOE/John Mclellan Iowa State University Ames, Iowa 50011-3020	
E-Mail Address		
Product/Service	Fourier Transform Infrared Photoacoustic Spectrometry of Solids	Phone Number 515 294-7948
Process Type	Sensors/Field Analysis Equipment	Fax Number 515 294-4748

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service 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 by 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,

Characterization

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: Vendor

Characterization

Company Name/POC	Aqua Tech Environmental Laboratories Inc./Customer Service 1776 Marion-Waldo Road Marion, Ohio 43301		
E-Mail Address			
Product/Service	Mobile & Stationary Laboratory Services	Phone Number	614 389-5991
Process Type	Laboratory Analysis	Fax Number	614 389-1481

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Off site On site

Brief Description: Aqua Tech Environmental Laboratories Inc. (ATEL), is a national environmental chemistry laboratory that has been providing comprehensive, state-of-the-art analytical and mobile laboratory services for the past 20 years.

Product/Service Maturity: Commercial use experience

Performance History: ATEL's services focus on engineering, industrial and governmental clients from four of its laboratory facilities in Marion and Melmore, Ohio, Sanford, North Carolina and Tucson, Arizona. ATEL participates in the U.S. Corps of Engineers Laboratory Program and maintains certification in 29 states for drinking water, wastewater and groundwater/hazardous water programs. Among many added services.

Comments: None.

Source of Information: Vendor

Company Name/POC	Argonne National Laboratory/Dr. Jacqueline C. Burton Environmental Research Division 9700 South Cass Avenue Building 203 Argonne, Illinois 60439		
E-Mail Address	http://www.anl.gov.ER/ESC/html		
Product/Service	Argonne Expedited Site Characterization/Quicksite (SM)		
Process Type	Other	Phone Number	630 252-8795
		Fax Number	630 252-5747

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site In-situ (saturated zone) On site Non-intrusive Other Application

Brief Description: Argonne has developed a methodology for remedial site investigation that has proven to be both technically superior to and more cost- and time-effective than traditional methods. The Argonne Expedited Site Characterization (ESC), is the basis for a newly proposed ASTM (American Society for Testing and Materials) ESC standard. The Argonne ESC process is abbreviated only in time and cost and never in terms of quality. The Argonne ESC is an iterative, integrated process using careful analysis of existing data, multiple complementary characterization methods, and on-site decision making to optimize site investigations. Key features are: (1) multidisciplinary, geoscience-based team with strong field experience, (2) a single technical team conducts the characterization from beginning to end, (3) a dynamic work plan allows adjustments based on on-site analysis and decision making, (4) communities and regulators are integrated into the process, and (5) the process emphasizes nonintrusive and minimally intrusive investigative methods. More usable data are produced than with traditional site characterization methods that are based on statistical-grid sampling and multiple monitoring wells.

Product/Service Maturity: Commercial use experience

Performance History: The Argonne ESC process has been successfully implemented for the Bureau of Land Management (multi-contaminant landfills) and for the Commodity Credit Corporation (CCC) of the U.S. Department of Agriculture (USDA) (at former grain storage facilities in Kansas and Nebraska). The CCC/USDA has been the principal sponsor for the development of the Argonne ESC process. Within the CCC/USDA program, the costs of Argonne ESC field programs are 1/10 to 1/5 those of traditional approaches and the field time required is as little as 1/30 of that needed in traditional approaches involving random sampling and multiple wells.

Following the success of the CCC/USDA program, Argonne was asked by both DOE and the U.S. Department of Defense to implement the Argonne ESC within their respective programs. Argonne has conducted a very successful ESC program for DOE at the Pantex Plant at Amarillo, Texas, that saved a minimum of \$14 million and

cut 4 years from initial projections for one site at the plant. The approach initiated by Argonne at Pantex remains in place today for the entire plant. Argonne has completed one ESC program for the Navy at the Tustin Marine Corps Air Station, a base in Orange County, California, undergoing closure. The Navy reports up to \$10 million in savings as a result of the Argonne program. Argonne is currently working with the Air force to implement the Argonne ESC approach at bases in Oklahoma and Illinois.

Comments: None.

Source of Information: Vendor

Company Name/POC	Ariano Technologies, Inc./Thomas J. Cody, Jr.	
	91 Harvey St.	
	Cambridge, MA 02140	
E-Mail Address		
Product/Service	Chemical Sensing with TelecommLink	Phone Number 617 661-6110
Process Type	Sensors/Field Analysis Equipment	Fax Number 617 661-6030

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service Maturity: Commercial use experience

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: Vendor

Company Name/POC Atlantic Screen & Manufacturing/Bill Lawson
118 Broadkill Road
Milton, Delaware 19968

E-Mail Address

Product/Service Perforated and Slotted Pipes

Phone Number 302 684-3197

Process Type Other

Fax Number 302 684-0643

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Slotted pipe, vertical or horizontal, perforated used for venting gasses, collection of liquid organic material.

Product/Service Maturity: Commercial use experience

Performance History: Material is being used by drolleries, consulting firms at State levels, Federal levels, in U.S.A., Canada, Mexico, and Taiwan.

Comments: None.

Source of Information: Vendor

Characterization

Company Name/POC Barnebey and Sutcliffe Corporation/Customer Service
P.O. Box 2526
Columbus, Ohio 43216-2526

E-Mail Address activated_carbon@msn.com

Product/Service Activated Carbon Technologies

Process Type Laboratory Analysis

Phone Number 614 258-9501

Fax Number 614 258-3464

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Off site On site

Brief Description: Supplier of activated carbon products produced from coconut shell, coal, and wood. Manufacturers of carbon adsorption equipment and systems for environmental control and remediation, corrosive gas removal, and indoor air quality. Carbon reactivation and laboratory analysis services available.

Product/Service Maturity: Commercial use experience

Performance History: Over 75 years experience in the manufacturing and use of activated carbon.

Comments: None.

Source of Information: Vendor

Company Name/POC	Bay Geophysical Associates, Inc./John Clark 868 Robinwood Ct. Traverse City, Michigan 49686		
E-Mail Address			
Product/Service	High Resolution Shear & Compressional Reflection Seismic		
Process Type	Geophysics/Hydrogeologic Measurements	Phone Number	616 941-7660
		Fax Number	616 941-7412

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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

Company Name/POC	Bio-Genesis Technologies, Inc./Victor Coukoulis 7343 E. Camelback Road Suite D Scottsdale, Arizona 85251		
E-Mail Address	rbmorr19@idt.liberty.com		
Product/Service	Bimelyze (R) Mercury Immunoassay	Phone Number	602 990-0709
Process Type	Sensors/Field Analysis Equipment	Fax Number	602 990-7745

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On site

Brief Description: BioNebraska's Bimelyze (R) Soil Extraction and Mercury Tube Assay is an immunochemical based analytical technique validated for detection of mercury in soils, sludges and sediments. The assay is intended for easy, rapid and cost-effective semi-quantitative field measurements during environmental characterization and remediation.

Product/Service Maturity: Commercial use experience

Performance History: The Bimelyze Immunoassay test kits are being used on site characterizations and remediation projects including battery recycling plants, chemical and dye manufacturing plants, gas transmission metering and compression stations, mining runoff sites, munitions and nuclear processing facilities. Some performance data have been published.

The Bimelyze Mercury Immunoassay test method has been evaluated, approved and published in the DOE Methods Compendium (Test Method MB-100), certified by California EPA (Certificate No. 95-01-014) and approved by U.S. EPA/OSW Inorganic Work Group (Test Method 4500).

Comments: Significant cost savings have been obtained using the Bimelyze real-time test results for site assessments and soil removal during remediation. Field testing eliminates waiting for laboratory results to determine whether the site clean-up was sufficient or whether a costly and time consuming return trip is necessary. Having real-time results also helps minimize the excavation and disposal of soil that is below the action level.

Source of Information: Vendor

Company Name/POC	Biorenewal Technologies, Inc./Alan J. Dines 2800 S. Fish Hatchery Rd. Madison, Wisconsin 53711		
E-Mail Address			
Product/Service	SMP (Sub Mitochondrial Particles)	Phone Number	608 276-8980
Process Type	Laboratory Analysis	Fax Number	608 273-6989

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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 typically require 7 days.

Product/Service 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.

Characterization

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 a contaminant's impact on the animal kingdom and the environment as a whole.

Source of Information: Vendor

Company Name/POC	Biorenewal Technologies, Inc./Alan J. Dines 2800 S. Fish Hatchery Rd. Madison, Wisconsin 53711		
E-Mail Address			
Product/Service	SMP (Sub Mitochondrial Particles)	Phone Number	608 276-8980
Process Type	Sensors/Field Analysis Equipment	Fax Number	608 273-6989

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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 typically require 7 days.

Product/Service 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 a contaminant's impact on the animal kingdom and the environment as a whole.

Source of Information: Vendor

Company Name/POC	Biorenewal Technologies, Inc./Craig A. Schanke 2800 S. Fish Hatchery Rd. Madison, Wisconsin 53711		
E-Mail Address			
Product/Service	VadoScan (TM) Systems Sensors	Phone Number	608 276-8980
Process Type	Sensors/Field Analysis Equipment	Fax Number	608 273-6989

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: VadoScan (TM) Systems sensors allow for unattended monitoring of vadose zone parameters including oxygen, hydrocarbons, pressure, and temperature. The sensors can either be hung inside existing monitoring wells with screened intervals that extend into the vadose zone or buried directly in the soil. Each sensor is connected by cable to a miniature data logger located at the surface. Measurements are recorded by the data logger at user-programmed intervals ranging from 5 seconds to 24 hours. A total of 502 measurements can be stored by the data logger. The loggers can be programmed to begin recording measurements immediately, or at some user-specified future time to allow for synchronized data collection from several sensor locations. Data are retrieved from the loggers by downloading to a desk-top, lap-top, or palm-top computer. The data can then be transferred to standard spreadsheet programs for analysis and presentation purposes.

Product/Service Maturity: Commercial use experience

Performance History: The oxygen sensors were evaluated in a laboratory setting and at several bioventing sites by the Unocal Environmental Technology Group. The results are described in several papers including: (1) Li, D.X., 1995. "Continuous Bioventing Monitoring Using a New Sensor Technology." In: R.E. Hinchee, G.S. Douglas, and S.K. Ong (Eds.), "Monitoring and Verification of Bioremediation." Battelle Press, Columbus, OH. ;. 115-126; (2) Li, D.X., 1995. "Bioventing Feasibility Assessment and System Design Using Subsurface Oxygen Sensors." J.Air & Waste Manage. Assoc 45:762-769; and (3) Li, D.X. and Lundegard, P.D., 1996. "Evaluation of Subsurface Oxygen Sensors for Remediation Monitoring." GWMR, pp. 106-111.

The petroleum hydrocarbon sensors are based on an adsorption sensitive resistor product (Adsistor [TM] Vapor Sensors are products of Adsistor Technology, Seattle, Washington). The Adsistor (TM) Vapor Sensors were evaluated by the Carnegie Mellon Research Institute for the U.S. EPA. The results are described in two documents: (1) Portnoff, M.A., Grace, R., Guzman, A.M., and Hibner, J., 1992. "Measurement and Analysis of Adsistor and Figaro Gas Sensors Used for Underground Storage Tank Leak Detection," EPA/600/R-92/219 and

(2) Portnoff, M.A., Grace, R., and Hibner, J., 1995. "Measurement and Analysis of Vapor Sensors Usded at Underground Storage Tank Sites," EPA/600/R-95/078.

Comments: VadoScan (TM) Systems sensors are manufactured by Datawrite Research Company, Visalia, California.

Not applicable to contaminants except for a hydrocarbon sensor used to monitor petroleum hydrocarbons.

Source of Information: Vendor

Company Name/POC	Biorenewal Technologies, Inc./Lori L. Graham 2800 S. Fish Hatchery Rd. Madison, Wisconsin 53711		
E-Mail Address			
Product/Service	Comparative Enumeration Assay	Phone Number	608 276-8980
Process Type	Laboratory Analysis	Fax Number	608 273-6989

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Off site

Brief Description: The Comparative Enumeration Assay (CEA) is a microbiological technique that provides tangible evidence of biodegradation potential at a site. CEAs provide information about the indigenous microbial populations existing in site samples. Specifically, the assay enumerates the total heterotrophic population capable of utilizing complex carbon sources and the "degrader" population capable of utilizing defined hydrocarbons as a sole carbon source. The CEA is a modified viable plate count method, based on the AWWA standard method No. 9215C. The modifications are intended to minimize the effects of unknowns and variability associated with soil and groundwater samples, and address the difficulties in incorporating hydrocarbons into growth media. A complete low-nutrient media, specifically designed for recovery of damaged or stressed organisms, is used to determine the total heterotrophic populations present. The "degrader" population is the microbial population capable of utilizing a specified contaminant of interest at a site. Degrader populations are enumerated using a defined minimal media containing the required macro and micro-nutrients plus the requested contaminant as a sole source of carbon. Five replicates of each site sample are analyzed, thereby providing a statistical data set with 95% confidence intervals. CEA data are also used to calculate order-of-magnitude estimates of the intrinsic biodegradation rate. CEA is an inexpensive method for obtaining preliminary rate data useful in evaluating bioremediation potential.

Product/Service Maturity: Commercial use experience

Performance History: Since 1991, approximately 3,000 CEAs have been performed on soil and groundwater samples collected from sites located throughout the U.S.

Comments: CEA's are only performed on samples where the site contaminant can be utilized as a sole source of carbon and energy for microbial growth. Examples of site contaminants that are appropriate for analysis using the CEA include: gasoline, diesel fuel, fuel oil, jet fuel, waste oils, motor oil, phenol, mineral oil, mineral spirits, and

BTEX. Conversely, CEAs would not be appropriate for samples from TCE contaminated sites, since TCE biodegradation is a cometabolic process.

Source of Information: Vendor

Characterization

Company Name/POC Bioscience, Inc./T.G. Zitrides
1550 Valley Center Parkway
Suite 140
Bethlehem, Pennsylvania 18017

E-Mail Address

Product/Service Soil/Water Characterization/Biotreatability Testing **Phone Number** 610 974-9693

Process Type Laboratory Analysis **Fax Number** 610 691-2170

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: Complete soil/water characterization and treatability testing. Specializes in biotreatability and solidification treatability testing.

Product/Service Maturity: Commercial use experience

Performance History: Extensive list of applications. Contact vendor for additional information.

Comments: None.

Source of Information: Vendor

Company Name/POC BioVir Laboratories, Inc./Craig Johnson
685 Stone Road
Benicia, California 94510

E-Mail Address

Product/Service Laboratory Analysis (Microbiology)

Phone Number 800 442-7342

Process Type Laboratory Analysis

Fax Number 707 747-1751

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Off site

Brief Description: Laboratory Analysis relating to microbes in the environment including: giardia, cryptosporidium, viruses, bacteriophage, legionella, salmonella, other bacteria and helminth ova. Technology employed: immunoassay, cell culture, polymerase chain reaction (PCR), bacterial culture.

Product/Service Maturity: Commercial use experience

Performance History: BioVir's analytical services have been used by utilities, consultants, and private industry for performance of routine "specialized" monitoring, plant performance evaluations, product performance evaluations and special projects involving pathogenic and non-pathogenic organisms.

Comments: 1-800-GIARDIA

Source of Information: Vendor

Company Name/POC	British Columbia Research Corporation/Dr. James Hill 3650 Wesbrook Mall Vancouver, Canada V6S 2L2		
E-Mail Address	Hill@bcr.bc.ca		
Product/Service	Flow Network Analyzer	Phone Number	604 224-4331
Process Type	Sensors/Field Analysis Equipment	Fax Number	604 224-0540

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: On site

Brief Description: The Flow Network Analyzer devices being build by BCRI are robust computer-controlled devices, which will support multiple chemistries simultaneously on one unit, internal standardization, and truly flexible solution manipulation. They represent a novel synthesis of state-of-the-art instrumentation and intelligent software which goes beyond existing technologies for automated solution handling and chemical analysis. They are presently at the demonstration prototype stage. They will help companies, national laboratories, and government analytical services divisions meet their analytical objectives of being "faster, better, cheaper and safer."

Product/Service Maturity: Pilot plant testing

Performance History: Met all environmental analysis requirements for water quality.

Comments: BCRI's analyzer has a significant analyst time advantage over comparable lab and field instruments, and offers new process control options.

Source of Information: Vendor

Company Name/POC	Bruel and Kjaer Innova (formerly Bruel and Kjaer)/Michael Vecht Skodsborgvej 307 DK-2850 Naerum, Denmark		
E-Mail Address			
Product/Service	Photoacoustic Spectroscopy (PAS)	Phone Number	45 42 80 05 00
Process Type	Sensors/Field Analysis Equipment	Fax Number	45 45 80 68 84

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: Analysis of gases and vapors; especially effective with halogenated hydrocarbons.

Product/Service 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 in monitoring and analysis of contaminated land. Reported in a number of DOE reports e.g., under contract DE-AC09-89SR/8035.

Comments: Features: High dynamic range; Battery Operation; Several sampling possibilities; User friendly; Data logging capability; Long intervals between calibrations; Field ruggedness; and Small size and height. Low detection limits.

Benefits: Low running costs; portability; well suited for field use; unattended long term monitoring.

U.S. Contact: Mr. Wayne Jalenak/18 Main Street/Unite 3D/Concord MA 01742/508 369 5046/(fx) 508 369-5108

Source of Information: Vendor

Company Name/POC	Bruker Instruments, Inc./J. Wronka 19 Fortune Drive Manning Park Billerica, Massachusetts 01821		
E-Mail Address			
Product/Service	Mobile Environmental Mass Spectrometer	Phone Number	508 667-9580
Process Type	Sensors/Field Analysis Equipment	Fax Number	508 667-5993

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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.

Product/Service 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.

Company Name/POC	BW Research & Technologies Ltd./Neil Campbell #242, 3030 - 3rd Avenue N.E. Calgary, AB, Canada T2A 6T7		
E-Mail Address			
Product/Service	Gas Monitors	Phone Number	403 248-9226
Process Type	Sensors/Field Analysis Equipment	Fax Number	403 273-3708

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service Maturity: Commercial use experience

Performance History: An example of the performance and use of BW equipment is in the Rig Rat system for the Environmental Protection Agency in the U.S. The equipment is being used to assist with site clean-up and emergency response around plants, crash sites of trucks and trains and other similar situations. In those situations, fixed (hard-wired) systems or hand-held portables will either not be available or put personnel in further danger. The Rig Rat can be deployed around the perimeter of a site in minutes and send radio warning signals back to a control point to assist the authorities in charge. Contact: William J. Fodor, Response/Prevention/Preparedness Team Leader of UOS/URS Operating Services, Inc. of the EPA at 1099 18th Street, Suite 710, Denver, Colorado 80202. Telephone 303-291-8218.

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.

Characterization

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.

"Other" contaminants are identified as toxic gases and oxygen.

Source of Information: Vendor

Company Name/POC	CEM Corporation/Gregory N. LeBlanc 3100 Smith Farm Rd. P.O. Box 200 Matthews, North Carolina 28105-200		
E-Mail Address			
Product/Service	Microwave Sample Digestion	Phone Number	800 726-3331
Process Type	Sensors/Field Analysis Equipment	Fax Number	704 821-7894

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Off site On 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.

Product/Service 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: Vendor

Company Name/POC	CEM Corporation/Gregory N. LeBlanc 3100 Smith Farm Rd. P.O. Box 200 Matthews, North Carolina 28105-200		
E-Mail Address			
Product/Service	Microwave Sample Digestion	Phone Number	800 726-3331
Process Type	Laboratory Analysis	Fax Number	704 821-7894

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Off site On 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.

Product/Service 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: Vendor

Company Name/POC	Chemrad Tennessee Corporation/Chuck Flynn 739 Emory Valley Road Oak Ridge, Tennessee 37830		
E-Mail Address			
Product/Service	Ultra-Sonic Ranging and Data Systems (USRADS)	Phone Number	423 481-2511
Process Type	Sensors/Field Analysis Equipment	Fax Number	423 483-9528

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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 day. Proficient deployment and optimum productivity is reached within 1 week 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 now user-friendly since the implementation of Windows-based software and an automatic setup feature. 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.

Applications: USRADS automatically obtains high density, high accuracy, position correlate data at rates up to 10 times per second for radiological, geophysical, UXO, and hazardous chemical surveys. These high data rates are

used to accurately measure and image soil contamination levels, area dose rates, land fill contents and boundaries, and UXO locations.

Nonintrusive: USRADS is used to perform non-intrusive surveys:

Source of Information: Vendor

Company Name/POC	Chromatofast, Inc./Robin Risser 912 N. Main Street Suite 14 Ann Arbor, Michigan 48104	
E-Mail Address		
Product/Service	Cold Trap Inlet System for GC	Phone Number 313 662-3410
Process Type	Laboratory Analysis	Fax Number 313 662-3462

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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 volatility's 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.

Product/Service 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: Vendor

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Company Name/POC	Computalog/K. Jordan 500 Winscott Road Ft. Worth, Texas 76126		
E-Mail Address			
Product/Service	FlexFlo, In Situ Ground Water Velocity Probe	Phone Number	817 249-7200
Process Type	Sensors/Field Analysis Equipment	Fax Number	817 249-7222

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: The FlexFlo in situ velocity probe provides direct measurement of the three dimensional groundwater flow velocity vector. It is designed for use in saturated permeable formations. It can be used in all phases of monitoring: site characterization through remediation, post closure monitoring. It is based on a thermal perturbation technique. The device contains a cylindrical heater with individual sensors uniformly spaced around the probe. As groundwater flows past the probe, its heat distribution is perturbed. The resulting pattern of temperature variation around the device reflects both the direction and magnitude of the groundwater. Installation is typically a hollow stemmed auger used to place the probe at the required depth.

Product/Service Maturity: Commercial use experience Field demo complete

Performance History: Installations have been done at Texas A&M University and also at the Strategic Oil Reserve on Avery Island, LA., Edwards AFB, Hanford, and Savannah River.

Comments: None.

Source of Information: Vendor

Company Name/POC D'Appolonia Environmental Service, Inc./William J. Johnson, Dave Leitze
275 Center Rd.
Monroeville, Pennsylvania 15146-1451

E-Mail Address**Product/Service** Ground Penetrating Radar**Phone Number** 412 856-9440**Process Type** Geophysics/Hydrogeologic Measurements**Fax Number** 412 856-9535**Contaminants**

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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

Company Name/POC	Daimler-Benz Aerospace Ag. Valxt/Hermann Hack P.O. Box 80 11 49 81663 Munich Germany		
E-Mail Address			
Product/Service	On-line Water Monitoring	Phone Number	0049 89 607 25112
Process Type	Sensors/Field Analysis Equipment	Fax Number	0049 89 607 20176

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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

Company Name/POC	Danish Geotechnical Institute/Per Bjerragaard Hansen Maglebjergvej 1 DK-2800 Lyngby, Denmark		
E-Mail Address			
Product/Service	Sealed Tube Soil Sampling	Phone Number	0045 4588 4444
Process Type	Physical Sampling	Fax Number	0045 4588 1240

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service 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

Company Name/POC	Danish Geotechnical Institute/Per Bjerragaard Hansen Maglebjergvej 1 DK-2800 Lyngby, Denmark	
E-Mail Address		
Product/Service	Intact Subsurface Block Technology	Phone Number 0045 4588 4444
Process Type	Laboratory Analysis	Fax Number 0045 4588 1240

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service 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

Company Name/POC	Delft Geotechnics/Mr. Viergever #2, Stieltjesweg, P.O. Box 69 2600 AB 2628CK Delft, Netherlands		
E-Mail Address			
Product/Service	Instrumented Cone Penetrometer	Phone Number	011 31 152 693500
Process Type	Sensors/Field Analysis Equipment	Fax Number	011 31 152 610 821

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: A series of instrumented cone penetrometers, Depth to 60m; measures ph, conductivity, redox potential; moisture, etc.; being developed for VOC's

Product/Service 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

Company Name/POC	Delta Research Corporation/Scott R. Henson 1501 Merchants Way Niceville, Florida 32541		
E-Mail Address	shenson@deltabg.com		
Product/Service	Remedial Action Cost Engineering and Requirements System (RACER)	Phone Number	904 897-5380
Process Type	Decision Support Tools	Fax Number	904 897-5388

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Off site On site

Brief Description: RACER is a parametric, automated cost engineering system operated from a MS Windows platform. RACER contains over 100 cost models for treatment technologies, processes, investigations and activities designed to estimate costs for environmental restoration projects and site work. Cost models can be applied to processes encountered in any phase of environmental restoration - from preliminary assessments to site closeout. RACER utilizes standard pricing databases and Work Breakdown Structure. RACER is designed with maximum flexibility for the user. User's can override system assumptions at many levels so that extremely site specific estimates can be produced. RACER is the industry standard cost engineering software.

Product/Service Maturity: Commercial use experience

Performance History: Initial release of the system based on US Air Force requirements. All subsequent releases based on multi-federal agency requirements and commercial contractor requirements. User base exceeds 1500. Tens of thousands of estimates have been generated using RACER. System parametric architecture allows minimum input and plenty of flexibility to tailor to site specific conditions. RACER flexibility allows application to projects and situations far beyond initial design criteria. EPA and other regulatory agencies currently utilizing RACER.

Comments: Typical commercial and government contractor response to seeing RACER for the first time is "Where was this ten years ago?" RACER fills a niche for both the client and contractor involved in environmental restoration activities. RACER provides both parties with a sanity check on costs and allows definition of resources; labor equipment and materials. RACER utilizes industry standard pricing data and accounting system. Training for the system is available. Please contact Scott R. Henson for training dates at Delta Research Corporation or via e-mail at shenson@deltabg.com.

Source of Information: Vendor

Company Name/POC	Dexsil Corporation/Jack Mahon One Hamden Park Drive Hamden, Connecticut 06517		
E-Mail Address			
Product/Service	PetroFLAG	Phone Number	800 433-9745
Process Type	Sensors/Field Analysis Equipment	Fax Number	203 248-6523

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: The PetroFLAG system provides the user with a complete method for analyzing soil samples for the presence of petroleum hydrocarbons. The procedure takes 15 minutes and up to 20 samples can be run concurrently. Hydrocarbons are detected by a simple three step process. The soil sample is first extracted with a solvent that effectively removes over 90% of the hydrocarbons present. The resulting extract is then filtered through a unique, non-clogging system that removes all particulate matter, even from clay and other difficult-to-filter samples. The filtrate is then added to a vial which contains an aqueous development solution. The vial is placed in the meter where a two channel turbidimeter measures the absorbency of the mixture and converts the reading into parts per million of petroleum hydrocarbons. The result is displayed on the unit's LCD readout. The instrument, reagents, vials, and balance are all contained in a carrying case that weighs less than ten pounds.

Product/Service Maturity: Commercial use experience

Performance History: PetroFLAG has been available since early 1995 and hundreds of units are in use. Users include state EPAs and DEPs as well as the Department of Energy and the Corps of Engineers. PetroFLAG has received SW-846 draft method approval from EPA's Office of Solid Waste.

Environment Canada/ Dave Roy/ 613-990-3222

Massachusetts DEP/ Dave Slowick/ 413-784-1100

New Hampshire DEP/ John Liptak/ 603-271-3503

Connecticut DEP/ Paul Clark/ 860-566-2110

New Jersey DEP/ Bruce Comfort/ 609-584-4130

Pennsylvania DER/ Pam Reigh/ 717-783-2300

US DOE Western Area Power Administration/ 970-490-7208

Comments: The PetroFLAG system is designed to be used by those with little or no experience in analytical or field chemistry. It tests for a broad range of hydrocarbons including diesel fuel, kerosene, crude oil, motor oil, hydraulic fluid, grease, transformer oil, and #2, #4, and #6 fuel oils. While the method is not specific for any particular hydrocarbon, if the type of hydrocarbon is known, it may be accurately quantified. The detection range is from 10 to 20000 ppm. No chlorinated solvents are used in any part of the procedure. Moisture does not affect test results up to saturation (20-25% water). Usable temperature range is from 5 C to 45 C. A complimentary video illustrating how the system is used is available on request.

Source of Information: Vendor

Company Name/POC	Dexsil Corporation/Jack Mahon One Hamden Park Drive Hamden, Connecticut 06517		
E-Mail Address			
Product/Service	Clor-D-Test	Phone Number	800 433-9745
Process Type	Sensors/Field Analysis Equipment	Fax Number	203 248-6523

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: The Clor-D-Test test kits (Clor-D-Test 1000 and Clor-D-Test Q4000) are designed to aid the user in complying with the waste oil disposal regulations as codified in 40 CFR 261. Clor-D-Test 1000 shows colorimetrically if an oil sample contains less than or greater than 1000 ppm chlorine. Clor-D-Test Q4000 performs the same test but provides a quantitative result over the range of 200 to 4000 ppm. These kits test for all sources of chlorine as is specified in the regulations. The kits provide an easy to discern color end point, and no instrumentation is required. The kits have a shelf life of one year and do not require refrigeration.

Product/Service Maturity: Commercial use experience

Performance History: Clor-D-Test has been available since 1988. It has been approved as an EPA method and has been assigned SW-846 method number 9077. Performance studies are available.

Comments: Clor-D-Test is the fastest, least expensive way to verify the total chlorine content of used oil samples in the field. Waste oil generators utilize it to check total chlorine levels before a waste oil is shipped off site, and used oil haulers can check that they are in compliance with both their transportation permits and the federal regulations. Enforcement agencies find Clor-D-Test to be an efficient technique for spot checking used oil samples that are being transported, recycled, re-refined or disposed of. All sources of chlorine, organic and inorganic, are detected. A complimentary video showing how the kit is used is available on request.

Source of Information: Vendor

Company Name/POC	Dexsil Corporation/Jack Mahon One Hamden Park Drive Hamden, Connecticut 06517		
E-Mail Address			
Product/Service	HydroClor-Q	Phone Number	800 433-9745
Process Type	Sensors/Field Analysis Equipment	Fax Number	203 248-6523

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: HydroClor-Q is a colorimetric test kit that tests water, waste water and water/glycol mixtures for organic chlorine content. It works over a range of 100 to 4000 ppm chlorine and does not detect inorganic chloride ions. Hydro-Clor Q provides a quantitative, colorimetric end point that is easy to discern. No instrumentation is required. Test kits do not require refrigeration and have a shelf life of one year.

Product/Service Maturity: Commercial use experience

Performance History: HydroClor Q has been available since 1990. It is in extended use worldwide. Performance data are available on request from the manufacturer.

Comments: HydroClor Q is based on the chemistry of the Clor-D-Test kit which tests for the presence of chlorinated compounds in used oil. The water sample is first extracted with a hydrocarbon-based solvent that removes any non-polar chlorinated compounds. The extracted solvent is then reacted with a sodium reagent that removes any covalently bonded chlorine atoms. The resulting chloride is then extracted into an aqueous solution where it is titrated colorimetrically. As soon as the solution color changes from yellow to purple, the titration is stopped and the concentration of chlorine in ppm is read off the side of the titrating syringe. Accuracy has been shown to be equal to +/- (10% + 50) ppm. This technique does not detect inorganic chloride or chlorinated organic compounds that are water soluble.

Source of Information: Vendor

Company Name/POC	Dexsil Corporation/Jack Mahon One Hamden Park Drive Hamden, Connecticut 06517		
E-Mail Address			
Product/Service	Clor-N-Oil	Phone Number	800 433-9745
Process Type	Sensors/Field Analysis Equipment	Fax Number	203 248-6523

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: The Clor-N-Oil PCB Screening Kit allows the user to analyze transformer oil for the presence of PCBs in less than five minutes. This test kit requires no instrumentation and provides a colorimetric result that identifies the oil sample as containing either greater than or less than 50 ppm PCBs. Test kits are also available at 20, 100, and 500 ppm.

Product/Service Maturity: Commercial use experience

Performance History: The Clor-N-Oil test kit has been available since 1983 and millions have been used worldwide. The test kit has received EPA approval and has been assigned EPA SW-846 number 9079.

Comments: Clor-N-Oil works by testing the oil sample (5 mL) for chlorine content. If an oil sample contains less than 21 ppm chlorine it cannot contain greater than 50 ppm PCB. If the test should reveal a positive (yellow) response it should be further tested by a method more specific for PCBs, e.g., gas chromatography. Confirmatory analysis of hundreds of thousands of samples shows that about 85% of all samples analyzed by Clor-N-Oil are true negative tests (less than 50 ppm by both Clor-N-Oil and GC). The false negative rate is far less than 1% of all tests. Test kits require no refrigeration and have a shelf life of one year. This test was developed in conjunction with the Electric Power Research Institute and General Electric.

Source of Information: Vendor

Characterization

Company Name/POC	Dexsil Corporation/Jack Mahon One Hamden Park Drive Hamden, Connecticut 06517		
E-Mail Address			
Product/Service	L2000 PCB/Chloride Analyzer	Phone Number	800 433-9745
Process Type	Sensors/Field Analysis Equipment	Fax Number	203 248-6523

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: The L2000 PCB/Chloride Analyzer is a portable instrument used to test for the presence of PCBs in soil, in transformer oil, and on surfaces. It uses a chloride specific electrode to quantify the concentration of PCBs in a sample after the sample has been reacted with a reagent that removes all of the chloride from the organic molecule. The instrument converts the chloride reading into ppm PCB and displays the result on the LCD readout. When the Aroclor type is known, the concentration of PCBs can be accurately quantified by the L2000. If the Aroclor type is unknown, a general screening test can be run that will provide an upper limit for the amount of PCB that the sample contains. An inexperienced operator can learn to use the L2000 in a few minutes by simply reviewing the operator's manual. A test takes less than 10 minutes to run. All required reagents are in the reagent pack that is supplied with the instrument.

Product/Service Maturity: Commercial use experience since 1989.

Performance History: The L2000 has been in the field since 1989. Hundreds of units are in use worldwide. The L2000 has received EPA approval and has been assigned SW-846 number 9078. Contact manufacturer for a list of users.

Comments: The L2000 is sensitive to organic chloride from any source, not just PCBs, so if other chlorinated organic compounds are present, they will be detected as well. This also means that the L2000 may be used to test for DDT and other chlorinated pesticides and herbicides. Inorganic chlorides such as road salt will not be detected by this method. A ten gram soil sample is required to complete the test. A portable electronic balance is included with the instrument. The range of detection for the instrument is from 2 ppm to 2000 ppm. It can be operated over a temperature range of 5 C to 45 C. The results achieved with the L2000 are unaffected by moisture up to 20%. Unlike other field tests for PCBs, petroleum hydrocarbons do not interfere with the test. The L2000 may be leased on a monthly basis as well as purchased outright.

Source of Information: Vendor

Characterization

Company Name/POC	Dexsil Corporation/Jack Mahon One Hamden Park Drive Hamden, Connecticut 06517		
E-Mail Address			
Product/Service	Clor-N-Soil	Phone Number	800 433-9745
Process Type	Sensors/Field Analysis Equipment	Fax Number	203 248-6523

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: The Clor-N-Soil PCB Screening Kit is a low cost, disposable test kit used to check soil for the presence of PCBs at the 50 ppm level. The kit requires no instrumentation and in less than 10 minutes tells the user if a soil contains less than 50 ppm PCB. The test is colorimetric and is easily run by field personnel with no previous experience.

Product/Service Maturity: Commercial use experience

Performance History: Clor-N-Soil has been in use since 1987. Thousands of tests have been performed worldwide. Clor-N-Soil is used by numerous regulatory agencies across the country. Contact the manufacturer for a list of users.

Comments: Clor-N-Soil is the fastest, least expensive way to screen soil samples for the presence of PCBs. A ten gram soil sample is extracted with an organic solvent. The resulting extract is then reacted with a reagent that removes all chlorine atoms from the PCB and converts them to chloride ions. The chloride ions are then extracted into an aqueous solution where they can be measured colorimetrically. A violet color shows that the sample contains less than 50 ppm PCB while a yellow solution reveals that the sample may contain greater than 50 ppm PCB. This test also may be used as a general screen for the presence of chlorinated compounds such as trichloroethane, perchloroethylene, DDT, and others.

Source of Information: Vendor

Company Name/POC	EA Technology Ltd./A. Tyson Capenhurst Chester CH16ES England, UK		
E-Mail Address			
Product/Service	Environmental Knowledge base (EXPERT)	Phone Number	151 347 2522
Process Type	Decision Support Tools	Fax Number	151 347 2138

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Characterization

Company Name/POC EAS Laboratories/Rosalie Milone
105 Commercial Street
Watertown, CT 06795

E-Mail Address

Product/Service Laboratory Analysis

Phone Number 860 274-5461

Process Type Laboratory Analysis

Fax Number 860 945-0449

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Off site

Brief Description: Fixed laboratory providing full range of services to environmental remediation contractors.

Product/Service Maturity: Commercial use experience

Performance History: Laboratory is certified in all New England States, plus New York and New Jersey. Special areas are trace organics, trace PCB's and trace metals.

Comments: None.

Source of Information: Vendor

Characterization

Company Name/POC	EFA Technologies, Inc./Customer Service 1611 Twentieth Street Sacramento, California 95814		
E-Mail Address			
Product/Service	LeakNet Leak Detection Systems	Phone Number	916 443-8842
Process Type	Sensors/Field Analysis Equipment	Fax Number	916 443-3759

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Non-intrusive

Brief Description: LeakNet is a fully developed and integrated pipeline leak detection product. It arrives on site ready to connect to existing field instrumentation and detect leaks. It can function with as little as one flow or pressure input. By combining pressure and flow inputs at the ends of the pipeline, LeakNet can become "intelligent" regarding alarm processing via the SmartPoint function -- eliminating nuisance alarms. In addition to Pressure Point Analysis (PPA) (TM) leak detection LeakNet includes a high resolution mass balance system with dynamic line pack correction, MassPack. MassPack's accuracy is limited only by the quality of meters used to supply the data. These completely independent leak detection methods provided within a single product give the user two complementary ways to monitor the pipeline. Leak location is also available as a software/hardware option.

LeakNet works in static and flowing conditions. EPA Third Party Certification meeting the UST Regulations for detection of 3 gallons per hour leaks was awarded to LeakNet in 1995. SmartPoint permits nuisance alarm free monitoring through operational transitions.

Product/Service Maturity: Commercial use experience

Performance History: LeakNet is currently in use on pipelines carrying liquid and gasses throughout the world. The oldest system installed in 1984 is still in operation. LeakNet is currently in use on the DOE's Strategic Petroleum Reserve pipeline between St. James and Bayou Choctaw. It routinely detects 1/4-inch diameter test leaks on losses of approximately 12 gallons of crude out of a total of 9,960,239 gallons. EPA Third Party Certification testing was conducted on the DFSC-San Pedro Marine Diesel Fuel pipeline. At NAS Lemoore LeakNet demonstrated its ability to detect leaks on losses of as little as 14 ml for the Kings County Board of Water Quality.

Comments: LeakNet is designed for simple operation. Displays and operator interfaces were developed over the course of several years incorporating the comments of operators using LeakNet on a daily basis. Everything

Characterization

is accessed through point-and-click buttons and icons. Dialog boxes contain extensive prompts enabling the operator to complete infrequently accessed functions without referring to the manual. Training can be completed in a single day. Customer service is available through a toll-free 800 number. Our Customer Service Department has been rated as "excellent" by our users every year.

Source of Information: Vendor

Company Name/POC EM Science/Bruce Crane
480 Democrat Road
Gibbstown, New Jersey 08027

E-Mail Address

Product/Service D Tech BTEX Test
Process Type Sensors/Field Analysis Equipment

Phone Number 800 222-0342

Fax Number 609 423-4389

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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.

Product/Service Maturity: Commercial use experience

Performance History: Immunoassay has become an increasingly useful method for on-site environmental sample screening. Immunoassay 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

Characterization

Company Name/POC Energy Laboratories/Paul Tarmann
1120 So. 27th Street
Billings, Montana 59107

E-Mail Address

Product/Service Environmental Laboratory Services

Process Type Laboratory Analysis

Phone Number 406 252-6325

Fax Number 406 252-6069

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Off site

Brief Description: Founded in 1952, Energy Laboratories has provided independent, quality controlled, high confidence analytical services in chemical and environmental testing. With four laboratories located in three western states, ELI offers broad-based analytical and advisory services to a national clientele. We are equipped to meet the testing needs of mining companies, oil & gas operations, petroleum refining, electrical utilities, industrial and manufacturing firms, large and small municipal water systems, professional engineering and consulting firms, and government agencies.

Product/Service Maturity: Commercial use experience

Performance History: Our active, comprehensive QA/QC program meets and exceeds the rigorous criteria established by the EPA and State Agencies. Energy Laboratories is certified under the Safe Drinking Water Act by Region VIII EPA, and the states of Idaho, Montana, Nevada, North Dakota, South Dakota, Washington, and Wyoming. Technical services are offered under both fee schedule and contract arrangements.

Comments: Energy Laboratories specialize in organic, inorganic, and radiochemical analysis of water, wastes, soil, air, and petroleum product samples. Capabilities include industrial hygiene, aquatic toxicity, NORM field surveys, radiation safety, and sampling services.

Source of Information: Vendor

Company Name/POC	EnSys Environmental Products, Inc./Kevin Carter, PhD P.O. Box 14063 Res. Triangle Park, North Carolina 27709	
E-Mail Address		
Product/Service	Environmental Enzyme-Linked ImmunoSorbant Assay (ELISA)	Phone Number 800 242-7472
Process Type	Sensors/Field Analysis Equipment	Fax Number 919 941-5519

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: On site.

Brief Description: ELISA technology is used to screen for selected contaminants in soil and water. EnSys products detect compounds in water in the ppb range and in soil in the ppm range. The tests employ antibodies to detect contaminants and provide colorimetric results appropriate to regulatory needs. All tests correlate to accepted USEPA Methods at levels of 85 percent or greater.

Product/Service 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.

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 12 months at 75 degrees Fahrenheit and must be used between 40 degrees Fahrenheit and 100 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 tests have received USEPA Methods approval for field quantitative screening.

Source of Information: Vendor

Company Name/POC	Environmental Biodetection Products Inc./Dr. Ran Lifshitz 14 Abacus Road Brampton, Ontario, Canada L6T 5B7		
E-Mail Address			
Product/Service	Toxicity & Genotoxicity Screening	Phone Number	905 794-2325
Process Type	Sensors/Field Analysis Equipment	Fax Number	905 794-2338

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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.

Characterization

Source of Information: Vendor

Characterization

Company Name/POC	Environmental Education Enterprises, Inc./Dr. Jay Lehrer 2764 Sawbury Blvd Columbus, Ohio 43235-4580		
E-Mail Address	E3JKLUCKY@aol.com	Phone Number	614 792-0005
Product/Service	Technical Training	Fax Number	614 792-0006
Process Type	Other		

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application:

Brief Description: Variety of training courses are offered in sampling, fate and transport, modeling, risk management, etc. Contact vendor for current schedule.

Product/Service Maturity:

Performance History: Contact company for performance data.

Comments: None.

Source of Information: Vendor

Company Name/POC	Environmental Technologies Group, Inc./Kurt Webber 1400 Taylor Ave. P.O. Box 9840 Baltimore, Maryland 21284-9840		
E-Mail Address			
Product/Service	FTIR Open Path Monitor	Phone Number	410 321-5111
Process Type	Sensors/Field Analysis Equipment	Fax Number	410 321-5255

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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

Characterization

Company Name/POC	EnviroSurv, Inc./Hunt Chapman 2800 C Dorr Ave. Fairfax, Virginia 22031	
E-Mail Address		
Product/Service	"Non-Drilling" Hydraulic Probe Sampling and Mobile Lab Analysis	Phone Number 703 204-3580
Process Type	Physical Sampling	Fax Number 703 204-3581

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service 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 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

Characterization

as more people become aware of the sample quality problems associated with handling, shipment and delayed analysis.

Source of Information: Vendor

Company Name/POC	EnviroSurv, Inc./Hunt Chapman 2800 C Dorr Ave. Fairfax, Virginia 22031	
E-Mail Address		
Product/Service	"Non-Drilling" Hydraulic Probe Sampling and Mobile Lab Analysis	Phone Number 703 204-3580
Process Type	Sensors/Field Analysis Equipment	Fax Number 703 204-3581

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service 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 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: Vendor

Company Name/POC ES Industries/Dr. Matthew Przybyciel
701 South Route 73
Berlin, New Jersey 08009-2621

E-Mail Address

Product/Service Siemens Continuous Water Analyzer

Phone Number 609 753-8400

Process Type Sensors/Field Analysis Equipment

Fax Number 609 753-8484

Contaminants

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

Media

☒ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: On site

Brief Description: The Siemens Water Analyzer is a fully developed and automated computer controlled instrument for the analysis of volatile and semi-volatile organic compounds (VOC) in water at ppb and ppm levels. The entire system requires no operator interaction and is intended for continuous uninterrupted operation. Results can be transmitted to process control systems via MODBUS protocol, analog outputs, or serial output. In addition remote control and monitoring can be performed via modem.

Product/Service Maturity: Commercial use experience

Performance History: The Siemens Continuous Water Analyzer has been successfully used for over 8 years at various municipal water authorities, water companies, industrial wastewater treatment plants, government city facilities. Reference users Panama Canal Commission, Panama City, Panama, and U.S. Arnold Air Force Base, TN.

Comments: With over 8 years experience in automated continuous water analyzer technology, ES Industries delivers, a turn-key system - from initial design through engineering, manufacturing, testing, validation, and documentation (CAD drawings). We manufacture the multipoint stream selectors for a variety of water types including ground water (with high iron contents) municipal wastewater, river water, and chemical wastewater. Installation, training, emergency service, and maintenance contracts are also provided. In addition, we have developed methods for treated/untreated groundwater and chemical wastewater influents and effluents. A list of some of the chemicals we have developed for water analysis is available.

Source of Information: Vendor

Company Name/POC	Exploranium G.S. Limited/Mel Suave 264 Watline Ave. Mississauga, Ontario, Canada L4Z 1P4		
E-Mail Address	info@exploranium.com		
Product/Service	Gamma Ray/Neutron/X-Ray Detection Systems	Phone Number	905 712-3100
Process Type	Sensors/Field Analysis Equipment	Fax Number	905 712-3105

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service 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

Company Name/POC	FCI Environmental, Inc./Gary Dotzlaw		
	1181 Grier Drive		
	Building B		
	Las Vegas, Nevada 89119-3709		
E-Mail Address			
Product/Service	PetroSense (R)	Phone Number	702 361-7921
Process Type	Sensors/Field Analysis Equipment	Fax Number	702 361-9652

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone) In-situ (vadose zone) On site Non-intrusive

Brief Description: PetroSense (R) combines patented fiber optic chemical sensor (FOCS [R]) technology with digital electronics and a microprocessor that makes PetroSense unique in the marketplace. FOCS technology is based on modulation of the transmitted light intensity when the sensor is exposed to hydrocarbons. The PetroSense sensor is designed with a proprietary chemical coating which responds reversibly to increasing or decreasing levels of petroleum hydrocarbons.

Product/Service Maturity: Field demo complete

Performance History: Numerous field studies by 3rd parties have been completed showing excellent correlation between GC in the lab and field measurements using PetroSense (R). 3rd party certified to correlate better than 98% to Method 8020. Numerous field studies by 3rd parties showing excellent correlation between Method 418 (Freon extraction followed by IR) and PetroSense (R).

Comments: In-situ, continuous TPH measurements provide unique data in real time for pollution prevention (leak detection, NPDES compliance, etc.). Optimization/control of innovative remediation technologies (SVE, etc.) and the ability to collect more data for GIS systems, enabling the user to determine 3-D profiles on LNAPL/DNAPL distribution in the groundwater table, etc., without sample collection or preparation. PetroSense has received a number of regulatory approvals including Intrinsic Safety by Underwriters Laboratories (R) for the United States and Canada, KEMA for Europe, and it meets European Union CE Mark standards. In addition, PetroSense has been third party certified as equivalent to EPA Method 8020, has been included on the US EPA list of providers for USTs, and has been approved by the State of Florida Department of Environmental Protection as equivalent to FID for soil vapor analysis.

Source of Information: Vendor

Company Name/POC	FPM Space Sensor GmbH/Michael Kandler Am St. Niclas Schacht 13 D-09599 Freiberg Sa. Germany	
E-Mail Address		
Product/Service	Portable Measuring System For Dose Rate with GPS and GIS Integration	Phone Number 49 3731 781 225
Process Type	Sensors/Field Analysis Equipment	Fax Number 49 3731 781 226

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service 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 Landesamt fuer Umwelt and Geologic Saxony.

Comments: The measuring system is a joint development of three partners in Saxony:

FPM Space Sensor GmbH, Freiberg
AMC Analytic and Messtechnik GmbH, Chemnitz
VACUTEC Messtechnik, Dresden

For detailed product description, please contact FPM Space Sensor GmbH.

AMC Analytic and Messtechnik GmbH Chemnitz contact person: Dr. Frank Neubert/Stollberger Str. 4A/D-09119 Chemnitz/49 37 1300 114

Source of Information: Vendor
Environmental Cleanup Privatization
Products and Services Directory

January 1997
C 83

Characterization

Company Name/POC	Gartner Lee Limited/David Osmond 6400 Roberts St. Burnaby, B.C. V5G 4C9		
E-Mail Address			
Product/Service	Hydrogeological Decision Analysis (COAST)	Phone Number	604 299-4144
Process Type	Decision Support Tools	Fax Number	604 299-1455

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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

Company Name/POC	General Electric, Corp. R&D/Mark Sneeringer P.O. Box 8, K1-3C3, Schenectady, New York 12301		
E-Mail Address			
Product/Service	Rapid Field Analysis of Mercury (RFA/Hg)	Phone Number	518 387-5334
Process Type	Sensors/Field Analysis Equipment	Fax Number	518 387-7611

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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

Company Name/POC GEO-CENTERS, Inc./Bruce Nelson
7 Wells Avenue
Newton Centre, Massachusetts 02159

E-Mail Address**Product/Service** pH Optrode-based Measurement System**Phone Number** 617 964-7070**Process Type** Sensors/Field Analysis Equipment**Fax Number** 617 527-7592**Contaminants**

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor-Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: The measurement system consists of a pH optrode (fiber optic sensor), a support optoelectronics 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.

Product/Service 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: Vendor

Characterization

Company Name/POC	Geo-Infometric/Leonardo van Straaten Richthofenstraße 29 31137 Hildesheim, Germany		
E-Mail Address			
Product/Service	Computer Aided Pumping and Sampling	Phone Number	49 5121 76 82 12
Process Type	Decision Support Tools	Fax Number	49 5121 51 57 00

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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 automation, groundwater remediation costs are reduced by higher efficiency due to better and reproducible data. Specific project demands can be met by adaptation. Five years of practical field use, certifications by ISO 9000.

Product/Service 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:

5 water authorities

1 mining authority

Former geological survey of East Germany

German cooperation for construction and management of nuclear waste storage sites

Geophysical service company

The next generation will be available in July 1997.

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

January 1997

C 90

Environmental Cleanup Privatization
Products and Services Directory

different small outdoor devices as convenient. Usually plezometric head, pumping rate, EC, T, pH and DO are monitored. Project related adaptations concerning client-availability hardware have been made.

Source of Information: Vendor

Company Name/POC	Geomega - SARL/Sophie Geraads 139 Chemin des Bassins F94035 Creteil Cedex - France		
E-Mail Address			
Product/Service	Electrostatic automatic mapping system (ELSAM)	Phone Number	33-1 49 56 00 78
Process Type	Geophysics/Hydrogeologic Measurements	Fax Number	33-1 49 56 00 82

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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).

Product/Service Maturity: Commercial use experience

Performance History: Applications already performed include: airport landing strip survey for investigation of subsurface heterogeneity's; investigation of contaminant leakages on a chemical plant premises; subsurface reconnaissance's 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

Company Name/POC	Geophex, Ltd/Dr. Ken Howard 605 Mercury Street Raleigh, North Carolina 27603-2343	
E-Mail Address		
Product/Service	Multi-Frequency Ground Electromagnetic Sensor (GEM)	Phone Number 919 839-8515
Process Type	Geophysics/Hydrogeologic Measurements	Fax Number 919 839-8528

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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.

Product/Service Maturity: Commercial use experience

Performance History: Have completed about 120 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: One-man field operation; internal electronic data memory that downloads to a laptop computer. Site characterization for landfills, trenches, drums, UXO, etc.
Technology includes: Geophysical Investigation Environmental Site Characterization.

Source of Information: Vendor

Company Name/POC Geoprobe Systems/Thomas M. Christy
601 N. Broadway
Salina, Kansas 67401

E-Mail Address

Product/Service Soil Probing Equipment

Process Type Physical Sampling

Phone Number 913 825-1842

Fax Number 913 825-2097

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: Small diameter soil probing equipment for the recovery of soil vapor, soil core and groundwater samples. Probes 1" diameter are driven to depths of 50' using hydraulic percussion hammers. Can replace the use of drilling equipment for sample recovery, eliminates generation of soil cuttings.

Product/Service Maturity: Commercial use experience

Performance History: There are approximately 80 soil probing (Geoprobe) units presently operating in the U.S. Projects range from soil vapor sensing at 10 pts, to a depth of 10 feet, to hundreds of points at depths of 30 to 60 feet for soil and groundwater sampling.

Comments: Use of this equipment is limited by soil conditions. Geoprobe equipment is used in sand, clay, silt or gravel strata. It is not applicable to bedrock sampling or heavily cobbled areas. Geoprobos are mobile units and as such require no change in infrastructure. Mobilization is easier than either conventional drilling equipment. The Geoprobe is an accomplished platform for the placement of tools in the subsurface. To date these tools include soil samplers, vapor samplers, and groundwater samplers.

Source of Information: Vendor

Company Name/POC	Geosys GmbH/Hausmann Bautzman Str. 67 D-04347 Leipzig, Germany		
E-Mail Address			
Product/Service	Geophysics	Phone Number	49 341 2421632
Process Type	Geophysics/Hydrogeologic Measurements	Fax Number	49 341 2421527

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ

Brief Description: Acoustic borehole televiewer.

Product/Service Maturity: Commercial use experience

Performance History: BLM GmbH Leializ 49 347 2323032
Oil and Gas Company, Russia

Comments: None.

Source of Information: International TechCon

Company Name/POC	Geotech Environmental/Crif Chilson/Jeff Sauck 1441 W 46th Ave. #17 Denver, Colorado 80211		
E-Mail Address	geotech@ix.netcom.com		
Product/Service	Remote Sensing	Phone Number	800 833-7958
Process Type	Remote Sensing	Fax Number	303 477-1230

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Broad range of groundwater monitoring, sampling, filtration, analysis and remediation equipment.

Product/Service Maturity: Commercial use experience

Performance History: Performance data are available. 20 years in business.

Comments: None.

Source of Information: Vendor

Company Name/POC	Geotech Environmental/Crif Chilson/Jeff Sauck 1441 W 46th Ave. #17 Denver, Colorado 80211		
E-Mail Address	geotech@ix.netcom.com		
Product/Service	Sensors/Field Analysis	Phone Number	800 833-7958
Process Type	Sensors/Field Analysis Equipment	Fax Number	303 477-1230

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Broad range of groundwater monitoring, sampling, filtration, analysis and remediation equipment.

Product/Service Maturity: Commercial use experience

Performance History: Performance data are available. 20 years in business.

Comments: None.

Source of Information: Vendor

Company Name/POC	Geotech Environmental/Crif Chilson/Jeff Sauck		
	1441 W 46th Ave.		
	#17		
	Denver, Colorado 80211		
E-Mail Address	geotech@ix.netcom.com		
Product/Service	Physical Sampling	Phone Number	800 833-7958
Process Type	Physical Sampling	Fax Number	303 477-1230

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Broad range of groundwater monitoring, sampling, filtration, analysis and remediation equipment.

Product/Service Maturity: Commercial use experience

Performance History: Performance data are available: 20 years in business.

Comments: None.

Source of Information: Vendor

Company Name/POC	GeoTrans/David Ward 46050 Manekin Place Suite 100 Sterling, Virginia 20166		
E-Mail Address	davew@geotrans.com		
Product/Service	Site GIS	Phone Number	703 444-7000
Process Type	Decision Support Tools	Fax Number	

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: SiteGIS is a Windows-based software package for analyzing and presenting environmental data for soil and groundwater remedial investigations. Groundwater, soil and geology databases are integrated with facility or site maps to prepare data visualization maps, time series charts and geologic sections. SiteGIS is an application for Map information.

Product/Service Maturity: Commercial use experience

Performance History: Over 20 software installations.

Comments: None.

Source of Information: Vendor

Company Name/POC GeoTrans/David Ward
46050 Manekin Place
Suite 100
Sterling, Virginia 20166

E-Mail Address davew@geotrans.com

Product/Service MODFLOWT

Process Type Decision Support Tools

Phone Number 703 444-7000

Fax Number

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone)

Brief Description: MODFLOWT is a new version of MODFLOW that includes modules for simulating three-dimensional contaminant transport.

The new model solves equations for advective-dispersive transport using a fully-implicit finite-difference technique developed for the public domain code FTWORK by GeoTrans.

MODFLOWT is fully compatible with previous versions of MODFLOW. The new program provides full support of existing MODFLOW modules and implements transport simulation through the addition of new packages for Basic Transport, Block-Centered Transport, and an ORTHOMIN solver.

Product/Service Maturity: Commercial use experience

Performance History: Recently released (3/12/96).

Comments: Pricing: Standard Edition: \$500 (Executable only)
Professional Edition: \$100 (Executable and source code)

Source of Information: Vendor

Company Name/POC	GeoTrans/David Ward 46050 Manekin Place Suite 100 Sterling, Virginia 20166		
E-Mail Address	davew@geotrans.com		
Product/Service	Model GIS	Phone Number	703 444-7000
Process Type	Decision Support Tools	Fax Number	

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone)

Brief Description: Model GIS is a comprehensive, menu-driven interface for groundwater modeling within the Arc/Info geographical information system (GIS) software on UNIX workstations. It allows model grids, model input, and model output to be created, stored, and displayed within Arc/Info. A complete preprocessor for the MODFLOW groundwater code is included, and required components for other finite-difference models (model grids, lists, matrices) can be created. This powerful interface increases modeling accuracy and efficiency, particularly when model re-gridding is required.

Product/Service Maturity: Commercial use experience

Performance History: In use at NATA and South Florida Water Management District.

Comments: None.

Source of Information: Vendor

Characterization

Company Name/POC	GeoTrans/David Ward 46050 Manekin Place Suite 100 Sterling, Virginia 20166	
E-Mail Address	davew@geotrans.com	
Product/Service	Swift/486	Phone Number 703 444-7000
Process Type	Decision Support Tools	Fax Number

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Débris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone)

Brief Description: Swift/486 is a fully transient, three-dimensional model which simulates the flow and transport of fluid, heat (energy), brine and radionuclide chains in porous and fractured geologic media. The primary equations for fluid, heat, and brine are coupled by fluid density, fluid viscosity, and porosity. Steady-state options are available for the fluid and brine equations, and both Cartesian and cylindrical coordinate systems may be used; however, the latter is restricted to two-dimensional r-z simulations. Both dual-porosity and discrete fracture conceptualizations may be considered for the fractured system. Migration within the rock matrix is characterized as a one-dimensional process.

Product/Service Maturity: Commercial use experience

Performance History: Contact vendor for list of users.

Comments: None.

Source of Information: Vendor

Company Name/POC	Gotting KG/Hans-H. Gotting Celler Str. 5 31275 Lehrte, Germany		
E-Mail Address			
Product/Service	Inductive Transponder System	Phone Number	0049 51 36 80 96 0
Process Type	Remote Sensing	Fax Number	0049 51 36 80 96 80

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Characterization

Company Name/POC	Groundwater & Environmental Services, Inc./Bob Rousseau 1340 Campus Parkway P.O. Box 1750 Wall, New Jersey 07719		
E-Mail Address			
Product/Service	Physical Sampling	Phone Number	908 919-1646
Process Type	Physical Sampling	Fax Number	908 919-1678

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Other Application

Brief Description: GES has extensive experience in soil, process water, vapor, surface water and groundwater sampling. We own and operate two GeoProbes for soil, groundwater and soil vapor sampling. In addition, GES maintains a staff of environmental sampling technicians who's primary responsibility is groundwater and process water sampling. GES has over 700 active projects with extensive soil, groundwater and process water requirements. The GES New Jersey office is NJDEP field certified for DO, pH, Temp., and Sp. Cond.

Product/Service Maturity: Commercial use experience

Performance History: GES has utilized physical sampling a numerous sites throughout the Northeast and Mid Atlantic States for variety of clients including major oil companies and government agencies. One specific project involved both RCRA and ISRA parcels of land. GES completed soil sampling and analysis to identify areas of concern for the ISRA parcel. The RCRA parcel involved groundwater sampling and reporting. GES also developed a closure sampling program and RCRA Soil Sample and Analytical Plan (SSAP).

Comments: None.

Source of Information: Vendor

Company Name/POC	Group 206 Technologies, Inc./J. Craig Watts 6705 NW 24th Place Gainesville, Florida 32606		
E-Mail Address	g206t@afn.org		
Product/Service	MetPAD and MetPLATE Heavy Metal Toxicity Test Kits	Phone Number	800 869-8729
Process Type	Sensors/Field Analysis Equipment	Fax Number	352 376-9135

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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 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.

*Environmental Cleanup Privatization
Products and Services Directory*

January 1997

C 105

Source of Information: Vendor

Company Name/POC	H2O Waste-Tec/Mr. I. Hallows Horsfield Way, Bredbury Industrial Park Stockport, SK6 2SU UK		
E-Mail Address			
Product/Service	Groundwater/Sludge Borehole Pumps	Phone Number	0161 406 7111
Process Type	Physical Sampling	Fax Number	0161 406 7222

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Product/Service 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: Vendor

Company Name/POC High Plains Consortium, Inc./Lance Loken
P.O. Box 1292
1720 Burnt Boat Drive
Bismarck, North Dakota 58502-1292

E-Mail Address

Product/Service Physical Sampling

Process Type Physical Sampling

Phone Number 701 255-6080

Fax Number 701 250-9177

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Off site On site Non-intrusive

Brief Description: Drilling, sampling and characterization of soils by professional soil classifiers, soil scientists and geologists. Drilling, well installation & sampling of groundwater by hydrogeologists. Surface water and runoff sampling by water quality specialists. Hazardous material identification, unknowns sampling, and landfills and site safety services provided by hazardous materials professionals.

Product/Service Maturity: Commercial use experience

Performance History: Years of experience handling a wide variety of projects involving sample collection, site safety, and site characterization/modeling. Sites have included petroleum/hazardous material contamination, municipal and special use landfills, mining operations, wetlands, and various commercial, industrial and agricultural sites.

Comments: None.

Source of Information: Vendor

Company Name/POC	High Plains Consortium, Inc./Lance Loken P.O. Box 1292 1720 Burnt Boat Drive Bismarck, North Dakota 58502-1292		
E-Mail Address			
Product/Service	Ground Penetrating Radar	Phone Number	701 255-6080
Process Type	Sensors/Field Analysis Equipment	Fax Number	701 250-9177

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone) In-situ (vadose zone) On site Non-intrusive

Brief Description: Ground penetrating radar or GPR is a long-wavelength radar system which penetrates surface materials to survey subsurface materials. GPR technology has expanded the options available to collect geophysical information. To collect information, the GPR is pulled along the ground across a survey area, scans the subsurface, and gathers data on materials beneath the surface. This data is then processed and pretreated to locate, identify, and map a variety of materials, objects and conditions.

Surveys can be conducted throughout the year under a wide variety of conditions -- through concrete, pavement, rock, frozen ground, snow cover, ice or water. Large areas can be surveyed in a day. In certain cases, information can be interpreted and conditions identified while on site.

Product/Service Maturity: Commercial use experience Field demo complete

Performance History: Overburden study and three-dimensional mapping of bedrock surface prior to granite mining; survey to locate and map sand and gravel deposits at an aggregate facility; subsurface layer mapping and identification of petroleum contaminants at an industrial facility prior to cleanup; subsurface survey to locate and map concretionary layers prior to overburden removal at a coal mine; locate and map subsurface agri-chemical contaminants at a commercial facility; survey and map bedrock elevations

Comments: None.

Source of Information: Vendor

Company Name/POC	HNU Systems Inc./John Moore 160 Charlemont Street Newton, Massachusetts 02161		
E-Mail Address			
Product/Service	Model 101 Portable PIDs	Phone Number	800 724-5600
Process Type	Sensors/Field Analysis Equipment	Fax Number	617 558-0056

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☐ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: On site

Brief Description: The most rugged and durable portable photoionizer in the market today. Extremely easy to use with minimal training required.

Product/Service Maturity: Commercial use experience

Performance History: Since its introduction in 1974, the HNU 101 has been the industry leader in portable photoionization detectors. Over 25,000 units have been sold worldwide.

Comments: None.

Source of Information: Vendor

Company Name/POC	HNU Systems Inc./John Moore 160 Charlemont Street Newton, Massachusetts 02161		
E-Mail Address			
Product/Service	SEFA-Px	Phone Number	800 724-5600
Process Type	Sensors/Field Analysis Equipment	Fax Number	617 558-0056

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: On site

Brief Description: Portable "point and shoot" energy dispersive x-ray fluorescence analyzer.

Product/Service Maturity: Bench scale testing only

Performance History: Contact vendor for performance data.

Comments: None.

Source of Information: Vendor

Company Name/POC HNU Systems Inc./John Moore
160 Charlemont Street
Newton, Massachusetts 02161

E-Mail Address

Product/Service 201-A

Phone Number 800 724-5600

Process Type Sensors/Field Analysis Equipment

Fax Number 617 558-0056

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Off site On site

Brief Description: Continuous monitor for VOC analysis using a very sensitive photoionization detector. Over 3000 units in use worldwide, many for remediation monitoring projects.

Product/Service Maturity: Commercial use experience

Performance History: In use at several Superfund sites for fence line monitoring. Also used for monitoring carbon beds during remediation at remote, field facilities.

Comments: None.

Source of Information: Vendor

Company Name/POC	HNU Systems Inc./John Moore 160 Charlemont Street Newton, Massachusetts 02161		
E-Mail Address			
Product/Service	XR-1000	Phone Number	800 724-5600
Process Type	Sensors/Field Analysis Equipment	Fax Number	617 558-0056

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Off site On site

Brief Description: Portable energy dispersive x-ray fluorescence analyzer for rapid analysis of elements Na through Cl. Minimal sample prep required.

Product/Service Maturity: Field demo complete

Performance History: Contact vendor for performance data.

Comments: None.

Source of Information: Vendor

Company Name/POC HNU Systems Inc./John Moore
160 Charlemont Street
Newton, Massachusetts 02161

E-Mail Address

Product/Service 311D-GC

Phone Number 800 724-5600

Process Type Sensors/Field Analysis Equipment

Fax Number 617 558-0056

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Off site On site

Brief Description: Compact field portable gas chromatograph with temperature programmable over and ability to use up to 2 detectors simultaneously. Excellent over temperature stability provides high precision and accuracy.

Product/Service Maturity: Commercial use experience

Performance History: Hundreds of 311D GCs have been sold worldwide for environmental applications and field use.

Comments: None.

Source of Information: Vendor

Company Name/POC	hydroGEOPHYSICS/Dr. James B. Fink 5865 S. Old Spanish Trail Tucson, Arizona 85747		
E-Mail Address			
Product/Service	Electromagnetic Interpretation Technique (EMIT)	Phone Number	520 647-3315
Process Type	Geophysics/Hydrogeologic Measurements	Fax Number	520 647-3428

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Characterization

Company Name/POC	In-Situ Inc./Jeff Davis 210 S. Third Street Laramie, Wyoming 82070-0920		
E-Mail Address			
Product/Service	Hermit Data Logger, Troll, Well Sentinel - Pressure Transducers (PXD-260, PTX 161D)		
Process Type	Geophysics/Hydrogeologic Measurements	Phone Number	800 446-7488
		Fax Number	307 721-7598

Contaminants

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

Media

☒ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Data Loggers and Pressure Transducer for water level measurements. Contact vendor for additional information.

Product/Service Maturity: Commercial use experience.

Performance History: In-Situ Inc. began operation over 15 years ago in Laramie, Wyoming, offering hydrologic consulting and computer modeling services to the energy and mining industries. Since then, In-Situ has expanded into environmental technologies.

Comments: None.

Source of Information: Vendor

Company Name/POC	Industrial Scientific Corp/Tony Slapikas 1001 Oakdale Road Oakdale, Pennsylvania		
E-Mail Address			
Product/Service	MG2100	Phone Number	412 265-1212
Process Type	Sensors/Field Analysis Equipment	Fax Number	412 265-1199

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: On site

Brief Description: Using a patented magnetic cycloidal mass analyzer, a proprietary pumping system, the MG2100 is designed for portable field use. With its small size and weight of less than 40 lbs., the MG2100 can be hand carried to remote sites for analysis of compounds in the 10-200 AMU mass range. Inlet systems are available for direct air, water sparging, and automatic purge and trap.

Product/Service Maturity: Pilot plant testing

Performance History: In Beta testing the MG2100 has successfully monitored VOC's in the effluent stream of a dual phase remediation plant at levels below 100 ppB.

Comments: None.

Source of Information: Vendor

Company Name/POC	INTERA, Inc./Dick Jackson 6850 Austin Center Boulevard, Suite 300 Austin, Texas 78731		
E-Mail Address			
Product/Service	Partitioning Interwell Tracer TEST (PITT)	Phone Number	512 346-2000
Process Type	Sensors/Field Analysis Equipment	Fax Number	512 346-9436

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service Maturity: Field demo complete

Performance History: INTERA is currently collaborating with the University of Texas at Austin on a number of field projects which involve characterization and estimation of the geometry of DNAPL zones using the PITT. These projects include:

Sandia National Laboratories Chemical Waste Landfill, Albuquerque, NM - A PITT was conducted in the vadose zone during late 1995 to determine the volume of DNAPL present at depths from 10 to 80 below ground surface. Perfluorocarbon tracers were used and measured on site with gas chromatographs. Results are being used to design an enhanced soil vapor extraction remediation system.

Operable Unit 2 at Hill AFB, UT - INTERA has recently completed a test to measure the volume of TCE DNAPL in a 20-foot interwell zone using a PITT. A micellar-polymer (MP) surfactant flood is scheduled for August 1996 with a follow-on PITT to assess the performance of the MP flood.

DOE's Portsmouth Gaseous Diffusion Plant, Portsmouth, OH - INTERA will be conducting a PITT - surfactant flood - PITT sequence beginning in July 1996. Installation of the injection/extraction/monitor wells and hydraulic testing in preparation for the PITTs and surfactant flood has already been completed.

Comments: 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, like the PITT, 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. The geological medium needs to have

January 1997

C 120

Environmental Cleanup Privatization
Products and Services Directory

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: Vendor

Company Name/POC	J. Dittrich Elektronik/Jurgen Dittrich	
	Bahnhofstr. 67	
	76532 Baden-Baden	
	Germany	
E-Mail Address		
Product/Service	Dynamic Oxygen Sensor	Phone Number 49 7221 64103
Process Type	Sensors/Field Analysis Equipment	Fax Number 49 7221 17103

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service Maturity: Commercial use experience

Performance History: 1000 units sold in last 4 years. Performance excellent. Dittrich Elektronik is OEM to Germany and multinational companies.

Comments: Very easy to install and use, no infrastructure needed. Not tested in high level radioactive environments.

For on site ex- and in-situ measurement, control and monitoring systems such as environmental control units, furnaces, industrial combustion facilities, devices for the measurement of efficiency of combustion processes, industrial process control systems, fanning (in silos), compost preparation systems, biotechnology and medicine.

Source of Information: Vendor

Characterization

Company Name/POC	Kampsax Geodan/Connie D. Johnsen Stamholmen 112 P.O. Box 1132 DK 2650 Hvidovre, Denmark	
E-Mail Address		
Product/Service	Pulled Array Continuous Vertical Electrical Sounding (PA-CVES)	Phone Number 45 36390737
Process Type	Geophysics/Hydrogeologic Measurements	Fax Number 45 36772310

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Characterization

Company Name/POC	Kampsax Geodan/Connie D. Johnsen Stamholmen 112 P.O. Box 1132 DK 2650 Hvidovre, Denmark		
E-Mail Address			
Product/Service	Ellog with Level-Specific Gas and Water Sampling	Phone Number	45 36390737
Process Type	Drilling	Fax Number	45 36772310

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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.

Characterization

Source of Information: Vendor

Company Name/POC	Kampsax Geodan/Connie D. Johnsen Stamholmen 112 P.O. Box 1132 DK 2650 Hvidovre, Denmark	
E-Mail Address		
Product/Service	CPT Continuous Soil Gas Sampling	Phone Number 45 36390737
Process Type	Sensors/Field Analysis Equipment	Fax Number 45 36772310

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service 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. Hard soil layers may limit depth; very low permeability soil may slow down the measured speed.

Source of Information: Vendor

Characterization

Company Name/POC	KEMA Nederland B.V./H.A.W. Cornelissen P.O. Box 9035, NL-6800 ET ARNHEM, The Netherlands	
E-Mail Address		
Product/Service	Radwaste Cementation and Process Control	Phone Number 31 26 356 6104
Process Type	Decision Support Tools	Fax Number 31 26 351 5835

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On 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 checked and improved. Various on-line measuring techniques have been developed to check the mechanical, chemical and radiological properties during the cementation process.

Product/Service 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: Vendor

Characterization

Company Name/POC KEMA Nederland B.V./J. van der Steen
P.O. Box 9035 NL-6800 ET
ARNHEM The Netherlands

E-Mail Address

Product/Service On Line Gamma Monitoring Systems

Phone Number 31 26 356 3370

Process Type Sensors/Field Analysis Equipment

Fax Number 31 26 442 3635

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: On line gamma monitoring systems for discrimination of radioactively contaminated and uncontaminated materials.

Product/Service 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: Vendor

Characterization

Company Name/POC	Kinetic Sciences Inc./David Kauffman 3250 E. Mall Vancouver, B.C. V6T 1W5		
E-Mail Address			
Product/Service	3-D Object Tracking Vision System	Phone Number	604 822-2144
Process Type	Remote Sensing	Fax Number	604 822-6188

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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).

Product/Service 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

Characterization

Company Name/POC	Landauer, Inc./Sue Morrow 2 Science Road Glenwood, Illinois 60425		
E-Mail Address			
Product/Service	Alpha Track Etch Detectors	Phone Number	708 755-7000
Process Type	Sensors/Field Analysis Equipment	Fax Number	708 755-7016

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Company Name/POC	Logic Beach Inc./Marty Osterling 8363-6F Center Drive La Mesa, California 91942		
E-Mail Address	loggers@logicbeach.com		
Product/Service	HyperLogger (TM) / BitLogger (TM) / Portable Data Logging System	Phone Number	619 698-3300
Process Type	Sensors/Field Analysis Equipment	Fax Number	619 469-8604

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: On site

Brief Description: The HyperLogger (TM) data logger meets your remote site and plant floor data collection and alarming needs. battery powered and weather-proof, the HyperLogger is equally at home collecting data in moving vehicles, on the plant floor, or in the lab. Sporting full differential, instrumentation amplified inputs (zap protected), programmable filtering, 13 bit analog to digital conversion, and sampling rates in excess of 100 S/S, the HyperLogger is a true precision grade instrument.

The BitLogger (TM) is a useful link in your data gathering process and can be easily field configured to record data from a range of analog and digital signal sources over time...minutes to months. The field collected data can then be downloaded into a personal computer for immediate graphical display and algebraic manipulation using the QuickGraph (TM) feature of the provided BitLogger Communications (BC) software. Additionally, using the File Conversion feature of BC, data can simply be converted into fully annotated, time tagged spreadsheet files which can be directly loaded into standard spreadsheets.

Product/Service Maturity: Commercial use experience

Performance History: Contact Logic Beach Inc if references are required. Wide variety of industrial and utility applications for all types of monitoring and data collection needs.

Comments: Beyond data collection, the HyperLogger provides control and alarming function. User programmable relay outputs, two line message display, and even telephone line paging are supported. Additional capabilities: delayed start logging, rotary memory logging, event initiated logging, setpoint control, time cycled logging, independent sampling rates, relay alarms, programmable sensor warm-up. The portable, weatherproof battery operation of the BitLogger enables quick set-up and tear down. Applications too punishing for a strip chart recorder are easily handled by the BitLogger. It offers widespread uses for industry

and labs, from farming to meteorology. Testing of energy consumption, water quality, flow rates, machine cycle times, heat exchanger efficiencies, pressures, loading, events, and process throughput can all be readily handled. In R&D facilities, measure lifetime cycles, device temperature rises, discharge curves, component strain, voltage fluctuations, pressures, and more.

Source of Information: Vendor

Company Name/POC	Loral Defense Systems - Eagan/Kevin D. Krueger PO Box 64525 St Paul, Minnesota 55164-0525	
E-Mail Address		
Product/Service	Rapid Optical Screening Tool (ROST-TM)	Phone Number 612 456-4160
Process Type	Sensors/Field Analysis Equipment	Fax Number 612 456-3098

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service Maturity: Commercial use experience

Performance History: The ROST system has been successfully demonstrated and/or applied to environmental investigations at over 100 sites that include oil refineries, air force bases (domestic and foreign), abandoned coal gasification plants, gas stations and 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 50-100 mg/kg (ppm).

Source of Information: Vendor

Characterization

Company Name/POC	Los Alamos National Laboratory/George Brooks P.O. Box 1663 CST-9 MS-K484 Los Alamos, New Mexico 87545	
E-Mail Address		
Product/Service	Mobil Radiological Analysis Laboratory (MRAL)	Phone Number 505 665-2583
Process Type	Sensors/Field Analysis Equipment	Fax Number 505 665-5982

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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 four units in operation that have been supporting field operations for four years. 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. Limited analytical capability.

Product/Service Maturity: Commercial use experience

Performance History: Performance data are available.

The Mobile Radiological Analysis Laboratories (four 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: Vendor

Company Name/POC	Lynx Geosystems Inc./Andrea Zollner #400, 322 Water St. Vancouver, B.C., Canada V6B 1B6		
E-Mail Address			
Product/Service	Lynx Geoscience Modeling Software	Phone Number	604 682-5484
Process Type	Decision Support Tools	Fax Number	604 669-3659

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service Maturity: Commercial use experience

Performance History: Performance data are available. Over 230 clients world wide. Yucca Mountain, McClellan AFB. Reference: Jim Burnett, Mitre Corp., 703 610-2120.

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: Vendor

Company Name/POC	MagneX Electric/Dr. R. Clayton Littlebrook Complex Littlebrook Manorway Dartford Kent DA1 5PY, UK		
E-Mail Address			
Product/Service	Contaminated Land Measurements	Phone Number	44 1322 282800
Process Type	Sensors/Field Analysis Equipment	Fax Number	44-1322 282819

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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.

Product/Service Maturity: Commercial use experience

Performance History: Many internal measurements on Magnox 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: Vendor

Company Name/POC	Meta MESSTECHNIK/Erich Ludwig OSTSTR 7 48341 Altenberge, Germany		
E-Mail Address			
Product/Service	Fast Short Column Gas Chromatography (GC/TID)	Phone Number	49 2505 8706
Process Type	Sensors/Field Analysis Equipment	Fax Number	49 2505 3006

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Characterization

Company Name/POC	Microsensor Systems, Inc./Mark Klusty 62 Corporate Court Bowling Green, Kentucky 42103		
E-Mail Address			
Product/Service	MSI-301 Organic Vapor Monitor	Phone Number	502 745-0099
Process Type	Sensors/Field Analysis Equipment	Fax Number	502 745-0095

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC	Microsensor Technology Inc. Analytical Instruments/David Sherve 41762 Christy Street Fremont, California 94538		
E-Mail Address			
Product/Service	Micromachined Portable Gas Chromatography	Phone Number	510 490-0900
Process Type	Sensors/Field Analysis Equipment	Fax Number	510 490 -0904

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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

Company Name/POC	Mount Sopris Instrument Company Inc./James J. LoCoco, CPG 17301 W. Colfax Avenue Suite 255 Golden, Colorado 80401-4886		
E-Mail Address	75147,2316@compuserv.com		
Product/Service	Portable Borehole Geophysical Instrumentation	Phone Number	303 279-3211
Process Type	Geophysics/Hydrogeologic Measurements	Fax Number	303 279-2730

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: These portable loggers, based on a simple, rugged light-weight winch and surface package, are designed to provide data to the serial port of a portable PC. Using proprietary software, the PC will display log data in real-time graphics display on the personal computer, while writing data to the hard drive and simultaneously providing a hard-copy via a dot-matrix or thermal printer. Our downhole probe selection will include all current Mount Sopris single conductor models, with new probes added periodically. Recent new additions include the GEP-2595 gamma-induction probe (with SP and SPR capability) and a new version of our 2WQA-1000 high resolution water quality probe measuring fluid resistivity and temperature. We will be building full waveform sonic probes for the MGX II instrument console.

Product/Service Maturity: Commercial use experience

Performance History: Since its inception in 1992, the MGX-portable digital logger has proven to be a dependable logging system service several industries. Over 200 units are operating world-wide. The new MGX II fully digital portable geophysical logger has the capability to acquire seven primary measurements in a single logging run. MGX II loggers have recently been delivered to Egypt, Denmark, Thailand, Spain, England, Korea and several U.S. customers.

Comments: None.

Source of Information: Vendor

Company Name/POC	New Mexico State University/Grég Moran Physical Science Lab P.O. Box 30002 Las Cruces, New Mexico 88003-0002		
E-Mail Address			
Product/Service	Radio Imaging Method (RIM)	Phone Number	505 522-9276
Process Type	Geophysics/Hydrogeologic Measurements	Fax Number	505 522-9434

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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 Boms (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: Vendor

Company Name/POC	NIS Ingenieurgesellschaft mbH/Ludwig Seyfferth Donaustraße 23 D-63452 Hanau Germany		
E-Mail Address			
Product/Service	Release Measurement (RM)	Phone Number	49 181 185 159
Process Type	Sensors/Field Analysis Equipment	Fax Number	011 49 6181 1200 33

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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.

U.S. Contact: Darrel Eisenhut, President/Halliburton NUS/910 Clopper Road/Gaithersburg, MD 20878/(ph) 301-258-2524/(fx) 301-258-2463

Source of Information: Vendor

Company Name/POC	NIS Ingenieurgesellschaft mbH/Ludwig Seyffert Donaustraße 23 D-63452 Hanau Germany		
E-Mail Address			
Product/Service	Software for Decommissioning Planning (STILLKO)	Phone Number	49 181 185 159
Process Type	Decision Support Tools	Fax Number	011 49 6181 1200 33

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service 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: Vendor

Company Name/POC	Northeast Research Institute, Inc./Fred DiBattista P.O. Box 859 270 Farmington Ave. Suite 128 Farmington, Connecticut 06034-0859	
E-Mail Address		
Product/Service	Petrex Passive Soil Vapor Surveys	Phone Number 203 677-9666
Process Type	Sensors/Field Analysis Equipment	Fax Number 203 677-7008

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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 as well as discharge areas under fresh, brackish, and marine water. Groundwater patterns and lithological information often can be inferred from the maps.

Product/Service 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. Inclusive to the in-situ vadose zone application is underwater.

Source of Information: Vendor

Company Name/POC	Northwest Environmental Services, Testing and Training (NESTT)/James Conca 2000 Logston Blvd Richland Washington 99352		
E-Mail Address	James@ufa.owt.com		
Product/Service	UFA Characterization Technology & Others	Phone Number	509 325-3268
Process Type	Geophysics/Hydrogeologic Measurements	Fax Number	509 375-4838

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (vadose zone)

Brief Description: A new technology, the UFA, is able to directly measure any transport property rapidly, e.g., hydraulic conductivity, vapor diffusivity, diffusion coefficient, in any porous media, e.g., soil, rock, cement, ceramic, sludge, with respect to any fluid, including aqueous and non-aqueous liquids. Hydraulic steady-state can be achieved in a matter of hours at any point over the complete range of fluid contents from saturated to completely unsaturated. The normal UFA operating range is from saturated down to 10 (-11) cm/s (10 [-8] darcy; 10 [-16] cm [2]) or 10 (-14) cm/s for saturated operation.

Product/Service Maturity: Commercial use experience

Performance History: The UFA has successfully characterized many government and private contaminated sites including the Hanford Site, LLNL, LANL, the Nevada Test Site, INEL, Edwards Air Force Base, and Keesler Air Force Base. For those sites where remediation went forward, it has been successful.

Comments: None.

Source of Information: Vendor

Company Name/POC ORS Environmental Systems/Customer Service
32 Mill Street
Greenville, New Hampshire 03048

E-Mail Address

Product/Service AccuSensor (TM) TCE
Process Type Sensors/Field Analysis Equipment

Phone Number 603 878-2500

Fax Number 603 878-3866

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: On site

Brief Description: AccuSensor TCE is a hand-held instrument capable of measuring trichloroethylene (TCE), with a minimum detection limit of 5ppb. AccuSensor requires only 4 easy steps and provides reliable results in just 5 minutes.

Product/Service Maturity: Commercial use experience

Performance History: Released to market October 1995. Currently have a number of units in the field for a variety of applications, including treatment-system efficiency monitoring, site characterization, equipment decontamination monitoring, and process control.

Comments: None.

Source of Information: Vendor

Company Name/POC	ORS Environmental Systems/Mark Shaver 7 Barnabas Road Marion Massachusetts 02738		
E-Mail Address			
Product/Service	ChemSensor	Phone Number	508 748-3399
Process Type	Sensors/Field Analysis Equipment	Fax Number	508 748-9727

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone) On site

Brief Description: ChemSensor is ORS Environmental Systems' new instrument for in-situ, real-time detection of VOCs in water using fiber optic technology. It is a rugged, hand-held field instrument designed to provide fast, repeatable, low-cost analyses. The response of the instrument's unclad quartz optical fiber core to organics is dependent on the quantity and mixture of analyte(s) in the sample. The response is measured and converted to the equivalent p-xylene response in PPM. The device is capable of measuring responses >1 ppm equivalent p-xylene.

Product/Service Maturity: Commercial use experience

Performance History: Shell Oil/Enviro Trac - used to reduce required samples needed for quarterly laboratory analysis; accepted by NYS DEP Region I for 18 sites. Shell bought instrument and was given to Envirotrac to use will send sic

Major Oil Company - California - used to reduce laboratory samples.
US Naval Weapons Lab, New Jersey - to test ship bridge sic

Comments: ChemSensor responds to many different organic chemicals in water and thus provides no information on the individual components in the mixture of contaminants.

Using ChemSensor to reduce laboratory analysis for long-term monitoring of a site can be accomplished by using ChemSensor data to estimate BTEX levels and to determine if laboratory analysis is necessary.

Source of Information: Vendor

Company Name/POC	Oxford Instruments UK Ltd./W. Proctor Osney Mead Oxford OX2 ODX U.K.		
E-Mail Address			
Product/Service	Nuclear Magnetic Resonance (NMR)	Phone Number	18 6526 9500
Process Type	Sensors/Field Analysis Equipment	Fax Number	18 6526 9501

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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.

Product/Service 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

January 1997

C 152

Environmental Cleanup Privatization
Products and Services Directory

done using new materials or compact (military) coolers. It is believed that spectrometry could be carried out in bore holes down to 100 meters 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

Company Name/POC	Oxford Instruments/Nigel Boulding Accelerator Technology Group Osney Mead Oxford OX2 ODX, UK	
E-Mail Address		
Product/Service	Differential DIE Away For Induced Fission Using NeuSight	Phone Number 44 1865 269500
Process Type	Sensors/Field Analysis Equipment	Fax Number 44 1865 269502

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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.

Product/Service 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

Company Name/POC	P-Squared Technologies, Inc./Jeff Holt 10938 Hardin Valley Road Knoxville, Tennessee 37932		
E-Mail Address	jholt@p2t.com		
Product/Service	Fluid Flow Modeling, Visualization, and Animation	Phone Number	423 691-3688
Process Type	Decision Support Tools	Fax Number	423 691-0611

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: P-Squared Technologies, Inc. (P2T) combines three areas of expertise to address problems and achieve an accurate assessment of the challenging problem at hand. This approach leads to the development of the most cost effective solution. The three areas are: (1) scientific and engineering analysis; (2) advanced modeling; and (3) visualization and animation.

Successful solutions must be based on a solid scientific and engineering evaluation of the situation. Modeling assimilates the available data with the scientific understanding/evaluation to provide a complete picture of the situation. It also allows the engineer/scientist to evaluate different approaches to solving problems and their effectiveness prior to constructing them.

Visualization through computer graphics and computer animation is the third area of expertise. It results in clear communication that enables rapid comprehension of what the current situation and conditions are and/or what the results of solutions will be. However, graphics alone are meaningless unless the information is based on an accurate model. And, the model can not be accurate unless the scientist/engineer can effectively evaluate the problem: For challenging problems, this three-prong approach works, and results in cost effective solutions.

Product/Service Maturity: Commercial use experience

Performance History: Numerical modeling of physical phenomena provides a way of understanding environmental processes that is unmatched by any other currently available technology. P2T has successfully employed environmental models in stakeholder negotiations, risk assessments, feasibility studies, remedial design, comments on proposed state and federal rulemaking, and value enhancement for hundreds of individual projects in the government and private sectors.

Comments: In order for modeling to be successful it requires the correct level and quantity of data to match the intended outcome of the project, and appropriate conceptual model of the site, the appropriate mathematical

formulation of the conceptual model, and skilled professionals to formulate the model and evaluate the results. P2T maintains hundreds of public sector and proprietary models for use in air, surface water, soil, groundwater and sediment assessments.

Source of Information: Vendor

Company Name/POC PCP, Inc./Martin J. Cohen
2155 Indian Road
West Palm Beach, Florida 33409-3287

E-Mail Address

Product/Service Ion Mobility Spectrometry
Process Type Sensors/Field Analysis Equipment

Phone Number 407 683-0507
Fax Number 407 683-0507

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: Real-time measurement of trace chemicals in laboratory or field (ppm to ppb and smaller).

Product/Service 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). Needs 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: Vendor

Company Name/POC	Promeco B.V./ A.J. M. Broeders P.O. Box 94 5741 OAB Beek En Donk, The Netherlands		
E-Mail Address			
Product/Service	Optimizing Separation	Phone Number	31 492 463903
Process Type	Decision Support Tools	Fax Number	31 492 465025

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC	Pylon Electronics Inc./Luc Desgagne 147 Colonnade Rd Ottawa, Ontario K1E 7L9		
E-Mail Address			
Product/Service	AB-5 Radiation Detector	Phone Number	613 226-7920
Process Type	Sensors/Field Analysis Equipment	Fax Number	613 226-8195

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: Based on its HIGH SENSITIVITY PMT. technology, this unit is an industry accepted standard for the measurement of radon gas in air, water and soil; working level with grab and continuous modes; surface contamination of alpha and beta particles; gamma detection. Using one instrument with various probes, detectors and other accessories to answer to the requirements of many customized solutions. Available sensitivities range from less than 0.1 to more than 25 cpm/pCi/l depending on the probe/detector used. Radon concentrations of 10,000,000 pCi/l to 0.005 pCi/l can easily be detected and monitored. The standard features include programmable sampling, data storage four modes of operations (continuous, radon, quasi-continuous and ratemeter), real-time clock, outputs in pCi/l or Bq/m3 and a long life internal rechargeable battery & AC power adapter/charger. To adapt the AB-5 to specific applications, a complete line of accessories is available including: portable printer, serial interface to download to other printers or PC's and software to enable radon and working level calculations.

Product/Service Maturity: Commercial use experience

Performance History: Number of size of jobs have varied over the years. AB-5 used by DOE Contractors (50), EPA Offices, and Health Physicists (50) for many different applications. Ref. Doug Daniels/Fermco 513 738-6088. Ten years of Interlaboratories Comparison performance data with DOE EML & EPA is also available.

Comments: The AB-5 is fully programmable with its function keys and its 8 digit LCD. Operating temperatures -10 to 45 degrees C, relative humidity up to 90% non condensing. Memory capacity is 675 user programmable interval lengths. AB-5 is delivered calibrated and ready for use in the field. The manual provides operating instructions for day to day operation and describes fully the use and changing of accessories for many applications. Periodic calibration traceable to NIST is part of the services offered. Unique calibration standards are available for the user to perform calibration and check proper operation.

Source of Information: Vendor

Company Name/POC	Pylon Electronics Inc./Luc Desgagne 147 Colonnade Rd Ottawa, Ontario K1E 7L9		
E-Mail Address			
Product/Service	WLX Working Level Measuring System	Phone Number	613 226-7920
Process Type	Sensors/Field Analysis Equipment	Fax Number	613 226-8195

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: The WLx detects, discriminates and measures radon and thoron progeny using spectroscopic analysis. It uses a solid state detector (PIPS) and a multi-channel analyzer. Complete with certificate of calibration traceable to National Reference Laboratories, printer, PC software, RS-232 cable and AC power adapter. The WLx can be used as a continuous working level meter or as a grab sample monitor with variable counting routines. It is preprogrammed with automatic sampling standard protocols but the operators may override these and create their own using the instrument keypad. Results output include: radon and thoron WL's; atomic and activity concentrations of all the principal radon and thoron progenies in atoms/l and pCi/l respectively, with the relative uncertainty associated with each of the above results. It will also report secular equilibrium factor and radon concentration when an AB-5 pulse output is connected.

Product/Service 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: Capability for external visual/audible alarm. The minimum detectable level is 0.6 mWL. Features also include a tamper resistant filter holder; internal audible alarm; graphic display and printer output; large internal memory; built-in servo controlled air pump for constant and accurate flow independent of filter loading, temperatures or pressures; configured with user replaceable Ni-Cad or alkaline batteries; rugged aluminum case and practically no setup required. The unit is delivered calibrated and periodic calibration is available. Unique calibration standards are available to test calibration and check proper operation. Automated with fast and easy self-driven routines while following user friendly menus.

Source of Information: Vendor
Environmental Cleanup Privatization
Products and Services Directory

January 1997
C 161

Company Name/POC	Pylon Electronics Inc./Luc Desgagne 147 Colonnade Rd Ottawa, Ontario K1E 7L9		
E-Mail Address			
Product/Service	AB-4 Radon Measurement System	Phone Number	613 226-7920
Process Type	Sensors/Field Analysis Equipment	Fax Number	613 226-8195

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: The AB-4 measures radon gas continuously using a high sensitivity passive scintillation cell-PMT technology. Capability for driving a modem, external printer and external alarm. Optional internal printer, and environmental sensors (humidity, pressure, temp.) enhance the AB-4. Standard features include RS-232 cable, rugged design, self-contained operation, removable detector cell, multitasking operating system, programmable start time, remote monitoring and NIST traceability. Power requirements are 110/220 VAC 50/60 Hz adapter/charger (included); two internal long life rechargeable gel cells (included)-external 12 VDC.

Product/Service Maturity: Commercial use experience

Performance History: Contact company for performance data.

Comments: The AB-4 is an integrated version of the AB-5 when used with the continuous passive scintillation cell configuration, all in a stand alone package. Operating temperatures - 10 to 45 degrees C, relative humidity up to 90% non condensing. With backlit alpha numeric LCD display and user friendly menus. Memory capacity is 84 days at one hour interval or 2000 user programmed intervals. Minimum detectable level of 0.1 pCi/l at 95% confidence level. The sensitivity of the AB-4 is nominally 1.25 cpm/pCi/l. The AB-4 can be adapted to special configurations/applications by the manufacturer. EPA qualified as a primary and/or secondary measurement device, and a mail-in device for the RMP Program. The unit is delivered calibrated and periodic calibration to NIST is available. Unique calibration standards are available for the user to test calibration and check proper operation.

Source of Information: Vendor

Company Name/POC	Quadrel Services, Inc./Bruce R. Tucker 1896 Urbana Pike Suite 20 Clarksburg, Maryland 20871		
E-Mail Address			
Product/Service	EMFLUX (R)	Phone Number	301 874-5510
Process Type	Sensors/Field Analysis Equipment	Fax Number	301 874-5567

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service Maturity: Commercial use experience

Performance History: EMFLUX has been successfully employed in mapping VOCs, SVOCs, complex mixtures (e.g., gasoline; jet, diesel, and kerosene fuels; heating and waste oils, methane, and other nonsorbable gases) on over 250 sites in 32 states. Specific jobs have ranged in size from 2,000 to 10 sample points and have covered as much as a hundred acres. No significant and/or unresolvable problems have been encountered on any site. References: Mr. Carl Nardin, U.S. Army Corps of Engineers, Omaha District, (402) 221-7774; Mr. Tom Weatherly, SAIC, McLean, VA, (703) 734-5584; Mr. Mike Pelletier, RUST Environment & Infrastructure, Columbia, SC, (803) 256-6791.

Comments: Extremely accurate, reproducible, and user friendly. Client or Quadrel personnel conduct surveys with small, light Field Kits. Broad range of detectable compounds (see "Performance History") and a wide variety of EPA-specified analytic methods. Multiple sorbents utilized, selected for compatibility with targeted contaminants. Surface-placed and shallow-subsurface (3-inch depth) options offered. Simple but effective field QA/QC. Rapid reporting; several formats available.

Source of Information: Vendor

Company Name/POC	Quantum Engineering Corporation/William R. Waldrop 112 Tigitsi Lane Tellico Village Louden, Tennessee 37774		
E-Mail Address	wrwaldrop@aol.com		
Product/Service	Electromagnetic Borehole Flowmeter (EBF)	Phone Number	423 458-0506
Process Type	Sensors/Field Analysis Equipment	Fax Number	423 458-0504

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone)

Brief Description: The Electromagnetic Borehole Flowmeter (EBF) is a field instrument for determining the vertical distribution of hydraulic conductivity in soil and flows in fractured rock. This portable instrument system provides important data for assessing the mobility of contaminated groundwater, designing effective monitoring systems, and implementing corrective actions at contaminated sites. The instrument is designed for rugged field use with no moving parts, and can be used in cased or uncased wells with diameters between 2 inches (5.08 cm) and 10 inches (25.4 cm). The EBF can accurately measure flows as low as 0.0026 GPM (10 ml/min).

Product/Service Maturity: Commercial use experience

Performance History: The EBF was developed by the Tennessee Valley Authority (TVA) to support groundwater assessments at TVA power generation facilities. Early testing was conducted in support of groundwater research projects performed by TVA for the Electric Power Research Institute and the USAF Armstrong Laboratory. The EPA Robert S. Kerr Environmental Laboratory funded a three-year demonstration of the EBF under diverse hydrogeologic conditions throughout the USA. It has been used extensively by TVA at numerous TVA facilities, and throughout the nation by Quantum Engineering Corporation (QEC).

Comments: QEC provides EBF field testing service and data analysis in cooperation with A&E firms performing environmental assessments and remediation. The EBF is available for purchase through QEC as a distributor of TISCO, Inc., the firm with commercial rights to the patent held by TVA. QEC also offers customized EBF training.

Source of Information: Vendor

Company Name/POC	Questron Corporation/Angelo Grillo 4044 Quakerbridge, RD. Mercerville, New Jersey 08619		
E-Mail Address			
Product/Service	On-Line Microwave Digestion	Phone Number	609 587-6898
Process Type	Laboratory Analysis	Fax Number	609 587-0513

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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. Has application to water, vegetation, soils, sediments, ores, geologicals, blood and other biologicals.

Product/Service Maturity: Commercial use experience

Performance History: Successful installation in nuclear facility, environmental testing labs, production sample preparation.

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: Vendor

Company Name/POC	Range Vision Inc./Gareth Jones 4003 Graveley Street Burnaby, B.C., Canada V5C 3T5	
E-Mail Address		
Product/Service	Range Camera Vessel Internal Inspection	Phone Number 604 473-9411
Process Type	Remote Sensing	Fax Number 604 299-4457

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Company Name/POC	RKK, Ltd./Ron Krieg or Doug Orkney 16404 Smokey Point Boulevard Suite 303 Arlington, Washington 98223	
E-Mail Address		
Product/Service	RESONANT SONIC (SM) DRILLING	Phone Number 360 653-4844
Process Type	Drilling	Fax Number 360 653-7456

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: The Resonant Sonic (SM) drilling method is an innovative and cost effective approach to environmental drilling applications. The technology is hydraulically driven, and incorporates a sonic drill head. Series of high frequency sinusoidal wave vibrations are generated into a steel drill pipe, creating a cutting action at the bit face. The tremendous forces produced by the resonant head and the external flush nature of the specialized drill pipe force material displaced by the bit into the borehole wall. The result, no drilling spoils. It is also possible to resonate a closed-end steel pipe into the ground, displacing formation media similar to a pile driver. Resonant Sonic (SM) drilling can produce boreholes of various depths and dimensions, yield continuous, relatively undisturbed cores, and requires no air, mud, water, or other circulatory medium for drilling. The method is extremely fast (up to one foot per second in certain formations), and can drill through virtually any media from horizontal to vertical. Again, this is with no drilling spoils.

Product/Service Maturity: Commercial use experience

Performance History: Current use at:

Beale AFB, CA for the U.S. DOD

Sandia Laboratories, Albuquerque Facility

Hanford, Washington Facility

Rocky Flats Facility, Colorado

Pantex Facility, Texas for U.S. DOE

Continual development with Westinghouse Hanford Company, Richland, WA, and involvement with Sandia Laboratories Technology Transfer Program with the U.S. DOE

Comments: A major advantage that RKK brings to any potential environmental site project is cost efficiency. Underground drilling comprises 40%-50% of a containment or remediation installation's cost. RKK incorporates various drilling techniques to install its containment and remediation technologies, which are evaluated to match

site requirements in the most cost effective approach. Resonant Sonic (SM) drilling will greatly reduce or eliminate drilling spoils normally associated with boring underground holes. In most cases this equates to considerable savings should a site's drilling media contain radioactive substances. The health and safety of installation personnel and the environment greatly benefit from this process.

Water Protection International was formed between RKK, Ltd. and the Water Development Corporation in order to provide turnkey service to clients in the containment marketplace. Each company has licensed their respective technologies to allow WPI to pursue barrier or containment project opportunities as a complete environmental service company. The RKK, Ltd. division provides the containment and remediation technologies, including technical and managerial expertise. The Water Development Corporation, a full service drilling company, provides the necessary drilling technologies with extensive environmental drilling experience, including the health science and safety experience to work at radioactive sites.

Source of Information: Vendor

Water Protection International, Inc.
10000 1st Avenue, Suite 100
Boulder, Colorado 80501
Phone: (303) 440-1000
Fax: (303) 440-1001

Water Protection International, Inc.
10000 1st Avenue, Suite 100
Boulder, Colorado 80501
Phone: (303) 440-1000
Fax: (303) 440-1001

Water Protection International, Inc.

Water Protection International, Inc. is a leading provider of environmental remediation services. The company's services include site characterization, drilling, and remediation. The company has a long history of providing high-quality services to its clients. The company's services are designed to meet the needs of its clients and to provide the highest level of service possible. The company's services are designed to meet the needs of its clients and to provide the highest level of service possible. The company's services are designed to meet the needs of its clients and to provide the highest level of service possible.

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Company Name/POC	Sage Earth Science/Glen Carpenter 2300 North Yellowstone Hwy. Suite #206 Idaho Falls, Idaho 83401		
E-Mail Address	ses@srv.net		
Product/Service	Rapid Geophysical Surveyor	Phone Number	208 522-5049
Process Type	Geophysics/Hydrogeologic Measurements	Fax Number	208 523-1049

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: On site Non-intrusive

Brief Description: The Rapid Geophysical Surveyor (RGS) is a unique technology jointly developed by Sage Earth Science and the U.S. Department of Energy. The system will cost effectively collect very closely spaced magnetic field data. Such surveys are commonly performed to locate buried objects such as 55-gallon steel drums, underground storage tanks, buried waste, unexploded ordnance, utilities, abandoned wells, and rebar. Conventional magnetic field surveys are typically conducted with 1 to 4 meters between data points. The RGS will collect data on profiles spaced as little as 0.5 meter apart with less than 0.1 meters between stations and do so at brisk walking speeds. This produces a dramatic increase in resolution of the data and lowers the cost of the survey through significantly higher productivity.

Product/Service Maturity: Commercial use experience

Performance History: The RGS was first reduced to practice in 1992. Its development was driven by the need for affordable high resolution magnetic field data. The RGS was initially demonstrated at two Dept. of Energy INEL sites, within the Radioactive Waste Management Complex. Subsequently, the systems performance was tested and verified at the Cold Test Pit, a carefully controlled buried waste test plot, also at the INEL. At that time the system produced high quality results in a controlled test environment. Since that time, the RGS technology has been transferred to the private sector. It has been used at many different environmental sites at the INEL, including two additional sites at the RWMC and numerous other locations. The RGS system has also been used to characterize two Environmental Protection Agency (EPA) Superfund sites, 38 locations at the United States Marine Corps Camp Pendleton, for the Department of Defense, and two other DOE facilities, Los Alamos National Laboratory in New Mexico and Brookhaven National Laboratory in New York as well as private sites. At each of these locations, low cost detailed magnetic field maps were produced to assist in the characterization of the sites.

Comments: The system is very portable so has no significant mobilization costs. The equipment is normally transported as checked airline baggage that travels with a standard field crew of two. Typical production rates achieve 5 to 10 acres per day. This means that most waste sites can be mapped in great detail at a low cost.

Source of Information: Vendor

Company Name/POC	Sensidyne, Inc./Sales Department 16333 Bay Vista Drive Clearwater, Florida 34620		
E-Mail Address			
Product/Service	Sensidyne FID Portable Hydrocarbon Monitor	Phone Number	800 451-9444
Process Type	Sensors/Field Analysis Equipment	Fax Number	813 539-0550

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Off site On site

Brief Description: The Sensidyne portable monitor uses a flame ionization detector to monitor total hydrocarbons/VOC's. A GC version is available to identify specific contaminants. The FID is rugged, portable and lightweight and offers a fast response time for rapid and accurate surveys. Three measuring ranges are incorporated on the FID, providing comprehensive measuring range of 0.1 to 10,000 ppm. An optional range extender is available which provides an increased measuring range up to 100,000 ppm.

Product/Service Maturity: Commercial use experience

Performance History: Product has been on the market over five years. An intrinsically safe version has been available about two years.

Comments: To achieve the valuable intrinsic safety rating, the FID incorporates flame arrestors on every entry and exit site to the flame chamber, providing maximum safety in potentially explosive situations. Sensidyne's FID has been certified using disposable alkaline batteries, which provide up to 40 hours of operation. Rechargeable batteries are optional and provide up to 16 hours of operation. The unit comes equipped with a standard multi-purpose sampling probe which allows for general surveying or pinpoint sampling. While most instruments require two (2) individual probes for these different sampling applications, Sensidyne's FID can accomplish both using the same probe. Sensidyne also offers an optional roller probe for use in situations that call for walking surveys on pavement and walkways.

When used with the GC version of the standard FID, the Integrgraph software package allows the operator to analyze gas samples, either graphically or in tabular form. It calculates retention times, peak areas, ratios and relative percentage values, either logarithmically or in a linear format, depending on the individual requirements.

Characterization

The information is digitally analyzed, providing information that is more precise and easier to evaluate than that from a chart recorder.

Source of Information: Vendor

Company Name/POC	Sensidyne, Inc./Sales Department 16333 Bay Vista Drive Clearwater, Florida 34620	
E-Mail Address		
Product/Service	Sensidyne Hazcat Kit/Sales Department	Phone Number 800 451-9444
Process Type	Sensors/Field Analysis Equipment	Fax Number 813 539-0550

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: The Hazcat Kit is designed specifically for use by emergency response teams for on-site identification and classification of virtually any unknown spilled or abandoned material - liquid or solid. The Kit uses a decisive step-by-step test and conclusion to identify over 1,000 different chemical substances. The system consists of 47 easily performed field tests, used in conjunction with a series of easy to follow, step-by-step diagrams and charts. The user is guided through a series of "decision-tree" type tests and based on the outcomes, arrives at the final identification of the chemical hazard.

Product/Service Maturity: Commercial use experience

Performance History: Used by Hazmat teams across the country including municipalities; U.S. Navy, Marines, Coast Guard, Air Force; utility companies, defense industry, and Westinghouse Hanford Company.

Comments: The kit contains all the required reagents, detector tubes, glassware, charts and diagrams and utilizes the field-proven Sensidyne/Gastec detector tube sampling system. The complete Hazcat Kit can be stowed in an emergency response vehicle for instant accessibility. Immediate results can be obtained in minutes so that clean-up procedures, if necessary, can be started quickly with confidence. Optional professional training is available and recommended to provide optimum proficiency and safety while using the Hazcat System.

Source of Information: Vendor

Company Name/POC Sensidyne, Inc./Sales Department
16333 Bay Vista Drive
Clearwater, Florida 34620

E-Mail Address

Product/Service Sensidyne/Gastec Detector Tubes

Phone Number 800 451-9444

Process Type Sensors/Field Analysis Equipment

Fax Number 813 539-0550

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: On site

Brief Description: A hand operated pump is used to draw an air sample through a glass tube containing reagents chosen to detect a specific target gas or gases. These reagents are contained on fine-grain silica gel, activated alumina, or other absorbing media. Sensidyne/Gastec detector tubes are the "direct-reading" type, with calibration markings right on the tube, so measurements can be made as simply and precisely as reading a thermometer. The reagent reacts quantitatively to provide a length-of-stain indication. The farther the color-stain travels along the tube, the higher the concentration of gas.

Product/Service Maturity: Commercial use experience

Performance History: Detector tubes have been used by OSHA and by private industry in worker exposure monitoring and process measurements for many years. A performance certification system is operated by the Safety Equipment Institute (SEI).

Comments: Sensidyne/Gastec offers direct-reading tubes for over 280 substances. Two critical factors affecting the accuracy of detector tube measurements are: the flow rate and the volume of air drawn through the tube by the pump. Designed for reliability and accuracy the Sensidyne/Gastec pump draws the same sample with every stroke. Designed to be fail-safe, the handle precisely locks at either 50 cc or 100 cc. This design virtually eliminated incomplete samples, which can occur with squeeze-type pumps when they are not fully collapsed.

Source of Information: Vendor

Company Name/POC	Sensor Electronics Corporation/Alan Petersen 5500 Lincoln Drive Minneapolis, Minnesota 55436		
E-Mail Address			
Product/Service	SEC 2000/SEC 1500 Oxygen, Combustible and Toxic Gas Detectors	Phone Number	612 938-9486
Process Type	Sensors/Field Analysis Equipment	Fax Number	612 938-9617

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ

Brief Description: The Sensor Electronics Corporation gas detection products serve a wide range of industrial markets. Sensor Electronics ability to not only listen, but actually hear customers needs allows us to supply the most innovative gas detection products found in the market today. This system provides low cost installation. Sensor Electronics offers over 20 different gas detectors that can be installed on the same data highway. Software packages are available to provide gas detection system overviews, detailed data logging reports, trending, and alarm reports. Information from the gas detection system can also be sent to a variety of control system hardware including programmable logic controllers and distributive control systems.

Product/Service Maturity: Commercial use experience

Performance History: Customer user list and application notes are available.

Comments: The SEC gas detectors are designed to monitor for combustible or toxic gases. Each SEC gas detector has an RS-485 data highway port. This unique feature greatly reduces the installation cost and provides an information link from the gas detection network to the plant control system. Each gas detector is equipped with an RS-485 data highway output allowing the gas detectors to communicate with each other and the system monitor on a data highway. For retrofitting existing gas detection equipment, an industry standard 4 to 20 mA analog output is a standard feature allowing the SEC gas detectors to be used as standalone units. Optional relay contacts for Low, Mid, High and Fault conditions are available for actuating field devices.

Programming and calibration is easily accomplished by using the SEC 2500 hand held programmer. The SEC 2500 communicates to SEC 2000 gas detectors using a bi-directional infrared communication link is established between one detector and the hand held programmer, the hand held programmer can communicate with any gas detector on the RS-485 data highway.

Source of Information: Vendor

Company Name/POC	Sensors & Software Inc./Steve Cosway 1091 Brevik Place Mississauga, ON L4W 3R7 Canada		
E-Mail Address			
Product/Service	Ground Penetrating Radar (GPR)	Phone Number	905 624-8909
Process Type	Geophysics/Hydrogeologic Measurements	Fax Number	905 624-9365

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Company Name/POC	Siemens Environmental Systems Ltd./Dr. W.E. Croydon Sopers Lane, Poole Dorset, BH 17 7ER England		
E-Mail Address			
Product/Service	SIGNATURE Gamma Radionuclide Detection and Analysis System	Phone Number	44 1202 782648
Process Type	Sensors/Field Analysis Equipment	Fax Number	44 1202 782157

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service Maturity: Field demo complete

Performance History: Trial systems for on-line fission product monitoring have been installed on three UK Power Station, both AGR and MAGNOX, and other PWR nuclear plant. 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%. 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. A trial system for environmental monitoring has been configured to detect atmospheric contamination, suitable for the UK national RIMNET 2 emergency response system. Laboratory evaluation has detected radionuclides at levels of a few Becquerels, and further improvements are under consideration.

Comments: This is a flexible system which can be tailored to meet the needs of a specific application. It may be stand-alone or connected to a network for remote operation. Trials have been carried out involving several isotopes, however, the system is not limited to available test isotopes, but will detect any gamma emitting radionuclide through the use of library data.

Discussions are underway with the Geosciences Advisory unit at Southampton University, UK with a view to combining a scintillation well detector and automated sample 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.

Source of Information: Vendor

Company Name/POC SiteView Software Inc./David Barber
297 Boston Post Road
Suite 203
Wayland, Massachusetts 01778

E-Mail Address

Product/Service

SiteView

Phone Number 508 358-8061

Process Type

Decision Support Tools

Fax Number 508 358-8065

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Other Application

Brief Description: PC-based software for decision support in site assessment and remediation. SiteView replaces slow, low-productivity manual data management and visualization techniques and point solution software systems.

Product/Service Maturity: Commercial use experience

Performance History:

Comments:

Source of Information: Vendor

Company Name/POC	SiteWorks, Inc./Mr. Jorgen Vestergaard 801 Main Street Wayside Square #7 Concord, Massachusetts 01742	
E-Mail Address		
Product/Service	Integrated Rapid Physical/Chemical Analysis	Phone Number 508 369-5646
Process Type	Sensors/Field Analysis Equipment	Fax Number 508 369-5714

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: Provide interactive program design and implementation for environmental restoration projects using a combination of alternative sample collection, chemical analysis, and geophysical techniques. Interactive approach includes rapid and quantitative on-site chemical analysis for EPA target compounds, including PCBs, PAHs, pesticides, explosives, and metals. Each analysis can be completed in 10-30 minutes. Data quality is suitable for contamination and risk assessment, engineering design, treatability studies, and litigation, if required.

Product/Service Maturity: Commercial use experience

Performance History: By itself or in partnership with Tufts University, SiteWorks has provided field analytical support for more than two dozen Superfund site restoration projects. These include:

- Army - Fort Devens (2 months)
- Navy - San Diego Harbor (3 weeks)
- Navy - Yuma, Arizona (6 months)
- Tenneco - Kentucky (1 month)
- Army - Joliet, Illinois (3 weeks)
- Air Force - Hanscom AFB, Massachusetts (2 weeks)
- Numerous EPA projects

Performance data are available on request.

Comments: Combination of tools, techniques, and approach can reduce typical restoration project time and costs by up to 70%. Unique GC/MS data interpretation software, in combination with thermal desorption and other rapid sample preparation and introduction techniques, allows for generation of high quality quantitative data

Source of Information: Vendor

2008-06-20

4-75425-2

THE UNIVERSITY OF CHICAGO
CHICAGO, ILLINOIS 60637

1950-1951
1952-1953
1954-1955

1. *Indikator* adalah alat ukur yang digunakan untuk mengukur suatu variabel yang abstrak atau konseptual menjadi bentuk yang konkret atau terukur. Indikator berfungsi sebagai jembatan antara konsep yang abstrak dengan data yang dapat diukur.

Address: _____

THE SECRETARY OF DEFENSE HAS AUTHORIZED THE DEPARTMENT OF DEFENSE TO REPLY TO THE FOLLOWING REQUEST FOR INFORMATION:

Company Name/POC	Skinstrument A/S Pollution Control/Tor Anders Petteroe Trykkeriveien 8 N-1653 Sellebark Norway	
E-Mail Address		
Product/Service	BioTector - On-line Analyser for Total Organic Carbon	Phone Number 47 69 36 32 90
Process Type	Sensors/Field Analysis Equipment	Fax Number 47 69 36 32 95

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: TOC analyzers especially designed to perform reliably in industrial on-lie applications. No filtration required. Long term stable operation experienced. No interference from chloride.

Product/Service 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 analyzer. 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 analyzer 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 analyzer is made of high quality components and materials. All cabinets are made of stainless steel. Unlike most TOC analyzers, 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 analyzers. All operations are made by step by step menus presented on a touch screen.

Characterization

Characterization

Company Name/POC Soil Technology/Harold Benny
7865 NE Day Road West
Bainbridge Island, Washington 98110

E-Mail Address

Product/Service Geotechnical Testing

Phone Number 206 842-8977

Process Type Laboratory Analysis

Fax Number 206 842-9014

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Off site On site

Brief Description: Laboratory testing for basic geotechnical properties on contaminated samples.

Product/Service Maturity: Commercial use experience

Performance History: Considerable experience on a variety of sites.

Comments: None.

Source of Information: Vendor

Company Name/POC Soil Technology/Harold Benny
7865 NE Day Road West
Bainbridge Island, Washington 98110

E-Mail Address

Product/Service

Treatability Testing

Phone Number 206 842-8977

Process Type

Laboratory Analysis

Fax Number 206 842-9014

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Laboratory treatability studies, using site-specific test parameters for low temperature thermal desorption, stabilization/solidification, bioremediation, soil washing/chemical extraction, and SVE.

Product/Service Maturity: Pilot plant testing

Performance History: We have performed treatability studies for a number of sites. Each site had specific contaminants and goals.

Comments: None.

Source of Information: Vendor

Company Name/POC Solomat/Neotronics/Customer Service
26 Pearl Street
Norwalk, Connecticut 06850

E-Mail Address IAQ@SOLOMAT.com

Product/Service Sensors/Field Analysis Equipment

Process Type Sensors/Field Analysis Equipment

Phone Number 203 849-3111

Fax Number 203 847-9320

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: On site

Brief Description: Manufacturer of air and water quality monitoring instrumentation.

Product/Service Maturity: Commercial use experience

Performance History: Performance data are available.

Comments: None.

Source of Information: Vendor

Company Name/POC	Steins Laboratorium A/S/Viggo Larsen Olof Palmes Alle 13a 8200 Aarhus N Denmark	
E-Mail Address		
Product/Service	Mapping of Soil/Groundwater Pollution	Phone Number 45 86 10 80 70
Process Type	Sensors/Field Analysis Equipment	Fax Number 45 86 10 88 89

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: Mobile laboratory.

Product/Service 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

Company Name/POC	SVS Environmental Systems, Inc./Maria Arrieta 6207 Pan American Freeway, NE Albuquerque, New Mexico 87109-3425		
E-Mail Address	marrieta@svsinc.com		
Product/Service	EnvironAIDE (TM)	Phone Number	505 345-5451
Process Type	Decision Support Tools	Fax Number	505 345-8303

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: EnvironAIDE (TM) provides advanced automous control utilizing PC microprocessor-based systems. Significant flexibility exists to adapt the system to multiple environmental restoration/waste management processes and to optimize performance during the life of the project.

Product/Service Maturity: Commercial use experience

Performance History: Provided process control and monitoring for three soil vapor extraction installations in New Mexico in 1995/96. Enabled remote access to optimize efficiency of extraction system performed well. Four systems installed as a retrofit at an SVE site in M Area at the Savannah River Site in South Carolina in late FY-96, checkout/testing now underway.

Comments: None.

Source of Information: Vendor

Company Name/POC	Teledyne Electronic Technologies/Vince Tabone 1274 Terra Bella Ave. P.O. Box 7244 Mountain View, California 94039-7244	
E-Mail Address		
Product/Service	Ion Trap Mass Spectrometer	Phone Number 415 962-6526
Process Type	Sensors/Field Analysis Equipment	Fax Number 415 967-4353

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: The Teledyne 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 TET Ion Trap Mass Spectrometer will permit field measurements of environmental contaminants in lieu of laboratory analysis.

Product/Service Maturity: Field demo complete

Performance History: Field evaluations of the TET 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 TET 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 TET 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 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

Characterization

be available by mid-1993. TET 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: Vendor

Company Name/POC	Telog Instruments, Inc./Stephen Lembaris 830 Canning Parkway Victor, New York 14564		
E-Mail Address			
Product/Service	Level Tracker, Telogers	Phone Number	716 742-3000
Process Type	Geophysics/Hydrogeologic Measurements	Fax Number	716 742-3006

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Off site On site

Brief Description: Telog manufactures economical paperless recorders for deep well level monitoring. All are programmable and record data digitally. The WLS-2102e and WLS-2109e are single-input recorders that operate for two years with supplied batteries and measure water level with either a transmitter sensor or strain gauge transducer. Each unit measures 5.6 cm x 7.4 cm x 22.4 cm and fit inside a 10 cm well. Collected data may be copied to a PC where Telog support software provides graphic and tabular analyses.

Product/Service Maturity: Commercial use experience

Performance History: Performance data are available.

Comments: Setup and installation of a Level Tracker and pressure sensor can be accomplished in less than an hour. The pressure sensor used by a Level Tracker consists of a strain gauge bridge that changes resistance with level. To compensate for the effects of atmospheric pressure, a sensor vent tube is used. With the sensor vented to the atmosphere, atmospheric pressure acts on both sides of the sensor diaphragm simultaneously. On one side, it is added to the well head pressure. On the other side, it acts directly on the sensor's backside. Equal forces cancel to zero to nullify the effect. Multiple sensor options are available for use in a variety of well sites and Teflon cable may be used in highly contaminated sites.

Source of Information: Vendor

Characterization

Source of Information: Vendor

Company Name/POC TN Technologies/Spectrace Instruments/Jim Moore
1275 Hammerwood Ave
Sunnyvale, California 94089

E-Mail Address

Product/Service

X-Ray Fluorescence

Phone Number 408 744-1414

Process Type

Sensors/Field Analysis Equipment

Fax Number 408 744-1313

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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.

Characterization

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: Vendor

Company Name/POC	Triangle Laboratories, Inc./Phil Fields 801 Capitola Drive Durham, North Carolina 27713	
E-Mail Address	75352.2421.compuserve.com	
Product/Service	Published EPA Methods	Phone Number 919 544-5729 x260
Process Type	Laboratory Analysis	Fax Number 919 544-5491

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Off site

Brief Description: Full service contract Laboratory using EPA-approved analytical methods. Triangle Laboratories can offer a unique solution or many low detection limit requirements because of high resolution mass spectrometry (HRMS) capabilities. The use of HRMS provides lower analyte detection limits which can be of vital importance. Current HRMS capabilities include dioxins/furans, PAHs, PCBs and pesticides.

Product/Service Maturity: Commercial use experience

Performance History: Founded in 1984.

Triangle Laboratories has developed extensive experience over the last five years analyzing marine and dredged sediments as well as saltwater and marine biota. Triangle Laboratories has performed analyses on over two dozen projects where environmental contaminants within port or harbor areas have been a concern. Previous clients for dredging and marine sediment projects include the Port Authority of New York and New Jersey, Charleston Harbor Authority, The US Army Corps of Engineers (NY Division) as well as many commercial clients.

Comments: None.

Source of Information: Vendor

Company Name/POC Triumph/Phillip Gardner
4004 Wesbrook Mall
Vancouver, B.C, Canada, V6T 2A3

E-Mail Address

Product/Service Accelerator Mass Spectroscopy (AMS)

Phone Number 604 222-1047

Process Type Laboratory Analysis

Fax Number 604 222-1074

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On site

Brief Description: This instrument measures the relative abundance of carbon 14/12, Iodine 129/122, etc. to better than 1 part in 1E15.

Product/Service 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

Company Name/POC	Troxler Electronic Laboratories/Eric Dunlap P.O. Box 12057 Research Triangle Park, North Carolina 27709	
E-Mail Address		
Product/Service	Model 4350 Depth Moisture/Density Gauge	Phone Number 919 549-8661
Process Type	Remote Sensing	Fax Number 919 549-0761

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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. Loznie Everett, Geraghty & Miller, Santa Barbara, CA 805 687-7559 or John Kramer, Condor Earth Technologies, Sonora, CA 209 532-0361 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: Vendor

Company Name/POC	TSI Incorporated/Roger D. Williams P.O. Box 64394 St. Paul, Minnesota 55164		
E-Mail Address	rwilliam@tsi.com		
Product/Service	Chlorinated Hydrocarbon Monitor	Phone Number	612 490-2863
Process Type	Sensors/Field Analysis Equipment	Fax Number	612 490-2704

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: This unique rare-earth sensor detects and measures contaminants such as carbon tetrachloride, trichloroethylene, 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.

Product/Service 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
DOE-INEL Soil gas survey/Kirk Dooley/Litco/208 526-2068

Comments: This instrument, identified as the RCL Monitor, detects and measures chlorinated hydrocarbon vapors to 100 ppm with a lower detection limit of 0.5 ppm. The RCL Monitor responds to all chlorinated compounds only but does not identify the specific chlorinated compound present. This inherent selectivity of the sensing device eliminates the ambiguity found in other measurement devices which respond to contaminants such as gasoline, methane, and other non-chlorinated chemicals commonly present. Real-time monitoring and selectivity permit quick analysis of the contamination situation, evaluation of safety conditions, and timely decision making. The RCL Monitor was developed by Transducer Research, Inc., a subsidiary of TSI Incorporated.

Source of Information: Vendor

Company Name/POC	U.S. Filter/Enviroscan/Doug Shubring 303 West Military Rd. Rothschild, Wisconsin 54474		
E-Mail Address			
Product/Service	Geoprobe/Mobile Lab	Phone Number	715 359-7226
Process Type	Sensors/Field Analysis Equipment	Fax Number	715 355-3221

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service 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 U.S. Filter/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. U.S. Filter/Enviroscan has no experience in handling this type of material.

Source of Information: Vendor

Company Name/POC	Uranium Resources Inc. (URI)/Mike Russel 5656 South Staples Suite 25 LB8 Corpus Christi, Texas 78411		
E-Mail Address			
Product/Service	Prompt Fission Neutron Logging	Phone Number	512 993-7731
Process Type	Remote Sensing	Fax Number	512 993-5744

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Detects presence of and quantity of thermal neutron fissionable radionuclides in situ.

Product/Service 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 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: Vendor

Company Name/POC	Viking Instruments Corporation/Thomas J. Kuehn 3800 Concord Parkway Suite 1500 Chantilly, Virginia 22021	
E-Mail Address		
Product/Service	Gas Chromatograph/Mass Spectrometer (Field GC/MS)	Phone Number 703 968-0101
Process Type	Sensors/Field Analysis Equipment	Fax Number 703 968-0166

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor
Environmental Cleanup Privatization
Products and Services Directory

January 1997
C 209

Company Name/POC	WASTECHEM Ltd/Dr. M.G. Down		
	Earl Road		
	Stanley Green		
	Wilnslow		
	Cheshire, SR93RL, UK		
E-Mail Address			
Product/Service	LAPS Probe for Detection of Radionuclides in Soil	Phone Number	161 485 8231
Process Type	Sensors/Field Analysis Equipment	Fax Number	161 482 8137

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service 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 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: Vendor

Company Name/POC	Water Protection International/Ron Kreig 16404 Smokey Point Boulevard Suite 303 Arlington, Washington 98223		
E-Mail Address			
Product/Service	RESONANT SONIC (SM) DRILLING	Phone Number	360 653-4844
Process Type	Drilling	Fax Number	360 653-7456

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: The Resonant Sonic (SM) drilling method is an innovative and cost effective approach to environmental drilling applications. The technology is hydraulically driven, and incorporates a sonic drill head. Series of high frequency sinusoidal wave vibrations are generated into a steel drill pipe, creating a cutting action at the bit face. The tremendous forces produced by the resonant head and the external flush nature of the specialized drill pipe force material displaced by the bit into the borehole wall. The result, no drilling spoils. It is also possible to resonate a closed-end steel pipe into the ground, displacing formation media similar to a pile driver. Resonant Sonic (SM) drilling can produce boreholes of various depths and dimensions, yield continuous, relatively undisturbed cores, and requires no air, mud, water, or other circulatory medium for drilling. The method is extremely fast (up to one foot per second in certain formations), and can drill through virtually any media from horizontal to vertical. Again, this is with no drilling spoils.

Product/Service Maturity: Commercial use experience

Performance History: Current use at:

Beale AFB, CA for the U.S. DOD

Sandia Laboratories, Albuquerque Facility

Hanford, Washington Facility

Rocky Flats Facility, Colorado

Pantex Facility, Texas for U.S. DOE

Continual development with Westinghouse Hanford Company, Richland, WA, and involvement with Sandia Laboratories Technology Transfer Program with the U.S. DOE

Comments: A major advantage that RKK brings to any potential environmental site project is cost efficiency. Underground drilling comprises 40%-50% of a containment or remediation installation's cost. RKK incorporates various drilling techniques to install its containment and remediation technologies, which are evaluated to match

Environmental Cleanup Privatization

Products and Services Directory

January 1997

C 211

site requirements in the most cost effective approach, Resonant Sonic (SM) drilling will greatly reduce or eliminate drilling spoils normally associated with boring underground holes. In most cases this equates to considerable savings should a site's drilling media contain radioactive substances. The health and safety of installation personnel and the environment greatly benefit from this process.

Water Protection International was formed between RKK, Ltd. and the Water Development Corporation in order to provide turnkey service to clients in the containment marketplace. Each company has licensed their respective technologies to allow WPI to pursue barrier or containment project opportunities as a complete environmental service company. The RKK, Ltd. division provides the containment and remediation technologies, including technical and managerial expertise. The Water Development Corporation, a full service drilling company, provides the necessary drilling technologies with extensive environmental drilling experience, including the health science and safety experience to work at radioactive sites.

Source of Information: Vendor

Company Name/POC	Westbay Instruments Inc./Rob Weiss 949 W. Third Street Unit 115 North Vancouver, B.C., Canada, V7P3P7		
E-Mail Address	75060.3304@CompuServe.COM		
Product/Service	Westbay MP System	Phone Number	800 663-8770
Process Type	Physical Sampling	Fax Number	604 984-3538

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone) Other Application

Brief Description: Multi-level groundwater monitoring systems - well 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 and conducting cross-hole interference tests. Incorporates borehole casings, packers, valved couplings, and associated wireline probes and tools. Replaces individual monitoring wells drilled to separate depths - reduces cost and schedules for site characterization and monitoring. Allows collection of fluid samples without repeated purging - reduces costs of handling purge fluids.

Product/Service Maturity: Commercial use experience

Performance History: Proven technology with excellent track record at a number of high profile sites in the U.S., Canada, and overseas. Considerable experience on high level nuclear waste sites. The 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 include the Airforce, EPA, NASA, Navy, Panama Canal Commission, 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 140 degrees F. The MP System (R) is modular in design and thus provides considerable versatility in the design of groundwater monitoring wells. The hardware is readily available and is easy to use with a small amount of training from Westbay. Very little infrastructure is required, apart from drillholes and storage or vehicle/trailer mounting of the portable wireline equipment. The major challenge facing this technology is simply lack of awareness of the availability, function and capabilities of the system. Coordination between the site operator, consultants, drillers and Westbay is helpful during implementation.

Source of Information: Vendor

Characterization

Company Name/POC	WISMUT GmbH/A. T. Jakubick [Waterloo Hydrogeologic/Thomas Franz] 09117 Chemnitz Jagdschanken-strabe 29 WATERLOO HYDROGEOLOGIC 19 McCauley Dr./Bolton, Ontario, Canada L7E 5B8	
E-Mail Address		
Product/Service	Vacuum Permeability (VacPerm)	Phone Number 49 371 8120 112
Process Type	Sensors/Field Analysis Equipment	Fax Number 49 371 8120 107

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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]

Product/Service 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, Kyushu, 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

*Environmental Cleanup Privatization
Products and Services Directory*

January 1997
C 215

Characterization

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: Vendor

Company Name/POC	WISMUT GmbH/A. T. Jakubick [Waterloo Hydrogeologic/Thomas Franz] 09117 Chemnitz Jagdschanken-strabe 29 WATERLOO HYDROGEOLOGIC 19 McCauley Dr./Bolton, Ontario, Canada L7E 5B8		
E-Mail Address			
Product/Service	Visual Airflow 3-D Gas FlowModelling	Phone Number	49 371 8120 112
Process Type	Decision Support Tools	Fax Number	49 371 8120 107

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On 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]

Product/Service 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 modeling 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: Vendor

Company Name/POC	WISMUT GmbH/A. T. Jakubick [Waterloo Hydrogeologic/Thomas Franz] 09117 Chemnitz Jagdschanken-strabe 29 WATERLOO HYDROGEOLOGIC 19 McCauley Dr./Bolton, Ontario, Canada L7E 5B8	
E-Mail Address		
Product/Service	Vacuum Permeability (VacPerm)	Phone Number 49 371 8120 112
Process Type	Geophysics/Hydrogeologic Measurements	Fax Number 49 371 8120 107

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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]

Product/Service 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, Kyushu, 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

January 1997

C 218

Environmental Cleanup Privatization
Products and Services Directory

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: Vendor

1. The first of these is the fact that the
entire population of the United States is
now being subjected to a process of
socialization which is entirely new
in the history of the world.

Extraction/Delivery/Materials Handling

Extraction/Delivery/Materials Handling

Company Name Index

A

A.P. van den Berg B.V., 1
Accutech Remedial Systems Incorp., 2
Alba Industrie Umweltschutz Service GmbH, 4
American Engineering Manufacturers, 5
Applied Membrane Technology, Inc., 6
Applied Research Associates, Inc., 8, 9, 10
ARK Enterprises Inc., The, 11

B

Bay Marketing, 12
Bio-Genesis Technologies, Inc., 13

C

CHEM-SECURITY (Alberta) Ltd., 14
Concept Engineering Group, Inc., 15
Croll-Reynolds Co., Inc., 16

D

Dames & Moore, Inc., 17
Drilex Systems, Inc., 18

E

Earth Remediation Services, Inc., 19, 20, 21
Edwards Engineering Corporation, 22
Extec Screens and Crushers, 23

F

Fabrico Environmental Liners, Inc., 24
Filter Flow Technology, Inc., 25
FKC Co., Ltd., 27
Flexible Liner Underground Tech., Ltd., 28
FlowTex GUT GmbH, 29

G

Gemstone Enviromental, 30
Geotech Environmental, 31
Great Lakes Environmental, Inc., 32, 34
Groundwater & Environmental Services, Inc.
(GES), 36, 37

H

Hansa Projekt Anlagentechnik GmbH, 38, 39
Haz-Mat Containment Corporation, 41
High Plains Consortium, Inc., 42
Hofstetter Umwelttechnik AG, 43
Horizontal Technologies, Inc., 44
Hudson Industries, 45
hydroGEOPHYSICS, 46

I

INTERA, Inc., 48, 50

International Reserve Equipment Corporation, 52
International Submarine Engineering LTD., 53

J

JWC Environmental, 54

K

Keck Instruments, 55, 56, 57
KEMA Nederland B.V., 58
Kernkraftwerke Gundremmingen, 60
Kinetic Sciences Inc., 61

L

Lopata Technical Service Corp., 62

M

Magnox Electric, 63, 64
Malcolm Pirnie, Inc., 65
Microfluidics Corp., 66
Modulaire Ltd., 67, 69

N

Nuclear Decommissioning LTD., 71

O

Oil Skimmers, Inc., 72
Ontario Hydro Technologies, 73
ORS Environmental Systems, 76
OR-TEC, Inc., 74, 75

P

Packaging Research and Design Corporation, 77
Power Fluidics, 78, 79
Power Plant Service, Inc., 80, 81
Pulse Drying Systems, Inc., 82

R

Rasmussen & Shioetz Anlaeg A/S, 83
Recra Environmental, Inc., 84
Remediation Service International (RSI), 85, 86
RMJ Machinery, 87
RSI Research Ltd., 88
Rusmar Incorporated, 89

S

Safe Enviornmental Storage, 91
Siemag Transplan GmbH, 92
Sprung Instant Structure, 93
Star Systems Filtration Division, 94
Stord, Inc., 95
Superior Industrial Maintenance Company, 96

Company Name Index (continued)

T
Teknisk Illustration HB, 97
telerob GmbH, 98, 99

V
VAC-U-MAX, 100

W
W.S. Atkins Consultants Ltd., 101

Process Type Index

Dewatering, 13, 21, 25, 27, 30, 36, 52, 74, 81, 84, 86, 94, 95
Directional Wells, 18, 29, 83
Dust Control, 46, 79
Emission Control, 16, 89
Excavation, Retrieval, and Off-Site Disposal, 14, 15, 19, 64, 92
Free Product Recovery, 12, 17, 20, 22, 31, 32, 37, 42, 48, 50, 55, 56, 57, 76, 85
Injection/Delivery Systems, 1, 6, 8, 9, 10, 28, 44, 73, 78
Oil/Water Separation, 11, 34, 45, 62, 72
Other, 4, 5, 24, 39, 41, 43, 69, 75, 77, 82, 87, 91, 93, 96, 100
Pneumatic Fracturing, 2, 65
Robotics, 53, 61, 63, 67, 71, 88, 98, 101
Size reduction, 23, 38, 54, 58, 60, 66, 80, 97, 99

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Company Name/POC	A.P. van den Berg B.V./ Engbert Welling 8440 AB Heerenveen Ijzerweg 4 The Netherlands.	
E-Mail Address		
Product/Service	Cone Penetrometer	Phone Number 31 513 631355
Process Type	Injection/Delivery Systems	Fax Number 31 513 631212

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: A full range of penetrometer equipment can be supplied varying from portable lightweight equipment for difficult accessible locations, to 25 tons truck mounted equipment. Applications are soil, water and gas sampling plus in-situ measurement of several parameters like: Cone tip resistance; local friction; inclination; pore water pressure; temperature; electrical cone conductance; pll-value; Redox; and hydro carbons.

Product/Service Maturity: Commercial use experience

Performance History: Contact company for performance data.

Comments: Contact in the U.S.A.:

A.P. van den Berg, Inc./Mr. Ed Brylawski/P.O. Box 654/8, Greenwood Hills/Milford, PA 18337
(717) 296-8224 / (717) 296-4886 (fax)

Source of Information: Vendor

Extraction/ Handling

Company Name/POC	Accutech Remedial Systems Incorp./John J. Liskowitz Cass Street, Hwy 35 Keyport, New Jersey 07735		
E-Mail Address			
Product/Service	Pneumatic Fracturing Extraction (R)	Phone Number	908 739-6444
Process Type	Pneumatic Fracturing	Fax Number	908 739-0451

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: The PF process is an in-situ enhancement process. 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. This creates an increased air permeability in the vadose zone and increased hydraulic conductivity and transmissivity in the saturated zone. The process has been shown to affect a radial distance as much as 65 feet away from an injection source. The process is highly applicable and cost effective when applied at sites where the geology consists of silts, clay, or fractured bedrock.

When integrated with in situ treatment technologies, air and fluid flow extraction rates and contaminant mass removal increases as much as several hundred times as compared to "pre-fracture" conditions have been observed. For saturated zone applications, transmissivity values have been demonstrated to increase several orders of magnitude. Pneumatic Fracturing has also been effectively used as an injection device for delivery of substances required for bioremediation.

Product/Service Maturity: Field demo complete

Performance History: Performance data are available. As of 4/1/96, thirty-six commercial field projects have been completed. Project sites varied by contaminant type, type of geology, (i.e., silts, clay, or fractured rock) and application zone (i.e., vadose or saturated zone). All field projects demonstrated increases in permeability and containment mass removal.

Comments: The PFE (R) technology was used at a USEPA SITE demonstration project at an industrial park in Somerville, NJ (Accutech Pneumatic Fracturing Extraction and Hot Gas Injection, Phase I, USEPA, July 1993). The PFE, used on shale, increased air flow 600 percent and increased the contaminant removal 675 percent. The PF enhanced Free Product Recovery technology was applied at a site in Oklahoma City, OK, where the geology consisted of tight clay. #2 Fuel Oil existing as free product was trapped within the clay. Application of the Pneumatic Fracturing technology increased the free product recovery from <0.5 gallons per day (gpd) to 8.6 gpd, a 1,620% increase.

Extraction/ Handling

Source of Information: Vendor

Extraction/ Handling

Company Name/POC	Alba Industrie Umweltschutz Service GmbH/Dr. K. Faber Rehrhoferweg 160 D29625 Munster Germany		
E-Mail Address			
Product/Service	Abrasive Water Jet Cutting Technology (A.S.J.T)	Phone Number	051 92 96 3212
Process Type	Other	Fax Number	051 92 96 3311

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service Maturity: Commercial use experience

Performance History: Working for two years in Russia and Germany.

Comments: None.

Source of Information: International TechCon

Extraction/ Handling

Company Name/POC	American Engineering Manufacturers/Customer Service 15886 Michigan Road Argos, Indiana 46501	
E-Mail Address		
Product/Service	Hi-tech Waste, Shower and Decontamination Units	Phone Number 219 892-5151
Process Type	Other	Fax Number 219 892-5150

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: All units have their own lighting and electric exhaust vent or air conditioning and patented fold-in-door steel steps with permanent attached handrails, plus exclusive epoxy lined steel holding tank with front and rear drain valves can be hooked to city sewage lines or can be pumped. Each compartment has a chrome plated floor drain which allows a complete scrub down using a hospital disinfectant or a steam cleaner. All walls are solid, coated in Kemlite and the floor is a seamless industrial grade vinyl.

Product/Service Maturity: Commercial use experience

Performance History: A selected list of users include: Ahern Painting, Browning-Fereis Industries (BFI), CLECO Painting, E.I. duPont de Nemours, Heritage Remediation, R.J. Romano Shipview Painting, National Science Foundation, Martin Marietta, U.S. Navy, VW DeMexico and Waste Management of North America (WMI),

Comments: Any of the units can be set-up by one service person in less than 10 minutes. A garden hose and a 110 volt electrical line are all that is necessary.

The company also manufactures a complete line of: A.D.A. Restroom Units, Dressing Room, Drug Screening, Environmental Labs, Food Service, Laundry Service, Mobile Homeless Shelters and Mobile Medical Waste Holding Units.

The basic #16 Decontamination Trailer will handle a crew of six (6) with units sized up to 24 people.

Source of Information: Vendor

Extraction/ Handling

Company Name/POC	Applied Membrane Technology, Inc./Stephen Conover		
	11558 Encore Circle		
	Minnetonka, MN 55343		
E-Mail Address			
Product/Service	AMT Membrane In-Situ Bubbleless Oxygenation	Phone Number	612 933 5121
Process Type	Injection/Delivery Systems	Fax Number	612 933-8839

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service 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

Extraction/ Handling

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: Vendor

Extraction/ Handling

Company Name/POC	Applied Research Associates, Inc./Linda Myers, Dir. of Mktg. 4300 San Mateo, NE Suite A-200 Albuquerque, New Mexico 87110	
E-Mail Address		
Product/Service	Cone Penetrometer Platform/Fuel Fluorescence Detector	Phone Number 505 881-8074
Process Type	Injection/Delivery Systems	Fax Number 505 883-3673

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Technology combines cone penetrometer and surface geophysics to permit a real-time, three-dimensional site characterization approach on soil sites.

Product/Service 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. 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. 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.

ARA holds a license for fuel fluorescence technology. ARA's FFD detects the fluorescence produced by hydrocarbons when excited by an ultraviolet light source. Pushed with CPT equipment, it will drastically cut the time needed to delineate the extent of hydrocarbon plumes from fuel spills or leaking storage tanks.

Source of Information: Vendor

Extraction/ Handling

Company Name/POC	Applied Research Associates, Inc./Linda Myers, Dir. of Mktg. 4300 San Mateo, NE Suite A-200 Albuquerque, New Mexico 87110	
E-Mail Address		
Product/Service	Cone Penetrometer Platform/ConeSipper	Phone Number 505 881-8074
Process Type	Injection/Delivery Systems	Fax Number 505 883-3673

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Technology combines cone penetrometer and surface geophysics to permit a real-time, three-dimensional site characterization approach on soil sites.

Product/Service 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. 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. 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.

ARA holds a license for the ConeSipper; technology developed through a CRADA between Westinghouse Savannah River, Co., and ARA. The ConeSipper can be attached directly behind a standard CPT cone to obtain gas of water samples as the CPT probe is advanced, saving substantial money and time by eliminating duplicate soundings.

Source of Information: Vendor

Extraction/ Handling

Company Name/POC	Applied Research Associates, Inc./Linda Myers, Dir. of Mktg. 4300 San Mateo, NE Suite A-200 Albuquerque, New Mexico 87110		
E-Mail Address			
Product/Service	Cone Penetrometer Platform	Phone Number	505 881-8074
Process Type	Injection/Delivery Systems	Fax Number	505 883-3673

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Débris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Technology combines cone penetrometer and surface geophysics to permit a real-time, three-dimensional site characterization approach on soil sites.

Product/Service 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. 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. 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: Vendor

Company Name/POC	ARK Enterprises Inc., The/Steve Snyder P.O. Box 725 Peculiar, Missouri 64078	
E-Mail Address	kc200358@sshare.com	
Product/Service	Oil Spill Cleanup Products, Soil Remediation	Phone Number 800 872-5741
Process Type	Oil/Water Separation	Fax Number 800 473-5741

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: On site

Brief Description: Exsorbet is sphagnum peat moss that is specially dried and augured for maximum absorption. The cellular structure draws hydrocarbons inside its capillaries. This encapsulation of hydrocarbons in small micron-sized droplets allows for the natural break-down of hydrocarbons to occur at an accelerated rate. It is hydrophobic, therefore its absorption of hydrocarbons is efficient and effective in multiple applications.

Product/Service Maturity: Commercial use experience

Performance History: Exsorbet has been used by many companies in various industries of varying experience and technical knowledge. Commercial users are in the aircraft, manufacturing, and trucking industries, Fire Departments (HazMat Teams) and spill response and environmental technology companies. Military usage has included soil remediation, dam maintenance, and fuel spill response in Operation Joint Endeavor.

Comments: Exsorbet can be used to: clean oil spills on water and land, transport contaminated hydrocarbons, fuel blending clean up work stations and facilities, remediate soil contamination, and deliver various microbes to remediate different contaminants. Exsorbet encapsulates and secures hydrocarbons and does not leach them back into the environments.

Exsorbet is available in loose particulate as well as pads, socks & booms and a variety of spill response kits. While Exsorbet excels technologically over all other absorbents, it has also demonstrated superior cost savings. Its ease of disposal, volume reduction at pick-up, and initial low prices have lowered overall costs for companies. **Safety:** Exsorbet has no known health risks itself, causes vapor reduction on contact, has low static charges, and encapsulates other contaminants with hydrocarbons.

Source of Information: Vendor

Company Name/POC	Bay Marketing/Barclay Kedslake P.O. Box 130 Callender, Ontario, Canada P0H 1H0		
E-Mail Address			
Product/Service	CAP (TM)	Phone Number	800 461-9500
Process Type	Free Product Recovery	Fax Number	705 752-4341

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☐ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Bay Marketing is an all-Canadian company manufacturing CAP (TM) absorbent products for cleanup of hydrocarbon spills.

CAP (TM) is produced from a natural, renewable resource (cork) with no chemical additives. It is non-toxic, biodegradable, environmentally safe and harmless to marine life. CAP (TM) is 100% oleophilic and hydrophobic and can absorb up to 21 times its own weight, depending upon viscosity of the material being cleaned up, yet it does not leach. CAP (TM) remains buoyant indefinitely even after complete saturation.

Product/Service Maturity: Commercial use experience Pilot plant testing Field demo complete Bench scale testing only

Performance History: Has undergone extensive laboratory testing by Zenon Labs and Canadian General Standards Board for determination of leachate compliance and values relating to absorption characteristics. Contact vendor for list of users:

Comments: CAP (TM) has an unlimited shelf life, will not rot or mildew, it is light and handles easily, and is unaffected by temperature change requiring no special storage.

CAP (TM) is available through stocking distributors nationally. The product line includes bagged particulate, pillows, 8" booms, 4" diameter socks to 50' in length. A complete line of spill kits are available in 20 to 400 litre capacities.

Source of Information: Vendor

Company Name/POC	Bio-Genesis Technologies, Inc./Victor Coukoulis 7343 E. Camelback Road Suite D Scottsdale, Arizona 85251		
E-Mail Address	rbmorr19@idt.liberty.com		
Product/Service	GT-1000 Series of Product	Phone Number	602 990-0709
Process Type	Dewatering	Fax Number	602 990-7745

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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

Brief Description: Bio-G.T. uses a proprietary process to culture and manufacture our products that results in a more concentrated microbe population. Culture counts in all of Bio-G.T.'s liquid products always exceed 10(8) per milliliter.

Product/Service Maturity: Commercial use experience Field demo complete

Performance History: BIO-G.T. is proud of its client roster. Their marketing strategy is to work closely with distributors and licensed representatives worldwide who have experience and have an established customer base. Some of BIO-G.T.'s clients are:

Arizona State University, Bio-GT, Central States, Continental Baking, Environmental Technologies Inc., City of Flagstaff WWTP, City of Tucson, Environmental Waste Solutions, Inc., Honeywell, Long Beach Memorial Hospital, Marriott Corporation, McDonalds Corporation, Mobil Oil Corporation, Pepsi Cola Bottling Co., PEMEX-Mexico, Pizza Hut Corporation, Ralston Purina, and Waste Management, Inc.

Comments: None.

Source of Information: Vendor

Company Name/POC CHEM-SECURITY (Alberta) Ltd./Art Mathes
#4 Manning Close N.E.
Calgary, Alberta, Canada T2E 7N5

E-Mail Address

Product/Service

Site Remediation Services

Phone Number 403 235-8361

Process Type

Excavation, Retrieval, and Off-Site Disposal

Fax Number 403 248-3430

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Off site

Brief Description: Full service excavation, packaging and treatment/disposal of contaminated media. Treatment and disposal is performed at the Alberta Special Waste Treatment Centre.

Product/Service Maturity: Commercial use experience

Performance History: Please contact company for performance data.

Comments: These processes are offered as a part of the services provided by the Alberta Waste Treatment Centre, a fully integrated waste treatment and disposal facility located in Alberta, Canada.

Source of Information: Vendor

Company Name/POC	Concept Engineering Group, Inc./R.D. Nathenson 610 William Pitt Way Pittsburgh, Pennsylvania 15238		
E-Mail Address			
Product/Service	Safe Excavation	Phone Number	412 826-3191
Process Type	Excavation, Retrieval, and Off-Site Disposal	Fax Number	412 826-3193

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: On site

Brief Description: CEG's Safe Excavation equipment uses a proprietary, synergistic combination of supersonic jets of air and high flow, pneumatic vacuum transport to dislodge and remove soil. Specifically for environmental cleanup, CEG's Safe Excavation system is:
Capable of digging around complicated substructures without damage; Capable of digging around deteriorating waste containers; Can safely uncover even glass bottles or vials; Can be combined with other treatment means; Selectively can collect/separate waste components; Contains debris and contaminants with vacuum system; Can use HEPA filtration if required; Operates on all terrains; Capable of completely remote operation; Competitive in rate to conventional equipment.

Product/Service Maturity: Field demo complete

Performance History: The Soft Trencher has undergone extensive field testing and use in Pittsburgh and at the Hanford Nuclear Site. In 1995, the Soft Trencher was demonstrated under the Unexploded Ordnance Advanced Technology Program at the Jefferson Proving Ground for the U.S. Army Environmental Center. It is available for use by contacting CEG in Pittsburgh.
The system at the Idaho national Engineering Lab is completing lab testing in Spring and Summer 1996 and can be made available for industrial use.
The tracked system will be undergoing field testing in the fall of 1996.

Comments: CEG concentrates on the design and construction of specialized Safe Excavation systems to meet specific customer or site requirements.

Source of Information: International TechCon

Extraction/ Handling

Company Name/POC	Croll-Reynolds Co., Inc./Dr. Isaac Ray P.O. Box 668 751 Central Avenue Westfield, New Jersey 07091		
E-Mail Address			
Product/Service	Wet Scrubbers, Electrostatic Precipitators, Carbon Adsorbers Phone Number 908 232-4200		
Process Type	Emission Control	Fax Number	908 232-2146

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: On site

Brief Description: Croll-Reynolds designs and manufactures air pollution control equipment utilized for the removal of particulate and/or toxic gases from contaminated gas streams.

Product/Service Maturity: Commercial use experience

Performance History: Contact vendor for performance data.

Comments: None.

Source of Information: Vendor

Company Name/POC	Dames & Moore, Inc./John Forsyth 2325 Maryland Road Willow Grove, Pennsylvania 19090		
E-Mail Address	PHLJVF@DAMES.COM		
Product/Service	Two-Phase Vacuum Extraction	Phone Number	215 657-5000
Process Type	Free Product Recovery	Fax Number	215 657-5454

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Dames & Moore Co-developed a patented two-phase vacuum extraction (VE) system that simultaneously remediates the groundwater and the soil without downhole pumping equipment. The two-phase VE process has been documented to increase groundwater yields in low-permeability soils, such as clays, up to one order of magnitude. The extraction process can also substantially reduce the VOC concentrations in the recovered groundwater by up to 99 percent, thereby reducing or eliminating the need for additional equipment, such as air strippers or liquid-phase GAS units. Case histories prove that vacuum extraction enhancement of pump and treat systems is a cost-effective remediation technique.

Product/Service Maturity: Commercial use experience

Performance History: Dames & Moore has extensive project experience in designing, installing, and operating two-phase VE systems to remediate soil contaminated with petroleum hydrocarbons, chlorinated solvents (e.g., trichlorethylene, perchlorethylene, trichloroethane, and methylene chloride, and other substances (e.g., mineral spirits). The system has also been used to recover floating and sinking free-phase product. We have successfully applied two-phase VE in various geologic strata, including sands, compact clays, and fractured bedrock, in projects that have included deep and shallow water table conditions. Dames & Moore's two-phase VE project experience ranges from gasoline service stations to manufacturing plants. The system is most often employed in low-permeability soils. It has increased recovery rates and capture zones in low permeability formations by as much as a factor of 10. When biodegradable compounds are present, the system can be used to introduce oxygen to the subsurface to stimulate biological activity.

Comments: None.

Source of Information: Vendor

Extraction/ Handling

Company Name/POC

Drilix Systems, Inc./David S. Bardsley
15151 Sommermeyer
(P.O. Box 801114)
Houston, Texas 77041 (77280-1114)

E-Mail Address**Product/Service**

Horizontal Drilling and Well Installation

Phone Number 713 937-8888

Process Type

Directional Wells

Fax Number 713 849-2390

Contaminants

- ☒ Pesticides/Herbicides
- ☒ Petroleum Hydrocarbons
- ☒ Nonhalogenated VOC

- ☐ Heavy Metals

- ☐ Radionuclides

- ☒ Halogenated VOC

- ☐ PCB

- ☐ SVOC

- ☐ N/A

- ☐ Explosives/Propellants

- ☐ Other Contaminant

Media

- ☒ Surface Impoundment

- ☐ Construction Materials/Debris

- ☐ Sediments in Water

- ☐ Process Wastes and Sludge

- ☒ Soil

- ☒ Landfills

- ☐ Vapor Phase

- ☐ Process Water

- ☐ Drums/Tanks/Piping

- ☒ Free Product

- ☐ Surface Water

- ☐ Containers/Equipment

- ☒ Ground Water

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

Brief Description: Drilix Systems, Inc. has designed a system for the drilling and installation of horizontal extraction/monitoring wells. Horizontal wells can access contaminated areas that are otherwise impossible to reach due to surface obstructions. Extended lengths of screen can be installed with one well, reducing the number of wells and the operation and maintenance cost of a pump and treat system. Horizontal wells can be utilized for vapor extraction, sparging, pump and treat, and bio-remediation solutions.

Product/Service Maturity: Commercial use experience

Performance History: Drilix has installed over thirty horizontal groundwater extraction wells. The wells have been installed as deep as 65' with screen lengths as long as 850'. Screen and casing materials utilized include; stainless steel, carbon steel and high density polyethylene (HDPE). Drilix has installed wells in four States at sites that include a DOD facility, an active manufacturing plant and a chemical plant with wells constructed under active process units.

Comments: The horizontal drilling systems are mounted on four truck trailers that are fully transportable to all locations. One of the drilling systems include a track-mounted drill rig for use in congested areas. Horizontal wells can be installed in most type of geologic formations at depths of 12' to over 200', with screen lengths over 850'. Wells can be installed in blind holes (no exit, only one surface access) or in continuous holes (exit hole, two surface access points).

Source of Information: Vendor

Extraction/ Handling

Company Name/POC	Earth Remediation Services, Inc./Larry Bee 21 Business Park Drive Branford, Connecticut 06405		
E-Mail Address	earthtct@callnet.com		
Product/Service	Excavation, Retrieval, and Off-Site Disposal	Phone Number	203 488-6713
Process Type	Excavation, Retrieval, and Off-Site Disposal	Fax Number	202 488-3628

Contaminants

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

Media

☒ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Off site On site

Brief Description: Contact ERS for additional information.

Product/Service Maturity: Commercial use experience

Performance History: Contact ERS for additional information.

Comments: Contact ERS for additional information.

Source of Information: Vendor

Extraction/ Handling

Company Name/POC	Earth Remediation Services, Inc./Larry Bee 21 Business Park Drive Branford, Connecticut 06405		
E-Mail Address	earthct@callnet.com		
Product/Service	Free Product Recovery	Phone Number	203 488-6713
Process Type	Free Product Recovery	Fax Number	202 488-3628

Contaminants

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

Media

☒ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone) On site

Brief Description: Contact ERS for additional information.

Product/Service Maturity: Commercial use experience

Performance History: Contact ERS for additional information.

Comments: Contact ERS for additional information.

Source of Information: Vendor

Company Name/POC	Earth Remediation Services, Inc./Larry Bee 21 Business Park Drive Branford, Connecticut 06405		
E-Mail Address	earthct@callnet.com		
Product/Service	Dewatering Services	Phone Number	203 488-6713
Process Type	Dewatering	Fax Number	202 488-3628

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone) On site

Brief Description: Dewatering services are provided to sites requiring control of groundwater as part of construction, excavation and installation of remediation systems or general contamination.

Product/Service Maturity: Commercial use experience

Performance History: Criteria are met when sufficient hydrogeology studies are performed in order to size appropriate extraction and treatment systems. ERS has successfully treated flows to 1,500 gallons per minute.

Comments: Contact ERS for additional information.

Source of Information: Vendor

Extraction/ Handling

Company Name/POC	Edwards Engineering Corp./Craig C. Bate 101 Alexander Avenue Pompton Plains, New Jersey 07444	
E-Mail Address	vapor@edwards-eng.com	
Product/Service	Edwards Vapor Recovery Systems	Phone Number 201 835-2800
Process Type	Free Product Recovery	Fax Number 201 835-3222

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: On site

Brief Description: For all types of chlorinated solvents, non-chlorinated solvents, gasoline and gasoline components, and virtually any condensable volatile component; Edwards Engineering offers unique solutions for solvents that can be removed by solidification and has a patented cooling recovery system that is utilized to minimize cooling requirements.

Product/Service Maturity: Commercial use experience

Performance History: Edwards Engineering has over 400 Vapor Recovery units in operation throughout the U.S., Canada, Mexico, and the world. Edwards Engineering has been providing quality units and service for over forty-five years. Edwards Engineering has a code shop and manufactures all the heat transfer equipment, vessels and structural components of these systems. All systems are skid-mounted and can be provided in enclosures. Truck-mounted systems are also available for tank cleaning or other mobile requirements. Edwards Engineering also revamps units to bring them up to current performance regulations.

Comments: Refrigeration based units offer low operating costs, low maintenance, and are completely automatic. They offer the safest operating conditions in hazardous applications and continuous operation where upsets often shut down other equipment due to safety or non-compliance. Edwards Engineering systems have a much greater tolerance for contamination and are much more versatile to variations in VOC type and concentration and do not require costly replacement of catalysts or adsorbents characterized by other treatment methods. Refrigeration units can handle explosive mixtures safely without dilution, have no compression requirements, do not have any hot surfaces or open flames, and avoid exothermic adsorption reactions that can create potentially hazardous conditions. Due to the very low pressure requirements of these systems, most systems operate without even the requirement for a blower.

Source of Information: Vendor

Company Name/POC	Exttec Screens and Crushers/P. Douglas Hearthcote Road, Swadlincote Derbyshire DE 11 9DU, U.K.	
E-Mail Address		
Product/Service	Exttec Screens and Crushers	Phone Number 44 1283 212121
Process Type	Size reduction	Fax Number 44 1283 217342

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On site

Brief Description: This equipment improves preparation and presentation of materials to be treated.

Product/Service Maturity: Commercial use experience

Performance History: Contact company for performance data.

Comments: None.

Source of Information: International TechCon

Extraction/ Handling

Company Name/POC	Fabrico Environmental Liners, Inc./Mike Nichols 4222 South Pulaski Road Chicago, Illinois 60632		
E-Mail Address	marketing@fabricoinfo.com		
Product/Service	Flexible Membranes	Phone Number	800 621-8546
Process Type	Other	Fax Number	312 890-4669

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: On site

Brief Description: Fabrico manufactures flexible membranes that are used for temporary or permanent containment of hazardous materials.

Product/Service Maturity:

Performance History: Contact vendor for performance data.

Comments: None.

Source of Information: Vendor

Extraction/ Handling

Company Name/POC	Filter Flow Technology, Inc./Tod S. Johnson, Ph.D. 122 Texas Ave. League City, Texas 77573		
E-Mail Address			
Product/Service	Colloid Filter Method	Phone Number	713 332-3438
Process Type	Dewatering	Fax Number	713 332-3644

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On site

Brief Description: Process wastewater, D&D and secondary wastewater from soil washing can be cost-effectively treated to: first, remove RCRA organics or hydrocarbons (if present); second, filter and dewater suspended solids; and third, polish heavy metals and non-tritium radionuclides using the innovative Colloid Polishing Filter Method (R) (CPFM [R]). Colloidal, organometallic and ionic inorganic metallic pollutants can be removed via sorption, chemical binding and exchange phenomena to meet strict discharge or water re-use criteria. The sorption bed material (i.e., Filter Flow 1000 [R]) has high capacity and reusable beds that provide long life times compared to ion exchange resins and most sorption materials. The methodology can be used as a mobile trailer (or skid) unit and in-line applications, and is cost-competitive with ultrafiltration, ion exchange and reverse osmosis for metals polishing. High performance is achievable with reduced disposal costs due to high bed capacity, bed reuse and site specific optimization of operating parameters.

Product/Service Maturity: Commercial use experience

Performance History: The Colloid Polishing Filter Method (R) has been bench and field tested at more than 40 groundwater sites, 58 industrial wastewater sites and four DOE NPL Radioactivity Cleanup sites. Independent laboratory analysis of control and test data indicates that 18 different heavy metals tested over diverse water chemistry conditions can be removed at efficiencies of 99 to >99.9% with DF values in the range of 300 to >1200. The % Removal Efficiency for uranium and transuranics (239 Pu, 241 Am) and LLRW such as 90 Sr, 60 Co, 137 Cs and NORM 238 U, 226 Ra range from 95->99.9% depending on the site and water chemistry. The presence of organometallic, complexed, chelated forms of the metal pollutants present challenges, but have been successfully removed by modifying pretreatment chemistry or by using mixed bed formulations. The CPFM (R) was tested under the Superfund EPA SITE Demo program at the DOE Rocky Flats Plant and designated as a BAT for removal of uranium, plutonium, americium, radium, and heavy metals. A DOE Technology Demo study at the Hanford 100N Site in early 1996 demonstrated applicability of the methodology for 90 Sr removal from groundwater. The methodology has been used to remove heavy metals from numerous industrial wastewater and groundwater projects, NORM uranium and radium from groundwater and tank-stored process water, weapons

Extraction/ Handling

production-related uranium, ^{239}Pu , ^{241}Pu at two NPL sites, and ^{90}Sr with or without ^{60}Co , ^{137}Cs at Hanford and several other commercial nuclear reactor sites. The methodology is in commercial application phase and equipment has been engineered, fabricated and tested successfully for heavy metals, uranium, transuranics, LLRW and NORM radionuclides. The methodology is being considered with pre-organics destruction/removal methods to treat LLMW process water and wastewater.

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: Vendor

Company Name/POC	FKC Co., Ltd/Jim Capell 2708 W. 18th Street Port Angeles, Washington 98363	
E-Mail Address		
Product/Service	Screw Press, Rotary Screen Thickener (Dewatering Equipment)	Phone Number 360 452-9472
Process Type	Dewatering	Fax Number 360 452-6880

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On site

Brief Description: FKC screw presses are used in a wide variety of pulp & paper, food, chemical, municipal, and industrial applications. Uses include dewatering of primary and secondary sludge, pulp, rejects, knots, production of fruit juices, imitation crab meat (surimi), various chemical products, oil recovery and extraction, metal plating wastewater, and municipal and industrial sludges.

The solid/liquid mixture enters the screw press by way of the headbox at the inlet end. The mixture is conveyed from the inlet end to the outlet end of the press by the rotating screw. As the material is conveyed along the length of the press it is squeezed between the tapered screw shell and the screen drums. Compression also occurs between the screw flights on variable pitch screw designs. The dry solids exit the press at the discharge end and fall down the discharge box. The liquid (pressate) that was forced out through the screens is collected in the pressate pan and flows to the pressate discharge flange.

Product/Service Maturity: Commercial use experience

Performance History: Contact vendor for list of users.

Comments: None.

Source of Information: Vendor

Company Name/POC	Flexible Liner Underground Tech., Ltd./Carl Keller 1640 Old Pecos Trail Suite H Santa Fe, New Mexico 87505		
E-Mail Address			
Product/Service	SEAMIST/Flute Systems	Phone Number	505 983-3199
Process Type	Injection/Delivery Systems	Fax Number	505 983-3476

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone) 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 and saturated zone vapor and liquid sampling, and borehole support lining.

Product/Service 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
Site Characterization to 800ft - Yucca MT., Gary Patterson (303) 236-5050 Ext. 256

Comments: System is presently mainly used in unsaturated zone; however, development is underway for a system to be used below the water table. For the greatest benefit, an uncased or temporary cased borehole should be used. Two people can deploy and operate the system. Borehole installation takes less than 30 minutes. All equipment (air source, elect. generator, SEAMIST system) are easily transported (no heavy equipment).

Source of Information: Vendor

Extraction/ Handling

Company Name/POC	FlowTex GUT GmbH/Dr. Ingo Sass Gesellschaft für Großbohr- und Umwelttechnik Chausseestraße 1 D-06317 Amsdorf, Post Roblingen, Germany	
E-Mail Address		
Product/Service	Curved Horizontal Wells with Ductile Porous Polyethylene	Phone Number 47 34601 40 164
Process Type	Directional Wells	Fax Number 47 34601 40 159

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Product/Service 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 collation resistivity; use of shelter casing procedure for well completion and filter cake destruction; hydrophobic screens.

Source of Information: International TechCon

Extraction/ Handling

Company Name/POC Gemstone Environmental/Marty Baer
750 Easy Street
Seamy Valley, California 93065

E-Mail Address willybbaer@aol.com

Product/Service Filter Press/Filter Press Plates & Screens

Phone Number 805 527-6990

Process Type Dewatering

Fax Number 805 526-7603

Contaminants

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

Media

☒ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☒ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: On site

Brief Description: Filter Press: dewatering of waste sludge and process water. Weight reduction of waste.

Product/Service Maturity: Commercial use experience Pilot plant testing

Performance History: Gemstone has over 20 years experience in the manufacture and construction of filter press and plates. We produce the patented polyethylene diaphragm plate. This unit provides broad thermal range of operation as compared to polypropylene plates.

Comments: None.

Source of Information: Vendor

Company Name/POC	Geotech Environmental/Crif Chilson/Jeff Sauck 1441 W 46th Ave. #17 Denver, Colorado 80211		
E-Mail Address	geotech@ix.netcom.com		
Product/Service	Free Product Recovery	Phone Number	800 833-7958
Process Type	Free Product Recovery	Fax Number	303 477-1230

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

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

Brief Description: Broad range of groundwater monitoring, sampling, filtration, analysis and remediation equipment.

Product/Service Maturity: Commercial use experience

Performance History: Performance data are available. 20 years in business.

Comments: None.

Source of Information: Vendor

Extraction/ Handling

Company Name/POC Great Lakes Environmental, Inc./David Field
315 S. Stewart Ave.
Addison, Illinois 60101-3300

E-Mail Address grtlakesi@aol.com

Product/Service Free Product Recovery

Phone Number 708 543-9444

Process Type Free Product Recovery

Fax Number 708 543-1169

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: On site

Brief Description: Great Lakes Environmental, Inc., was incorporated in October 1978 to supply industrial wastewater pretreatment equipment to the industrial market.

The Model SRC Slant Rib Coalescing Oil Water Separator was the first product marketed by GLE. It was well received and development of other industrial wastewater pretreatment products soon followed. Currently, GLE manufactures a complete line of Oil Water Separators, a range of Inclined Plate Clarifiers, Dissolved Air Flotation Systems, Rotary Vacuum Precoat Filters, and an automatic backwashing multi-media sand filter. The unique feature of Great Lakes Environmental, Inc. is our ability to incorporate the complete physical chemical treatment packages and system controls around the central core of products. We offer a complete treatment package to the consultant and end user.

Complete process design and mechanical specifications are prepared by dedicated GLE staff at the corporate Headquarters in Addison, IL. Fabrication is accomplished by a core of competent, independent fabrication shops while component assembly, performance checks, and inspection of the integrated unitized skids are completed at our shop. Experienced personnel assist in operator training and start up after installation. We offer lifetime back up support.

Product/Service Maturity: Commercial use experience

Performance History: Asahi Motor Wheel - Kentucky: Plant manufactures wheel covers for most of the Japanese cars built in the U.S. Design flow was 50 GPM, system now running over 75 GPM. Wastewater contained oils and most heavy metals which required reduction to various levels.

Exide Battery - South Carolina: Plant manufactures lead batteries. Treatment system was for rain run-off and drainage which was contaminated with lead and zinc. Discharge point is a creek. Water is collected and stored in a 3,000,000 gallon pond. Treatment system runs near continuously. Influent lead shows 3.35 mg/l on composites and zinc .510. Composite effluents values are .022 mg/l for lead and <.050 for zinc.

Watec - Texas: There are two sites, Odessa I and Odessa II. Both are designed for approximately 100 GPM. Influent chrome levels ranged from 2.3 mg/l to 3.1 mg/l at Odessa I and .37 mg/l to .53 mg/l at Odessa II. Effluent are generally less than .050 mg/l.

January 1997

E 32

Environmental Cleanup Privatization
Products and Services Directory

Extraction/ Handling

Merced - California: Project is the treatment of contaminated groundwater. Design flow is 350 GPM. Influent metals range up to 10.0 mg/l as hexavalent chrome. Effluent values are consistently below .003 mg/l.

Comments: None.

Source of Information: Vendor

Company Name/POC Great Lakes Environmental, Inc./David Field
315 S. Stewart Ave.
Addison, Illinois 60101-3300

E-Mail Address grtlakesi@aol.com
Product/Service Oil Water Separation
Process Type Oil/Water Separation

Phone Number 708 543-9444
Fax Number 708 543-1169

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: On site

Brief Description: Great Lakes Environmental, Inc., was incorporated in October 1978 to supply industrial wastewater pretreatment equipment to the industrial market.

The Model SRC Slant Rib Coalescing Oil Water Separator was the first product marketed by GLE. It was well received and development of other industrial wastewater pretreatment products soon followed. Currently, GLE manufactures a complete line of Oil Water Separators, a range of Inclined Plate Clarifiers, Dissolved Air Flotation Systems, Rotary Vacuum Precoat Filters, and an automatic backwashing multi-media sand filter. The unique feature of Great Lakes Environmental, Inc. is our ability to incorporate the complete physical chemical treatment packages and system controls around the central core of products. We offer a complete treatment package to the consultant and end user.

Complete process design and mechanical specifications are prepared by dedicated GLE staff at the corporate Headquarters in Addison, IL. Fabrication is accomplished by a core of competent, independent fabrication shops while component assembly, performance checks, and inspection of the integrated unitized skids are completed at our shop. Experienced personnel assist in operator training and start up after installation. We offer lifetime back up support.

Product/Service Maturity: Commercial use experience

Performance History: Asahi Motor Wheel - Kentucky: Plant manufactures wheel covers for most of the Japanese cars built in the U.S. Design flow was 50 GPM, system now running over 75 GPM. Wastewater contained oils and most heavy metals which required reduction to various levels.

Exide Battery - South Carolina: Plant manufactures lead batteries. Treatment system was for rain run-off and drainage which was contaminated with lead and zinc. Discharge point is a creek. Water is collected and stored in a 3,000,000 gallon pond. Treatment system runs near continuously. Influent lead shows 3.35 mg/l on composites and zinc .510. Composite effluents values are .022 mg/l for lead and <.050 for zinc.

Waterc - Texas: There are two sites, Odessa I and Odessa II. Both are designed for approximately 100 GPM. Influent chrome levels ranged from 2.3 mg/l to 3.1 mg/l at Odessa I and .37 mg/l to .53 mg/l at Odessa II. Effluent are generally less than .050 mg/l.

January 1997

E 34

Environmental Cleanup Privatization
Products and Services Directory

Extraction/ Handling

Merced - California: Project is the treatment of contaminated groundwater. Design flow is 350 GPM. Influent metals range up to 10.0 mg/l as hexavalent chrome. Effluent values are consistently below .003 mg/l.

Comments: None.

Source of Information: Vendor.

Extraction/ Handling

Company Name/POC.	Groundwater & Environmental Services, Inc./Bob Rousseau		
	1340 Campus Parkway		
	P.O. Box 1750		
	Wall, New Jersey 07719		
E-Mail Address			
Product/Service	Dewatering	Phone Number	908 919-1646
Process Type	Dewatering	Fax Number	908 919-1678

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone) On site

Brief Description: The GES Mobile Dewatering/Treatment System(s) are fully enclosed, trailer mounted water treatment system(s). The treatment systems consist of primary and secondary activated carbon units (GACs). They are capable of processing between 20 to 140 gallons per minute (gpm), up to 200,000 gallons per day (gpd). The system(s) include all pumps and controls to provide automated, continuous operation. Sediment filters are provided to ensure consistent system operation and discharge permit compliance. To ensure site-specific permit compliance the system is tooled with all necessary flow meters and influent/effluent sampling ports.

Product/Service Maturity: Commercial use experience

Performance History: As the manager of an 80-site service station construction program for a major client GES completed a large dewatering effort involving discharge treatment. Expecting a 10 to 20 gallon per minute flow rate based on limited site precharacterization, GES ultimately arranged for staff and equipment to handle more than 300 gallons per minute to maintain the water table at 16 feet below grade while the new tanks were set. An additional dewatering trailer with carbon treatment was provided on short notice by the Syracuse office. Nearly around the clock attention enabled GES to meet the client's goal.

Comments: None.

Source of Information: Vendor.

Extraction/ Handling

Company Name/POC	Groundwater & Environmental Services, Inc./Bob Rousseau 1340 Campus Parkway P.O. Box 1750 Wall, New Jersey 07719		
E-Mail Address			
Product/Service	Free Product Recovery	Phone Number	908 919-1646
Process Type	Free Product Recovery	Fax Number	908 919-1678

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone) On site Non-intrusive

Brief Description: GES has extensive experience in free phase recovery applications utilizing pneumatic and electrical product recovery systems. Remote applications include battery and solar powered product recovery pumps. GES specializes in free product separation at the water table surface. We also have experience with above grade oil water separation from three and two phase extraction systems.

Product/Service Maturity: Commercial use experience Pilot plant testing

Performance History: On an ECRA parcel of land in Paulsboro, New Jersey, GES conducted a 180 day free product recovery program, which included the installation of monitoring wells, soil sampling, and the development and submission of a clean-up plan. Most recently, GES conducted biotreatability and vapor extraction studies. GES has also conducted free product recovery and groundwater quality monitoring of perimeter wells at a Refinery site in Toledo, Ohio.

Comments: None.

Source of Information: Vendor

Company Name/POC	Hansa Projekt Anlagentechnik GmbH/Michael Szukala Tarpenring 4 22419 Hamburg, Germany		
E-Mail Address			
Product/Service	2000mt High Pressure Compactor	Phone Number	49 40 527 02 62
Process Type	Size reduction	Fax Number	49 40 527 56 64

Contaminants

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

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On 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.

Product/Service 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 Brunsbittel, 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: Vendor

Extraction/ Handling

Company Name/POC	Hansa Projekt Anlagentechnik GmbH/Michael Szukala Tarpenring 4 22419 Hamburg, Germany		
E-Mail Address			
Product/Service	Sludge Dryer / Concentrate Dryer with Post-Feeding Capability	Phone Number	49 40 527 02 62
Process Type	Other	Fax Number	49 40 527 56 64

Contaminants

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

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On 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.

Product/Service 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

Extraction/ Handling

Source of Information: Vendor

Company Name/POC	Haz-Mat Containment Corporation/Customer Service 712 Bancroft Road No. 216 Walnut Creek, California 94598		
E-Mail Address			
Product/Service	Environmentally Safe Hazardous Material Containment	Phone Number	800 943-6510
Process Type	Other	Fax Number	510 210-1054

Contaminants

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☒ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Other Application

Brief Description: Prefabricated hazardous material storage buildings. 50-500 sq. ft..HVAC options.

Product/Service Maturity: Commercial use experience

Performance History: DOE, DHHS

Comments: None.

Source of Information: Vendor

Extraction/ Handling

Company Name/POC High Plains Consortium, Inc./Lance Loken
P.O. Box 1292
1720 Burnt Boat Drive
Bismarck, North Dakota 58502-1292

E-Mail Address

Product/Service Environmental Engineering Services

Phone Number 701 255-6080

Process Type Free Product Recovery

Fax Number 701 250-9177

Contaminants

☒ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☒ SVOC	☒ Other Contaminant
☐ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Off site In-situ (saturated zone) In-situ (vadose zone) On site

Brief Description: Installation of recovery wells and pump systems to cleanup contaminated groundwater. Recoverable product has included petroleum products and agrichemicals. Fertilizers have been recovered and recycled.

Product/Service Maturity: Commercial use experience

Performance History: Projects have included a wide variety of sites including spills and leaking underground storage tanks.

Comments: None.

Source of Information: Vendor

Extraction/ Handling

Company Name/POC	Hofstetter Umwelttechnik AG/U.P. Hofstetter Anlagenbau CH-3324 Hindelbank, Switzerland		
E-Mail Address			
Product/Service	Autoflash Multi-Stage Evaporation	Phone Number	41 0 34 51 23 11
Process Type	Other	Fax Number	41 0 34 51 25 08

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: Evaporation of highly contaminated water, for instance leachate from sanitary landfills.

Product/Service 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, 24-hour operation, and very low maintenance and servicing. Need for protection against frost and vandalism.

Source of Information: Vendor

Extraction/ Handling

Company Name/POC	Horizontal Technologies, Inc./Donald R. Justice, Greg Rawl 2309 Hancock Bridge Parkway (33990) P.O.Box 150820 Cape Coral, Florida 33915-0820		
E-Mail Address			
Product/Service	Linear Contaminant Remediation System (LCRS)	Phone Number	941 995-8777
Process Type	Injection/Delivery Systems	Fax Number	941 995-8465

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone) In-situ (vadose 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.

Product/Service 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 construction and should be in operation prior to the end of 1996.

Comments: Cannot be installed directly under buildings. The maximum installation depth below the water table is approximately 30 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: Vendor

Extraction/ Handling

Company Name/POC	Hudson Industries/Eric Kenney P.O. Box 2212 Hudson, Ohio 44236	
E-Mail Address		
Product/Service	CS-Series Coalescing Oil/Water Separators	Phone Number 800 487-9668
Process Type	Oil/Water Separation	Fax Number 216 487-0811

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: On site

Brief Description: Hudson Industries designs and manufactures a complete line of coalescing oil/water separators, from 1-5500 gpm for a wide variety of industrial and environmental applications. Hudson Industries CS series separators effectively reduce free oil and grease content in waste streams to 10 mg/l or less through the use of high efficiency PVC and CPVC corrugated plate modules providing high quality, consistent effluent results.

Product/Service Maturity: Commercial use experience

Performance History: Contact vendor for list of users.

Comments: Oil and water influent is induced through the standpipe to the tank interior. The influent is evenly distributed by the flow diffusion baffle before entering the coalescing module, which consists of corrugated PVC/CPVC plates thermobonded into a dense module. The module being oleophillic (oil attractive) begins to attract the oil droplets which in turn begin to bond or coalesce into large droplets. These large droplets continue to rise where they form a layer of oil on the surface.

The separator employs a continuous acting rotary pipe oil skimmer to remove the oil from the surface and deposit it into the oil separation tube. The majority of the water which may have been removed with the skimmed oil separates back out into the waste stream. The separated oil then discharges out of the separator.

The water continues through a series of underflow and overflow baffles before discharging from the unit.

Operating Temperature Range: 35 degrees - 190 degrees Fahrenheit. P.H. Range: 2-13.5

Source of Information: Vendor

Extraction/ Handling

Company Name/POC	hydroGEOPHYSICS/Stuart Hoenig 5865 S. Old Spanish Trail Tucson, Arizona 85747		
E-Mail Address			
Product/Service	Electrically Charged Fog (Fog Gun)	Phone Number	520 887-3815
Process Type	Dust Control	Fax Number	520 647-3428

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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.

January 1997

E 46

Environmental Cleanup Privatization
Products and Services Directory

Extraction/ Handling

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: Vendor

Extraction/ Handling

Company Name/POC	INTERA, Inc./ Kent Lantz 6850 Austin Center Boulevard, Suite 300 Austin, Texas 78731		
E-Mail Address	kdlantz@dpcmail.dukepower.com		
Product/Service	Surfactant-Enhanced Aquifer Remediation (SEAR)	Phone Number	512 346-2000
Process Type	Free Product Recovery	Fax Number	512 346-9436

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☒ SVOC	☐ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone)

Brief Description: Surfactant-enhanced aquifer remediation (SEAR) has developed out of the failure of ground-water extraction (pump-and-treat) methods as applied at hazardous waste sites. SEAR may involve one of two approaches, and variations thereof, that can be referred to as the chemically-enhanced solubilization (CES) and the enhanced oil recovery (EOR) approaches. Surfactants are capable of increasing the solubility of contaminants such as chlorinated solvents and JP-4 by orders of magnitude, resulting in the increased performance of aquifer remediation systems.

Product/Service Maturity: Field demo complete

Performance History: INTERA is currently conducting a number of field projects involving surfactant and water flooding to remove NAPLs from aquifer systems. These projects include:

Operable Unit 2 at Hill AFB, UT - INTERA recently completed a pilot test to determine the efficacy of a sulfosuccinate surfactant solution to remove TCE DNAPL from a 20-foot interwell zone. This injected solution raised the TCE concentration in the effluent from recovery wells from 500 to 40,000 milligrams/liter of TCE. A field-scale micellar-polymer surfactant flood is scheduled for August 1996.

DOE's Portsmouth Gaseous Diffusion Plant, Portsmouth, OH - INTERA is scheduled to conduct a field-scale surfactant flood in September of 1996 to demonstrate the efficacy of SEAR to remove a TCE-PCB DNAPL from a shallow sand and gravel aquifer.

Comments: INTERA, in collaboration with the University of Texas at Austin and DOE's Idaho National Engineering Lab, are also exploring a SEAR approach that utilizes a surfactant-alcohol-polymer (SAP) system in order to solubilize chlorinated solvents present beneath the water table as DNAPLs and in the dissolved and sorbed states. The particular feature of this SAP system which is most noteworthy is that the resulting microemulsion, comprising the surfactant, alcohol and the solubilized DNAPL, will be of neutral buoyancy with respect to groundwater. That is, the microemulsion formed by the SAP and the DNAPL will have the same specific gravity as the groundwater of the aquifer, therefore, there is little or no tendency for the solubilized DNAPL

January 1997

E 48

Environmental Cleanup Privatization
Products and Services Directory

to migrate vertically through the aquifer. Such a loss of hydraulic control of DNAPLs has been held, in some quarters, as reason enough to avoid the use of SEAR for DNAPL remediation. However, experimental research at the Idaho National Engineering Laboratories (INEL) and at the University of Texas at Austin (UT) has demonstrated that the SAP approach can minimize vertical migration of solubilized DNAPLs in an aquifer which has no underlying capillary barrier to prevent further downward migration of DNAPLs which have been mobilized by the reduced interfacial tension of surfactant solutions.

Source of Information: Vendor

Company Name/POC	INTERA, Inc./ Kent Lantz	
	6850 Austin Center Boulevard, Suite 300	
	Austin, Texas 78731	
E-Mail Address	kdlantz@dpcmail.dukepower.com	
Product/Service	Chemically-Enhanced Solubilization for Aquifer Remediation (CESAR)	Phone Number 512 346-2000
Process Type	Free Product Recovery	Fax Number 512 346-9436

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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

January 1997

E 50

Environmental Cleanup Privatization
Products and Services Directory

Extraction/ Handling

selection of surfactants, reduction in interfacial tension can be minimized to the point that vertical mobilization does not occur.

Source of Information: Vendor

Extraction/ Handling

Company Name/POC	International Reserve Equipment Corporation/Sales Dept. Fourth South Prospect Ave. P.O. Box 198 Clarendon Hills, Illinois 60514-0198		
E-Mail Address			
Product/Service	Centrifuges, Separators	Phone Number	630 325-7040
Process Type	Dewatering	Fax Number	630 325-7045

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: On site

Brief Description: Since 1970, International Reserve Equipment Corporation has been a leading supplier of good, used and reconditioned centrifuges and separators (all major brands: Bird, Sharples, Alfa-Laval, Dorr-Oliver, Tolhurst, Baker-Perkins, Kruger, Western States, Westfalia/Centrico, and others), to the environmental cleanup field for sludge dewatering, pollution control, wastewater treatment and liquids-solids separations applications.

Product/Service Maturity: Commercial use experience

Performance History: Not applicable.

Comments: Our machines are available for "immediate" sale and delivery as opposed to three months to two years wait for delivery of new equipment. Also, our machines are priced at approximately 50 percent of the cost of new.

Source of Information: Vendor

Extraction/ Handling

Company Name/POC	International Submarine Engineering LTD./Owen Williams 1734 Broadway Street Port Coquitlam, B.C. V3C 2M8 Canada	
E-Mail Address		
Product/Service	Robotic Manipulator and Control Systems	Phone Number 604 942-5223
Process Type	Robotics	Fax Number 604 942-7577

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☒ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☒ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Extraction/ Handling

Company Name/POC	JWC Environmental/Marketing Department 290 Paularino Ave. Costa Mesa, California 92626	Phone Number 800 331-2277
E-Mail Address		Fax Number 714 833-8858
Product/Service	Muffin Monster (R) / Channel Monster (R)	
Process Type	Size reduction	

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: JWC Environmental's Muffin Monster (R) solid waste grinders effectively solve today's tougher solids problems in a wide variety of wastewater treatment applications. In water-borne solids applications, the grinders prevent clogging in the system and damage to process equipment. Muffin Monsters are capable of grinding a multitude of materials of various sizes, shapes, and hardnesses. The grinders' cutters shear, cut and tear solid materials allowing for a more manageable and uniform particle size. Each grinder consists of dual counter-rotating shafts that are comprised of multi-tooth rotary cutters. The Muffin Monster (R) is available in Model 30000 and 40000 Series depending on specific applications details. JWC Environmental offers full factory support for technical and customer service on all products.

Product/Service Maturity: Commercial use experience

Performance History: Muffin Monster (R) line of products has been used in a wide variety of municipal and industrial applications nationally and internationally since 1972.

Comments: None.

Source of Information: Vendor

Company Name/POC	Keck Instruments/Dan Tuttle 1099 W. Grand River Williamston, Michigan 48895		
E-Mail Address	water@keckInc.com		
Product/Service	Keck Canister	Phone Number	517 655-5616
Process Type	Free Product Recovery	Fax Number	517 655-1157

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone)

Brief Description: Passive hydrocarbon recovery canister. Collects free floating hydrocarbons from a 2" or larger well without air or electricity.

Product/Service Maturity: Commercial use experience

Performance History: Developed in 1991 with over 800 units purchased.

Comments: Featured in Lust Line - an EPA publication.

Source of Information: Vendor

Extraction/ Handling

Company Name/POC Keck Instruments/Dan Tuttle
1099 W. Grand River
Williamston, Michigan 48895

E-Mail Address water@keckinc.com

Product/Service PRS-90 Recovery System

Process Type Free Product Recovery

Phone Number 517 655-5616

Fax Number 517 655-1157

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone)

Brief Description: Pneumatic hydrocarbon recovery system. Floating skimmer recovers floating hydrocarbons in a 2" or larger well. Skimmer features a hydrophobic filter for recovery of hydrocarbons without water.

Product/Service Maturity: Commercial use experience

Performance History: Developed in 1990 systems are operating across the nation in multiple well head installations.

Comments: Available for single or multiple well head installations.

Source of Information: Vendor

Extraction/ Handling

Company Name/POC	Keck Instruments/Dan Tuttle 1099 W. Grand River Williamston, Michigan 48895	
E-Mail Address	water@keckInc.com	
Product/Service	KIR-96 Interface Probe	Phone Number 517 655-5616
Process Type	Free Product Recovery	Fax Number 517 655-1157

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone)

Brief Description: Hydrocarbon detection in groundwater. Determines product thickness, level and water level in a 2 inch or larger monitor well. Materials are teflon and stainless steel.

Product/Service Maturity: Commercial use experience

Performance History: Industry standard with over 1500 units in use. Introduced in 1984.

Comments: None.

Source of Information: Vendor

Extraction/ Handling

Company Name/POC	KEMA Nederland B.V./H.A.W. Cornelissen P.O. Box 9035, NL-6800 ET ARNHEM, The Netherlands		
E-Mail Address			
Product/Service	Concrete Decontamination and Volume Reduction	Phone Number	31 26 356 6104
Process Type	Size reduction	Fax Number	31 26 351 5835

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☒ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service 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

Extraction/ Handling

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: Vendor

Company Name/POC	Kernkraftwerke Gundremmingen/Norbert Eickelpasch Betriebsgesellschaft mbH Postfach 3 00 D-89355 Gundremmingen, Germany		
E-Mail Address			
Product/Service	Ice Sawing	Phone Number	49 8224 78 1
Process Type	Size reduction	Fax Number	49 8224 78 3508

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☒ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Company Name/POC	Kinetic Sciences Inc./Guy Immega 3250 E. Mall Vancouver, B.C. V6T1W5		
E-Mail Address			
Product/Service	Tentacle Robotic Arm - Extensible (Tentacle)	Phone Number	604 822-5782
Process Type	Robotics	Fax Number	604 822-6188

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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

Company Name/POC Lopata Technical Service Corp./Jim Lopata
1130 N. Dearborn St.
Suite 1702
Chicago, Illinois 60610

E-Mail Address

Product/Service Hydrocarbon/Water Separators

Phone Number 312 280-1574

Process Type Oil/Water Separation

Fax Number 312 951-0484

Contaminants

☒ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☒ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: On site

Brief Description: The coalescing plate interceptors are very easy to operate. To make them work better: the use of positive displacement pumps (such as rotor/stator, diaphragm air, or peristaltic) is suggested . . . in order to minimize mechanical agitation as experienced in a centrifugal pump that has a tendency to cause the materials to become mechanically emulsified. The membrane filtration systems are slightly more complex to operate and may require up to two days to start up assistance and training by a company engineer/technician.

Product/Service Maturity: Commercial use experience

Performance History: The hydrocarbon/water separation takes two forms: a coalescing plate interceptor (CPI) to remove free product from aqueous phase and a membrane separation system for emulsified hydrocarbons in the aqueous phase. The separation in the CPI is based on Stoke's law for the separation of materials of differing phases and/or specific gravities. The CPI units are available either as atmospheric flow through units or as pressurized units to enable pumps to feed through the separator and on to additional treatment technologies. The membrane separation system utilizes a unique surface treated membrane of polyacrylonitrile that is not fouled by free hydrocarbons -- offering filtration/separation in the range from 0.001 to 0.05 microns. This filtration range will easily separate most hydrocarbon contaminants (C12 and larger) from water.

Comments: More than 25 commercial installations are available.

Source of Information: Vendor

Company Name/POC	Magnox Electric/Dr. R. Clayton Littlebrook Complex Littlebrook Manorway Dartford Kent DA1 5PY, UK		
E-Mail Address			
Product/Service	Multi-Limb, Long-Reach, Heavy Duty Hydraulic Manipulator	Phone Number	44 1322 282800
Process Type	Robotics	Fax Number	44 1322 282819

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☒ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Extraction/ Handling

Company Name/POC	MagneX Electric/Dr. R. Clayton Littlebrook Complex Littlebrook Manorway Dartford Kent DA1 5PY, UK	
E-Mail Address		
Product/Service	Retrieval of Stored Wastes	Phone Number 44 1322 282800
Process Type	Excavation, Retrieval, and Off-Site Disposal	Fax Number 44 1322 282819

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☒ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Extraction/ Handling

Company Name/POC	Malcolm Pirnie, Inc./David L. Pry 1 International Blvd. Mahwah, New Jersey 07495		
E-Mail Address			
Product/Service	Pneumatic Fracturing	Phone Number	201 529-4700
Process Type	Pneumatic Fracturing	Fax Number	201 529-1415

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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

Extraction/ Handling

Company Name/POC	Microfluidics Corp./Irwin Gruverman 30 Ossipee Rd. Newton, Massachusetts 02164-9101	Phone Number 617 969-5452 Fax Number 617 965-1213
E-Mail Address		
Product/Service	Microfluidizer (TM)	
Process Type	Size reduction	

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCBs	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOCs	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service Maturity: Pilot plant testing

Performance History: Not available.

Comments: None.

Source of Information: Vendor

Company Name/POC	Modulaire Ltd./Mikko Sampo P.O. Box 10 14201 Turenki Finland		
E-Mail Address			
Product/Service	Remotely Controlled and Video-Assisted Remotely Controlled Excavation		Phone Number 358 17 6878433
Process Type	Robotics	Fax Number	358 17 6881510

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC	Modulaire Ltd./Mikko Sampo P.O. Box 10 14201 Turenki Finland		
E-Mail Address			
Product/Service	Remotely Controlled and Video-Assisted Remotely Controlled Excavation		Phone Number 358 17 6878433
Process Type	Other	Fax Number	358 17 6881510

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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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: Vendor

Extraction/ Handling

Company Name/POC	Nuclear Decommissioning LTD./Mike Napper 9 Queen Sq. Bristol, England BS1 4HR		
E-Mail Address			
Product/Service	Use of Remotely Operated Vehicles	Phone Number	011 44 1179 29 3691
Process Type	Robotics	Fax Number	011 44 1179 29 3692

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☒ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Extraction/ Handling

Company Name/POC	Oil Skimmers, Inc./Customer Service	Phone Number	216 237-4600
	P.O. Box 33092	Fax Number	216 582-2759
	Cleveland, Ohio 44133		
E-Mail Address			
Product/Service	Oil Skimmer		
Process Type	Oil/Water Separation		

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB's	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC's	☐ Halogenated VOC	☐ N/A	

Media

☒ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: Oil skimmer equipment to separate petroleum hydrocarbons from water.

Product/Service Maturity: Commercial use experience

Performance History: Equipment has been used for over 25 years as an efficient, trouble-free method of continuous, unattended oil removal. Units in operation at all type of facilities throughout the world.

Comments: None.

Source of Information: Vendor

Extraction/ Handling

Company Name/POC	Ontario Hydro Technologies/Walter Shmáydá 800 Kipling Ave #KR252 Etobicoke Ontario, Canada M87 5S4		
E-Mail Address			
Product/Service	Piezocone/Drill Rig Truck with Computerized Stratigraphic and Environmental Analysis	Phone Number	905 855-4724
Process Type	Injection/Delivery Systems	Fax Number	905 823-8020

Contaminants

☒ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☐ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone) In-situ (vadose 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.

Product/Service Maturity: Commercial use experience

Performance History: Contact company for performance history data.

Comments: Requires field access for 10-ton truck, or unit can be dismantled to 5-ton flat-bed truck or barge for lakes/rivers/swamps.

Source of Information: Vendor

Extraction/ Handling

Company Name/POC OR-TEC, Inc./Ciaran O'Melia
380 Salon Road
#9
Bedford, Ohio 44146

E-Mail Address

Product/Service OR-TEC HP Belt Press/Thickener System **Phone Number** 216 232-4224

Process Type Dewatering **Fax Number** 216 232-7775

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: OR-TEC's sludge dewatering/thickener system is designed for small to medium size W.W.T.P. This system can be converted into a thickener with the change of a belt. Systems are available as a mobile or skid-mounted package.

Product/Service Maturity: Commercial use experience

Performance History: Municipality

Processing 10,000 gal/day

Belt Press Size: 1 meter

Inlet Solids Concentration: 2%

Dry Solids Feed Rate: 210 Lbs D.S./Hr.

Dry Cake Concentration: 14%

Polymer Dosage Rate: 90 MG/L

Total HP: 10 HP

Comments: OR-TEC is a manufacturer of sludge dewatering/thickening belt press systems, flotation units, and polymer dosing equipment.

Source of Information: Vendor

Extraction/ Handling

Company Name/POC	OR-TEC, Inc./Ciaran O'Melia 380 Salon Road #9 Bedford, Ohio 44146		
E-Mail Address			
Product/Service	OR-TEC HP Belt Press/Thickener System	Phone Number	216 232-4224
Process Type	Other	Fax Number	216 232-7775

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: OR-TEC's sludge dewatering/thickener system is designed for small to medium size W.W.T.P. This system can be converted into a thickener with the change of a belt. Systems are available as a mobile or skid-mounted package.

Product/Service Maturity: Commercial use experience

Performance History: Municipality

Processing 10,000 gal/day

Belt Press Size: 1 meter

Inlet Solids Concentration: 2%

Dry Solids Feed Rate: 210 Lbs D.S./Hr.

Dry Cake Concentration: 14%

Polymer Dosage Rate: 90 MG/L

Total HP: 10 HP

Comments: OR-TEC is a manufacturer of sludge dewatering/thickening belt press systems, flotation units, and polymer dosing equipment.

Source of Information: Vendor

Extraction/ Handling

Company Name/POC	ORS Environmental Systems/Customer Service	Phone Number 603 878-2500
	32 Mill Street	Fax Number 603 878-3866
	Greenville, New Hampshire 03048	
E-Mail Address		
Product/Service	Scavenger (R) Recovery Systems	
Process Type	Free Product Recovery	

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCBs	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone)

Brief Description: These unique products use membrane and sensor technology to separate product from water in-situ. Systems available for recovery up to 20 gpm and can recover product to a sheen. Configurations to meet most applications, including open lagoons, trenches, ponds, and large and small diameter wells.

Product/Service Maturity: Commercial use experience

Performance History: Used in thousands of projects since 1975. An industry favorite because of their reliability and durability.

Comments: None.

Source of Information: Vendor

Company Name/POC	Packaging Research and Design Corporation/Customer Service P.O. Box 678 Madison, Mississippi 39130-0678		
E-Mail Address			
Product/Service	Disposable Bag Liners	Phone Number	800 833-9364
Process Type	Other	Fax Number	601 853-1202

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ

Brief Description: Packaging Research and Design Corporation offers disposable heavy-duty polyethylene bag liners for roll-offs, dump trailers, and railroad gondolas. Unique patented bag liner is a form fit design that fits squarely in the corners of the container to virtually eliminate tearing and gives triple thickness leak protection at the bottom of the container's tailgate. These bag liners are ideal for transporting hazardous waste, industrial waste, asbestos, sewage treatment sludge, contaminated soil and dusty or odorous material.

Product/Service Maturity: Commercial use experience

Performance History: Fifteen years of service in all 50 states and 6 foreign countries.

Comments: Bag liner offers safer transportation and cleaner dump than flat poly sheeting.

Source of Information: Vendor

Company Name/POC	Power Fluidics/Paul Murray 13245 Reese Blvd West Campbell Bldg Suite 100 Hunterville, North Carolina 28078	
E-Mail Address		
Product/Service	Power Fluidic RFD Pump	Phone Number 704 875-9573
Process Type	Injection/Delivery Systems	Fax Number 704 875-8114

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service Maturity: Commercial use experience

Performance History: Contact company for performance data.

Comments: None.

Source of Information: Vendor

Company Name/POC	Power Fluidics/Paul Murray 13245 Reese Blvd West Campbell Bldg Suite 100 Hunterville, North Carolina 28078	
E-Mail Address		
Product/Service	Power Fluidic Gas Contactor	Phone Number 704 875-9573
Process Type	Dust Control	Fax Number 704 875-8114

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☒ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC	Power Plant Service, Inc./John Boerger 2500 W. Jefferson Blvd Fort Wayne, Indiana 46802		
E-Mail Address			
Product/Service	E-Series Waste Water Evaporator	Phone Number	219 432-6716
Process Type	Size reduction	Fax Number	219 436-3340

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Off site On site

Brief Description: The E-Series waste water evaporators are tanks open to the atmosphere designed to hold water to which heat is applied. The solution is heated to boiling which drives off the water and concentrates non-water parts of the solution. These units are not designed for wastes containing quantities of volatile compounds.

Product/Service Maturity: Commercial use experience

Performance History: Waste water evaporators are used within a variety of industries to reduce a variety of waste waters such as spent cutting fluids, emulsified oils, boiler and air compressor blow-down, stamping and die casting solutions, mop waters, wire drawing solutions, parts washer effluent or a variety of other water based that are free of a quantity of volatile organic compounds.

Comments: None.

Source of Information: Vendor

Extraction/ Handling

Company Name/POC Power Plant Service, Inc./John Boerger
2500 W. Jefferson Blvd
Fort Wayne, Indiana 46802

E-Mail Address

Product/Service E-Series Waste Water Evaporator

Phone Number 219 432-6716

Process Type Dewatering

Fax Number 219 436-3340

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Off site On site

Brief Description: The E-Series waste water evaporators are tanks open to the atmosphere designed to hold water to which heat is applied. The solution is heated to boiling which drives off the water and concentrates non water parts of the solution. These units are not designed for wastes containing quantities of volatile compounds.

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Performance History: Waste water evaporators are used within a variety of industries to reduce a variety of waste waters such as spent cutting fluids, emulsified oils, boiler and air compressor blow-down, stamping and die casting solutions, mop waters, wire drawing solutions, parts washer effluent or a variety of other water based that are free of a quantity of volatile organic compounds.

Comments: None.

Source of Information: Vendor

Extraction/ Handling

Company Name/POC	Pulse Drying Systems, Inc./Samuel G. N. Duncan		
	822 N.W. Murray Road		
	Suite 119		
	Portland, Oregon 97229		
E-Mail Address			
Product/Service	Pulse Drying/Evaporation	Phone Number	503 641-9427
Process Type	Other	Fax Number	503 641-7266

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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: Vendor

Company Name/POC	Rasmussen & Shioetz Anlaeg A/S (R&S Anlaeg A/S)/Lene W. Hartmann Industriholmen 82 2650 Hvidovre Denmark		
E-Mail Address			
Product/Service	Horizontal Guided Drilling	Phone Number	45 36 77 08 99
Process Type	Directional Wells	Fax Number	45 36 77 21 22

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: In-situ (saturated zone) In-situ (vadose zone)

Brief Description: Horizontal guided drilling is a technology used for in situ treatment of polluted soil and groundwater. Perforated pipes are positioned to give optimum contact to pollution, and treatment by pumping the polluted groundwater away, or injecting/extracting air can be carried out.

The technology has proved its applicability on traditional cleanup projects, where the normal approach would suggest a digging-away solution or use of vertical wells. However, the real strong feature of the horizontal guided drilling technology is its applicability on complicated locations, where other technologies cannot be used. R&S Anlaeg A/S has used the technology with success under landfills, houses, railroads and public parks.

Precise design of position of wells is prerequisite, as well as detailed geological and hydrogeological description of the ground in which the horizontal wells are to be drilled.

Product/Service 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. R&S Anlaeg A/S developed the technology to its present stage, and the development is ongoing, heading among other things towards new sampling techniques.

Comments: While drilling and installing production pipe, the only equipment needed is the drilling rig together with some ordinary construction equipment, including freshwater supply and power supply. The technology is difficult to use in very rocky soils. Easy and flexible to use for a well trained staff. Available everywhere.

Source of Information: International TechCon

Extraction/ Handling

Company Name/POC: Recra Environmental, Inc./Ken Kinecki	
10 Hazelwood Drive Amherst, New York 14228-2298	
E-Mail Address	
Product/Service Mini-Miser (TM) Dewatering System	Phone Number 716 691-2600
Process Type Dewatering	Fax Number 716 691-2617

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phases	☐ Free Products	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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 viscosity's, 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).

Product/Service 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: Vendor

Company Name/POC	Remediation Service International/Michael J. Joy 2060 Knoll Drive Suite 200 Ventura, California 93003		
E-Mail Address	rsi@west.net		
Product/Service	S.A.V.E. (TM) System	Phone Number	805 644-5892
Process Type	Free Product Recovery	Fax Number	805 654-0720

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☒ SVOC	☐ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ In-situ (saturated zone) In-situ (vadose zone) On site

Brief Description: The S.A.V.E. (TM) system is a unique and innovative approach to soil and groundwater remediation. It was designed to simultaneously extract hydrocarbon contamination from soil and remove benzene and MTBE from impacted groundwater while abating the off gasses created from both processes. RSI's equipment has been used successfully for soil venting, (hot) air injection, bioslurping, air stripping and abating off gasses with compressive thermal-catalytic oxidation.

Product/Service Maturity: Commercial use experience

Performance History: Remediation Service International (RSI) has produced over 150 remediation systems for the environmental industry during the past 9 years. RSI's systems have been used by the U.S. Air Force and Navy for soil venting, bioventing, bioslurping and bioremediation at various projects. Our technology has been used by IT Corporation to increase yield from a shallow aquifer using enhanced vacuum recovery. Still others have used our spray aeration to remove VOC (halogenated and nonhalogenated), MTBE, and other contaminants from extracted groundwater. In most cases RSI was also required to abate off gasses created from the processes to meet local air pollution control district guidelines. In some instances, we have treated condensate from land fill soil venting systems and/or abated methane from the soil venting process itself. Many consultants have applied the S.A.V.E. (TM) system successfully on many projects.

Comments: RSI has developed the Phoenix 1000 Auto Air Fuel Controller which is a fully automated operating system for the above mentioned systems. We generate our own necessary power and have no need for outside electrical power. We manufacture systems for sale, lease, or rent. Installation costs are minimal.

Source of Information: Vendor

Extraction/ Handling

Company Name/POC	Remediation Service International/Michael J. Joy		
	2060 Knoll Drive		
	Suite 200		
	Ventura, California 93003		
E-Mail Address	rsi@west.net		
Product/Service	S.A.V.E. (TM) System	Phone Number	805 644-5892
Process Type	Dewatering	Fax Number	805 654-0720

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☒ SVOC	☐ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☒ Surface Water
☐ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☒ Vapor Phase	☒ Free Product	☒ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ In-situ (saturated zone) In-situ (vadose zone) On site

Brief Description: The S.A.V.E. (TM) system is a unique and innovative approach to soil and groundwater remediation. It was designed to simultaneously extract hydrocarbon contamination from soil and remove benzene and MTBE from impacted groundwater while abating the off gasses created from both processes. RSI's equipment has been used successfully for soil venting, (hot) air injection, bioslurping, air stripping and abating off gasses with compressive thermal-catalytic oxidation.

Product/Service Maturity: Commercial use experience

Performance History: Remediation Service International (RSI) has produced over 150 remediation systems for the environmental industry during the past 9 years. RSI's systems have been used by the U.S. Air Force and Navy for soil venting, bioventing, bioslurping and bioremediation at various projects. Our technology has been used by IT Corporation to increase yield from a shallow aquifer using enhanced vacuum recovery. Still others have used our spray aeration to remove VOC (halogenated and nonhalogenated), MTBE, and other contaminants from extracted groundwater. In most cases RSI was also required to abate off gasses created from the processes to meet local air pollution control district guidelines. In some instances, we have treated condensate from land fill soil venting systems and/or abated methane from the soil venting process itself. Many consultants have applied the S.A.V.E. (TM) system successfully on many projects.

Comments: RSI has developed the Phoenix 1000 Auto Air Fuel Controller which is a fully automated operating system for the above mentioned systems. We generate our own necessary power and have no need for outside electrical power. We manufacture systems for sale, lease, or rent. Installation costs are minimal.

Source of Information: Vendor

Company Name/POC	RMJ Machinery/Richard M. Janko 4915 Van Epps Road Cleveland, Ohio 44131	
E-Mail Address		
Product/Service	Drum Decanter/Extruder and Drum Auger	Phone Number 216 351-8900
Process Type	Other	Fax Number 216 351-9508

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On site

Brief Description: RMJ's Drum Decanting Machine and Drum Auger System provides hazardous waste drum handling without endangering workers and equipment to hazardous environments or explosions.

RMJ provides safe, reliable systems with easy-to-use controls; safety interlocks, instrumentation; and programmed diagnostic software features. PLC diagnostics run continuously and can be accessed through the operator interface to show the system's operating status and any faults that may exist.

Unlike alternative processing methods such as shredders, which require a second process to separate the drum shell from the waste, RMJ units provide total separation of drum and waste in a single unit. This represents a considerable savings in terms of the initial investment of one process unit versus two, installation of a single unit and total time required to process a single drum.

Product/Service Maturity: Commercial use experience

Performance History: Contact company for list of users.

Comments: Maintenance costs are greatly reduced due to simplicity of design and ease of access to all control areas. The simplicity of design also means that very little operator training is required for machine operation, and one operator can now do the job that previously required two or three people. In addition, both units are manufactured as self-contained platforms which greatly reduce the customer's installation costs.

Source of Information: Vendor

Company Name/POC	RSI Research Ltd./Brad Moore Bldg. #3-203 Harbour Road Victoria, BC, Canada V9A 3S2		
E-Mail Address			
Product/Service	Radio Controlled Fork-Lift - Trucks	Phone Number	604 360-1025
Process Type	Robotics	Fax Number	604 360-1161

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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

Extraction/ Handling

Company Name/POC	Rusmar Incorporated/Laura White 216 Garfield Avenue West Chester, Pennsylvania 19380	
E-Mail Address		
Product/Service	Long Duration Foam	Phone Number 610 436-4314
Process Type	Emission Control	Fax Number 610 436-8436

Contaminants

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☐ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

Media

☐ Surface Impoundment	☒ Soil	☐ Process Water	☒ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☒ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ On site

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.

Product/Service 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

Extraction/ Handling

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 duration's 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: Vendor

Extraction/ Handling

Company Name/POC	Safe Environmental Storage/Customer Service 180 Devan Avenue Bensenville, Illinois 60106		
E-Mail Address			
Product/Service	Spill King	Phone Number	800 593-7233
Process Type	Other	Fax Number	800 593-0345

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: On site

Brief Description: 4 drum palletized spill containment pallets (secondary containment).

Product/Service Maturity: Commercial use experience

Performance History: Products have been in use for over 5 years with various case applications available. Meets and exceeds EPA and RCRA regulations.

Comments: None.

Source of Information: Vendor

Extraction/ Handling

Company Name/POC	Siemag Transplan GmbH/Klaus Simmich P.O. Box 1451 Obere Industriestrasse 8 57238 Netphen, Germany		
E-Mail Address			
Product/Service	Transport and Handling of Radioactive Waste	Phone Number	49 2738 21321
Process Type	Excavation, Retrieval, and Off-Site Disposal	Fax Number	49 2738 21502

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On 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.

Product/Service 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: Vendor

Company Name/POC	Sprung Instant Structures Inc./Glenn Harshman 5000 Tilghman Street #230 Allantown, Pennsylvania 18104-9102		
E-Mail Address	OLSONC@SPRUNG.COM		
Product/Service	Sprung Instant Structure	Phone Number	610 391-9553
Process Type	Other	Fax Number	610 391-0669

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: On site

Brief Description: Sprung instant structures are large span, relocatable enclosures utilized for waste remediation, warehousing, asbestos abatement, composting, recycling and environmental protection. These structures help to provide a sealed environment to effectively contain emissions during excavations. Sprung structures are modular in design, with widths ranging from 30ft to 180 ft requiring minimal foundations, if any. The structures withstand extreme high winds and by design shed snow. Available from inventory for lease or purchase.

Product/Service Maturity: Commercial use experience

Performance History: Contact vendor for list of users.

Comments: None.

Source of Information: Vendor

Extraction/ Handling

Company Name/POC	Star Systems Filtration Division/Judy Watkins
	101 Kershaw Street
	P.O. Box 518
	Timmons ville, South Carolina 29161
E-Mail Address	
Product/Service	Star Polypress
Process Type	Dewatering
	Phone Number 803 346-3101
	Fax Number 803 346-3736

Contaminants

☐ Pesticides/Herbicides	☒ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☒ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

Media

☐ Surface Impoundment	☐ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: On site

Brief Description: Star Systems has introduced larger semi-automatic filter presses for wastewater sludge dewatering. The Star PolyPress utilizes 1000MM recessed chamber plates constructed of polypropylene for lighter weight and lower cost. Other features and benefits include a plate shifter to minimize clean-out labor and an automatic pump control to minimize operator attention. Other options including feed pumps and sludge tanks are available.

Product/Service Maturity: Commercial use experience

Performance History: Performance data are available.

Comments: None.

Source of Information: Vendor

Extraction/ Handling

Company Name/POC Stord, Inc./Bruce Low
309 Regional Road South
Greensboro, North Carolina 27409-9674

E-Mail Address

Product/Service Stord ROTADISC Processor

Phone Number 910 668-7727

Process Type Dewatering

Fax Number 910 668-0537

Contaminants

☒ Pesticides/Herbicides	☒ Heavy Metals	☒ PCB	☐ Explosives/Propellants
☒ Petroleum Hydrocarbons	☒ Radionuclides	☒ SVOC	☒ Other Contaminant
☒ Nonhalogenated VOC	☒ Halogenated VOC	☐ N/A	

Media

☐ Surface Impoundment	☒ Soil	☒ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☒ Ground Water
☒ Process Wastes and Sludge			

Application: Ex-situ Off site On site

Brief Description: Thermal dewatering/desorption of compounds volatile within the operating temperature range of the ROTADISC Processor.

Product/Service Maturity: Commercial use experience Pilot plant testing Field demo complete

Performance History: Performance data are available.

Comments: None.

Source of Information: Vendor

Extraction/ Handling

Company Name/POC	Superior Industrial Maintenance Company/Steven E. Smith		
	P.O. Box 535		
	Mt Holly, North Carolina 28120		
E-Mail Address			
Product/Service	UST Services	Phone Number	704 827-0001
Process Type	Other	Fax Number	704 827-0013

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☒ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☒ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: On site

Brief Description: Superior Industrial Maintenance Company Inc.

...has specialized for several years in tank removal, tank installation, tank cleaning, sludge disposal, sandblasting, lead abatement, interior lining, exterior coating, fiberglass lining, installation of floating roofs, roof seals, geodesic domes, ultrasonic thickness testing, and various mechanical repairs and alterations.

...recognizes the importance of safety and employees are trained as required by the OSHA 29 CFR 1910.120 standards.

...has the following additional safety programs: Medical Surveillance, Qualitative Respirator Fit Testing, Hearing Conservation Program, CPR/First Aid Training, and Drug and Alcohol Free Work Place, and many others.

...is fully insured, bondable, and capable of handling large projects.

...will work evenings, nights, or weekends, as your situation demands.

Product/Service Maturity: Commercial use experience

Performance History: Contact vendor for additional information.

Comments: None.

Source of Information: Vendor

Extraction/ Handling

Company Name/POC	Teknisk Illustration HB/Mats Edvardsson Box 281 S-901 06 UMEA Sweden	
E-Mail Address		
Product/Service	AFAB Method (registered)	Phone Number 46 90 13 64 00
Process Type	Size reduction	Fax Number 46 90 13 78 00

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☒ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ Off site On site

Brief Description: Crushing of industrial waste to achieve higher density. Performance is between 50 - 100 percent better than existing methods.

Product/Service Maturity: Commercial use experience

Performance History: Testing during 92-93
Commercial use 93 and continued
Very good results for this application

Comments: Highly adaptable to most landfill sites.

Source of Information: Vendor

Extraction/ Handling

Company Name/POC telerob GmbH/Dr. Bernd Birkicht
Vogelsangstrasse 8
D-73760
Ostfildern, Germany

E-Mail Address

Product/Service Remote Robotics

Phone Number 49 711 348 0189

Process Type Robotics

Fax Number 49 711 348 0156

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

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.

Product/Service 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: Vendor

Extraction/ Handling

Company Name/POC	telerob GmbH/Dr. Bernd Birkicht Vogelsangstrasse 8 D-73760 Ostfildern, Germany	
E-Mail Address		
Product/Service	High Performance Pulsed Power Technology (HP3T)	Phone Number 49 711 348 0189
Process Type	Size reduction	Fax Number 49 711 348 0156

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☒ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☒ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: This technology uses high power pulses to crack solid materials (concrete, etc.) without harming the base material (tank, piping).

Product/Service 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: Vendor

Extraction/ Handling

Company Name/POC	VAC-U-MAX/Customer Service 37 Rutgers Street Belleville, New Jersey 07109	
E-Mail Address	VACUMAX37@AOL.COM	
Product/Service	Industrial Vacuum Cleaning Systems	Phone Number 201 759-4600
Process Type	Other	Fax Number 201 759-6449

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☒ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☐ N/A	

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
☐ Construction Materials/Debris	☐ Landfills	☐ Drums/Tanks/Piping	☐ Containers/Equipment
☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☒ Process Wastes and Sludge			

Application: Other Application

Brief Description: VAC-U-MAX is a worldwide provider of industrial vacuum cleaning systems and pneumatic conveying systems. Our products are in use in most major markets.

Product/Service Maturity: Commercial use experience Field demo complete

Performance History: VAC-U-MAX invented the worlds first venturi powered air vacuum in the 1950s.

Comments: None.

Source of Information: Vendor

Company Name/POC	W.S. Atkins Consultants Ltd./Dr. R. B. Dean/Mr. R. Dexter-Smith Woodcote Grove Ashley Road Epsom, Surrey, KT18 5BW, UK	
E-Mail Address		
Product/Service	Innovative Approach to Robotics Design	Phone Number 1372 726140
Process Type	Robotics	Fax Number 01372 740055

Contaminants

☐ Pesticides/Herbicides	☐ Heavy Metals	☐ PCB	☐ Explosives/Propellants
☐ Petroleum Hydrocarbons	☐ Radionuclides	☐ SVOC	☐ Other Contaminant
☐ Nonhalogenated VOC	☐ Halogenated VOC	☒ N/A	

Media

☐ Surface Impoundment	☐ Soil	☐ Process Water	☐ Surface Water
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☐ Sediments in Water	☐ Vapor Phase	☐ Free Product	☐ Ground Water
☐ Process Wastes and Sludge			

Application: Ex-situ On site

Brief Description: Innovative approach to adapting existing technology for design and manufacture of robotics for survey and sampling in hazardous environmental/radioactive conditions.

Product/Service 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