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SURVEY OF COMMERCIAL FIRMS
WITH MIXED-WASTE TREATABILITY STUDY CAPABILITY

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ABSTRACT

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According to the data developed for the Proposed Site Treatment Plans, the U.S. Department of Energy (DOE) mixed low-level and mixed transuranic waste inventory was estimated at 230,000 m³ and embodied in approximately 2,000 waste streams. Many of these streams are unique and may require new technologies to facilitate compliance with Resource Conservation and Recovery Act disposal requirements. Because most waste streams are unique, a demonstration of the selected technologies is justified. Evaluation of commercially available or innovative technologies in a treatability study is a cost-effective method of providing a demonstration of the technology and supporting decisions on technology selection.

This paper summarizes a document being prepared by the Mixed Waste Focus Area of the DOE Office of Science and Technology (EM-50). The document will provide DOE waste managers with a list of commercial firms (and universities) that have mixed-waste treatability study capabilities and with the specifics regarding the technologies available at those facilities. In addition, the document will provide a short summary of key points of the relevant regulations affecting treatability studies and will compile recommendations for successfully conducting an off-site treatability study.

Interim results of the supplier survey are tabulated in this paper. The tabulation demonstrates that treatment technologies in 17 of the U.S. Environmental Protection Agency's technology categories are available at commercial facilities. These technologies include straightforward application of standard technologies, such as pyrolysis, as well as proprietary technologies developed specifically for mixed waste. The paper also discusses the key points of the management of commercial mixed-waste treatability studies.

INTRODUCTION

Treatability studies represent a ready vehicle for U.S. Department of Energy (DOE) waste managers to evaluate and demonstrate both available and innovative treatment technologies on mixed-waste streams. The U.S. Environmental Protection Agency's (EPA) Resource Conservation and Recovery Act (RCRA) regulations (Title 40, Code of Federal Regulations, Part 261 and following) exempt limited volumes of waste from treatment in fully permitted facilities for the purposes of technology screening and process data compilation. In most states, up to 1,000 kg of hazardous waste and up to 10,000 kg of media contaminated with hazardous waste can be treated under the RCRA treatability study exemption. The Toxic Substances Control Act (TSCA) regulations are less specific on this point but recognize the need.

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COMMERCIAL MIXED-WASTE TREATABILITY STUDY SUPPLIERS

To provide a service to DOE's waste managers, the Mixed Waste Focus Area (MWFA) of the DOE Office of Science and Technology (EM-50) is undertaking a survey to identify firms with current capability in the treatment of mixed waste at the treatability study scale. The survey has compiled candidate firms from three sources of information. The EPA's Vendor Information System for Innovative Treatment Technologies (VISITT) database was queried for firms with a background in the treatment of both hazardous and radioactive waste. The DOE Tech-Con database, resident at Argonne National Laboratory, was also reviewed. Finally, Lockheed Martin Idaho Technologies published an announcement in the *Commerce Business Daily* to identify any new sources.

Over 100 firms were identified from these three sources, and a representative from the MWFA contacted all firms by phone to determine whether they have current capability and interest in participating in the survey. Subsequently, the interested firms were sent questionnaires to characterize their capability and history in mixed-waste treatability studies. Contact information of some firms was not correct, and those leads were deleted from further consideration. To identify and confirm each firm's specific capability, the questionnaire asked for the following:

- Name of facility and facility contact
- Technologies available through that firm
- Waste matrices/hazardous constituents treated by that firm
- Copies of radioactive material licenses (to identify curie limits in acceptance)
- Relevant other limits of their waste acceptance criteria
- Demonstration unit capacity
- Treatability study history
- Lists of publications or technical papers presented on the results of that firm's treatability studies.

Information from the survey forms has been received, and pertinent information has been compiled into a database. At this time, the survey results are considered "work in progress," as a number of firms failed to respond and some responses raise questions. In addition, the MWFA intends to categorize the companies into several groups after detailed review of the questionnaires.

Table I presents the information received (to date) according to the general treatment technology category available from the firms. It also lists the firms in each technology category along with their contact names and phone numbers. This table was compiled directly from the questionnaire results with limited validation.

DOE facilities interested in complete questionnaire responses should contact the MWFA at the Idaho National Engineering Laboratory in Idaho Falls, Idaho.

The following conclusions result from the data presented:

- Eighty-two processes are available in 17 of the EPA's general technology categories.
- Responses have included both waste management and environmental restoration technologies.
- At least three different categories of firms responded to the questionnaire. A limited number have current capability for mixed-waste treatability studies in existing processing systems with U.S. Nuclear Regulatory Commission (NRC) (or state) permits for radioactive materials and have either treatability study capability or full RCRA operating permits. A second group of respondents has technologies available, but mixed-waste treatability studies are available at permitted facilities owned by others. A third group identified technologies but made no indication of mixed-waste treatability study capability.
- Several firms expect an NRC or state radioactive materials license very soon.
- Many firms responded positively to the telephone screen but did not return the completed questionnaire.
- Radioactive license limits are typically radionuclide-specific, but total curie possession as high as 10 is available.
- Two commercial suppliers identified the ability to accept plutonium in gram quantities.

Prior to issuance of the report from the MWFA, several additional checks will be made. Data will be presented to identify the firms by category: those with fully permitted facilities, those with a technology and access to fully permitted facilities, and those with a technology only. Note that the MWFA requested copies of relevant permits and licenses. This information will be used to confirm capabilities, where appropriate. In addition, each firm will have an opportunity to correct or expand on information presented. After these data checks, the supplier data are expected to be considered complete for publishing.

TREATABILITY STUDY MANAGEMENT ISSUES

The MWFA document also provides recommendations for conducting mixed-waste treatability studies. This information was compiled from several EPA guidance manuals and discussions with DOE waste managers who have contracted for off-site treatability studies as well as from reports generated within DOE. The document discusses the issues in detail. The following are some key points taken from the discussion:

- The document generally advises that each of DOE's waste streams is in some fashion unique, and a quick confirmation of the applicability of a technology is excellent insurance against process failure.

- Several of the EPA guidance documents (1, 2, 3, 4, 5) address the development of the overall project objectives. Generally speaking, the level of data quality should be adjusted to reflect whether the treatability study is a simple screening test or one that is performed to develop complete process design data.
- The availability of commercial suppliers of a technology and treatability study can significantly affect cost. In particular, the availability of an existing pilot plant can offer a significant cost and schedule advantage.
- Residues disposition should be carefully considered. Generally, the residues from a treatability study are subjected to a hazardous waste determination, and it is important that the original generator not be required to perform additional treatment on the residues.
- Jolley et al. (6) recommends a readiness review to ensure that all contractual, regulatory, and health and safety issues be considered prior to conducting the test.
- At least one run of a treatability study should be observed to ensure compliance with the test plan.
- A management process for approving quick changes in the treatability study should be implemented. Frequently, project changes may be warranted based on interim results, and a rapid change approval expedites the treatability study completion.

TREATABILITY STUDY REGULATORY FRAMEWORK

DOE mixed-waste treatability studies, conducted in accordance with the RCRA, are potentially subject to numerous other national and state regulations, as well as to various DOE Orders. Treatability studies dealing with environmental restoration wastes generated at sites regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) will be subject to CERCLA requirements. If the treatability study involves polychlorinated biphenyls, the requirements of the TSCA will apply. If the study is conducted at a commercial treatability study laboratory or treatment facility, the facility must have a received radioactive materials license from the NRC. Waste samples transported to off-site facilities by common carriers must meet packaging requirements of RCRA, the NRC, and the U.S. Department of Transportation. DOE Orders on the management of a commercial facility will also apply. The DOE is also responsible for complying with the provisions of the National Environmental Policy Act.

The MWFA document will discuss each of these regulatory frameworks separately and will summarize pertinent issues to be addressed.

CONCLUSION

Treatability studies represent a viable option for demonstrating available and innovative technologies on DOE mixed wastes. The MWFA will continue to collect information from treatability study firms, analyze the data, and verify capabilities before publishing the results. Interim results from the survey indicate that there are a number of commercial and university suppliers who can currently demonstrate technologies in their own licensed facilities, and there are many other technology owners with access to facilities with the appropriate permits and licenses.

REFERENCES

1. U.S. ENVIRONMENTAL PROTECTION AGENCY, "Data Quality Objectives for Remedial Response Activities," EPA/540/g-87/003, Environmental Protection Agency (1987).
2. U.S. ENVIRONMENTAL PROTECTION AGENCY, "Guide for Conducting Treatability Studies Under CERCLA: Soil Vapor Extraction," EPA/540/2-91/019a, Environmental Protection Agency (September 1991a).
3. U.S. ENVIRONMENTAL PROTECTION AGENCY, "Guide for Conducting Treatability Studies Under CERCLA: Soil Washing," EPA/540/2-91/020a, Environmental Protection Agency (September 1991b).
4. U.S. ENVIRONMENTAL PROTECTION AGENCY, "Guide for Conducting Treatability Studies Under CERCLA: Solvent Extraction," EPA/540/R-92/016a, Environmental Protection Agency (August 1992).
5. U.S. ENVIRONMENTAL PROTECTION AGENCY, "Guide for Conducting Treatability Studies under CERCLA," EPA.540R-92/071A, EPA Office of Solid Waste and Emergency Response (October 1992).
6. R.L. JOLLEY, M.I. MORRIS, and S.P.N. SINGH, "Guidance Manual for Conducting Technology Development Activities," ORNL/TM-11848, Oak Ridge National Laboratory (December 1991).

Table I
Interim Results of Treatability Study Survey

Technology by Category	Company	Contact	Phone
<u>Amalgamation</u>			
Amalgamation	IT Corporation	Ed Alperin, QEP	(423) 690-3211
<u>Biodegradation</u>			
Air Sparging/Soil Vapor Extraction	Brown and Root Environmental	Richard Ninestee	(412) 921-8746
Excavated Soil Biotreatment (BIOFAST)	IT Corporation	Ed Alperin, QEP	(423) 690-3211
Insitu/Exsitu Biological Treatment	IT Corporation	Ed Alperin, QEP	(423) 690-3211
Modified Activated Sludge	Maxim Technologies, Inc.	Robert Bessent	(314) 426-0880
Research and Development	Radian Corporation	David Swindle	(423) 220-8218
<u>Chemical Oxidation</u>			
Chemical Photolysis	Institute for Environmental Health & Safety	Solomon Leung	(208) 236-2524
Fenton's Reagent Oxidation	Institute for Environmental Health & Safety	Solomon Leung	(208) 236-2524
UV Photolysis	IT Corporation	Ed Alperin, QEP	(423) 690-3211
<u>Containment</u>			
Soil Saw Barrier System	Brown and Root Environmental	Richard Ninestee	(412) 921-8746
<u>Deactivation</u>			
Compressed Gases	Earth Resources Corporation	Sheila Berry	(407)877-0877
Deactivation	IT Corporation	Ed Alperin, QEP	(423) 690-3211
<u>Debris Washing</u>			
Debris Decontamination	IT Corporation	Ed Alperin, QEP	(423) 690-3211

Table I (Continued)
Interim Results of Treatability Study Survey

Technology by Category	Company	Contact	Phone
<u>Incineration</u>			
Disposal of Liquid Organics	Perma-Fix Environmental Services	Bob Foster	(904) 373-6066
Fluid-Bed Calcination	Energy and Environmental Research Center	Ed Steadman	(701) 777-5157
Incineration	IT Corporation	Ed Alperin, QEP	(423) 690-3211
Industrial boiler used for energy recovery	Chemical Waste Management, Inc.	Richard Dabolt	(423) 376-0084
LVS Processing	Perma-Fix Environmental Services	Bob Foster	(904) 373-6066
Pyrolysis	Energy and Environmental Research Center	Ed Steadman	(701) 777-5157
<u>Macroencapsulation</u>			
Macroencapsulation	IT Corporation	Ed Alperin, QEP	(423) 690-3211
<u>Organic Destruction</u>			
Base Catalyzed Decomposition (BCD)	IT Corporation	Ed Alperin, QEP	(423) 690-3211
Chemical Dehalogenation	IT Corporation	Ed Alperin, QEP	(423) 690-3211
Electrochemical Ion Exchange (EIX)	Selentec	Michael J. Dunn	(770) 640-7059
H ₂ O ₂ /Ozone Treatment of Liquid Waste	Maxim Technologies, Inc.	Robert Bessent	(314) 426-0880
Incineration studies	Hazen Research Inc.	Rodney C. Hodgson	(303) 279-4501
Molten Salt Oxidation	WMX Technologies Inc	Edward Wannemacher	(803) 646-2413
PO*WW*ER	WMX Technologies Inc.	Edward Wannemacher	(803) 646-2413
UV Photolysis/Chemical Oxidation	IT Corporation	Ed Alperin, QEP	(423) 690-3211

Table I (Continued)
Interim Results of Treatability Study Survey

Technology by Category	Company	Contact	Phone
<u>Recovery of Metals</u>			
Activated Carbon	Energy and Environmental Research Center	Ed Steadman	(701) 777-5157
Centrifugal Membrane Filtration	Energy and Environmental Research Center	Ed Steadman	(701) 777-5157
CHEMIC	Atomic Energy of Canada Limited	Leo D. Buckley	(613) 584-3311
Chemical Leaching/Mineral Flotation	Hazen Research Inc.	Rodney C. Hodgson	(303) 279-4501
Diphonix Ion Exchange	Eichrom Industries, Inc.	Jim Harvey	(708) 963-0320
Electro-Chemical Separation	IT Corporation	Ed Alperin, QEP	(423) 690-3211
Freeze Separation	WMX Technologies Inc.	Edward Wannemacher	(803) 646-2413
MAG*SEP	Selentec	Michael J. Dunn	(770) 640-7059
Precipitation	IT Corporation	Ed Alperin, QEP	(423) 690-3211
Quantum-Catalytic Extraction Processing	M4 Environmental Management Inc.	Robert Sameski	(423) 220-5017
Reverse Osmosis	IT Corporation	Ed Alperin, QEP	(423) 690-3211
Solvent Extraction	Hazen Research Inc.	Rodney C. Hodgson	(303) 279-4501
<u>Recovery of Organics</u>			
Adsorption Media	IT Corporation	Ed Alperin, QEP	(423) 690-3211
Chemical Extraction with/without chelants	IT Corporation	Ed Alperin, QEP	(423) 690-3211
DECHLOR	WMX Technologies Inc.	Edward Wannemacher	(803) 646-2413
Liquified Gas Solvent Extraction	CF Systems	Michael Finton	(216) 523-5286
Low Temperature Thermal Desorption	IT Corporation	Ed Alperin, QEP	(423) 690-3211
Thermal Desorption	Hazen Research Inc.	Rodney C. Hodgson	(303) 279-4501
VAC*TRAX	WMX Technologies Inc.	Edward Wannemacher	(803) 646-2413

Table I (Continued)
Interim Results of Treatability Study Survey

Technology by Category	Company	Contact	Phone
<u>Retorting for Mercury</u>			
Low Temperature Thermal Desorption	IT Corporation	Ed Alperin, QEP	(423) 690-3211
Retorting for Mercury	Hazen Research Inc.	Rodney C. Hodgson	(303) 279-4501
<u>Soil Washing</u>			
Acid Extraction of Soil/Sediment	Maxim Technologies, Inc.	Robert Bessent	(314) 426-0880
ACT*DE*CON	Selentec	Michael J. Dunn	(770) 640-7059
Materials Handling/Soil Washing/Gravity Separation	Hazen Research Inc.	Rodney C. Hodgson	(303) 279-4501
Segmented Gate System	Thermo Nutech	Jeff Brown	(423) 481-0683
Soil Washing	Alternative Remedial Technologies	Michael J. Mann	(813) 264-3571
Soil Washing	Westinghouse STC	Nancy H. Ulerich	(412) 256-2198
Soil Washing/Flushing	IT Corporation	Ed Alperin, QEP	(423) 690-3211
SOIL*EX	WMX Technologies Inc.	Edward Wannemacher	(803) 646-2413
TERRAMET Technology	Cognis, Inc.	Eric Klein	(707) 576-6239
TVIES	TVIES	Dr. Myron Kuhlman	(713) 799-5289
<u>Stabilization</u>			
Aquaset/Petroset	Fluid Tech, Inc.	Thomas Murarik	(702) 871-1884
Auger Mixing System	Brown and Root Environmental	Richard Ninesteel	(412) 921-8746
CHEM MATRIX	WMX Technologies Inc.	Edward Wannemacher	(803) 646-2413
High Shear Waste Immobilization	Westinghouse STC	Nancy H. Ulerich	(412) 256-2198
Jet Grouting	Brown and Root Environmental	Richard Ninesteel	(412) 921-8746
Non-Thermal Stabilization	Envirocare of Utah, Inc.	Sue Rice	(801) 532-1330
Perma-Fix Process	Perma-Fix Environmental Services	Bob Foster	(904) 373-6066
Phoenix Ash Technology (TIDE Bricks)	WMX Technologies Inc.	Edward Wannemacher	(803) 646-2413
Research and Development	Perma-Fix Environmental Services	Bob Foster	(904) 373-6066

Table I (Continued)
Interim Results of Treatability Study Survey

Technology by Category	Company	Contact	Phone
<u>Stabilization (Continued)</u>			
Soil Rake	Brown and Root Environmental	Richard Ninesteel	(412) 921-8746
Stabilization/ Solidification	IT Corporation	Ed Alperin, QEP	(423) 690-3211
Superset	Carlo Environmental Technologies, Inc.	Keith Flemingloss	(810) 468-9580
<u>Steam Stripping</u>			
Organic Phase Transfer	Maxim Technologies, Inc.	Robert Bessent	(314) 426-0880
Steam/Air Stripping	IT Corporation	Ed Alperin, QEP	(423) 690-3211
<u>Vitrification</u>			
Cold Crucible Vitrification	WMX Technologies Inc.	Edward Wannemacher	(803) 646-2413
DC Graphite Arc Melter	Electro-Pyrolysis, Inc.	J. Kenneth Wittle	(610) 687-9070
In Situ Vitrification (ISV)	Geosafe Corporation	Matthew Haass	(505) 375-0710
Joule-Heated Melters	WMX Technologies Inc.	Edward Wannemacher	(803) 646-2413
Plasma	Westinghouse STC	Nancy H. Ulerich	(412) 256-2198
Plasma Centrifugal Furnace	MSE Technology Applications, Inc.	Jeff Ruffner	(406) 494-7412
Plasma Hearth Process	Science Applications International Corporation		(208) 528-2179
Vitrification	IT Corporation	Ed Alperin, QEP	(423) 690-3211
<u>Wet Oxidation</u>			
Hydrothermal Boiler	Energy and Environmental Research Center	Ed Steadman	(701) 777-5157
Wet Air Oxidation	IT Corporation	Ed Alperin, QEP	(423) 690-3211

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