
MIXED WASTE INTEGRATED PROGRAM

The Challenges of Mixed Waste Program Research, Development, Demonstration, Testing and Evaluation (RDDT&E)

Mixed waste contains both radioactive and hazardous contaminants. Throughout the U.S. Department of Energy (DOE) Complex, the mixed waste problem is significant because definitive treatment standards have not been established and no disposal facilities designated for mixed waste are available. In addition to these constraints, treatment capability and capacity are very limited. Therefore, DOE sites must store mixed waste for future disposal, despite that this situation may pose a risk to the public, and in addition may result in not complying with applicable regulations governing mixed waste.

In response to the urgent need for a comprehensive and consistent approach to the complex issue of mixed waste management, the DOE Office of Technology Development (EM-50), has established the Mixed Waste Integrated Program. The program is linked to environmental restoration and waste management needs, to ensure that treatment capability is developed.

Special Regulatory Considerations

DOE's approach to mixed waste treatment and site remediation is governed by state and federal regulations for both hazardous and radioactive materials. This creates circumstances where dual regulations, which were designed to govern the management of either hazardous or radioactive wastes, apply. Inconsistencies among these regulations complicates development of methods for treating and disposing of mixed waste.

Definitive treatment standards are lacking for low-level and transuranic mixed waste from DOE facilities. Available capacity and technology are insufficient to treat mixed waste both commercially and within the DOE system. Such wastes must therefore be stored for future disposal in facilities for which criteria have not been established. This has required DOE to enter into compliance agreements with various regulatory agencies. Despite the lack of disposal criteria, regulations and compliance agreements governing mixed waste require waste treatment and/or site remediation by specific deadlines. Simultaneously, the generation of mixed waste continues from plant operations. This regulatory quandary forms a challenging framework for development and implementation of mixed waste technology research, development, demonstration, testing and evaluation (RDDT&E).

An approach addressing DOE mixed waste has been developed using requirements set forth in the Resources Conservation and Recovery Act (RCRA) for Waste Management projects supervised by EM-30, and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) for Environmental Restoration projects under EM-40. This approach includes a hierarchy of activities.

The Size and Scope of the Mixed Waste Problem

A total of approximately 247,000 cubic meters of mixed low-level waste is stored at DOE site. DOE is working to comply with new Land Disposal Restrictions (LDR). Meanwhile, the generation of mixed waste continues at the rate of 56,000 cubic meters per year.

DOE has classified over 1400 mixed waste streams into categories that require similar processing steps for assignment of baseline treatment. Baseline treatment schemes for each waste category have been segregated into various technical areas including: front end handling; physical/chemical treatment; waste destruction; off gas treatment; and final forms. The program requires significant funding for research, development and implementation of effective treatment and disposal technologies.

System Requirements for Effective Mixed Waste Treatment

Key issues that affect the ability of DOE to assign definitive system requirements to the treatment of mixed waste include:

Waste acceptance criteria for disposal. No criteria for on-site disposal have been established, and limited commercial disposal of radioactive materials has been approved.

Recycle of decontaminated material. No de minimus levels for radioactivity have been established.

Incineration of organic material and oxidation through thermal reaction. The public generally does not support combustion technology.

Analysis to address additional system requirements will consider methods such as CERCLA's evaluation criteria.

The Future of the Program

The DOE Office of Technology Development (EM-50) is conducting ongoing RDDT&E to assist the Offices of Environmental Restoration (EM-40), and Waste Management (EM-30), within the DOE Office of Environmental Restoration and Waste Management (EM), in selecting alternative treatment methods for mixed waste.

A baseline treatment scheme, using current technologies, has been established by EM-30. This includes disposal of radioactive material, recycle of contaminated material, and thermal treatment. System requirements are being determined for these activities. The goals of the EM-50 program are to assist in establishing system requirements, and to enhance or improve the baseline technologies such that the chosen treatment systems can be implemented at lower cost, and at lower risk than the baseline. When this goal is met, then the cost of RDDT&E will be recovered.

DOE must store wastes while treatment capacity is being developed. The role of EM-30 is to construct waste treatment facilities and procure waste treatment services to ensure that adequate treatment capacity is available for mixed waste. The role of EM-50 is to develop a suite of technologies that will treat mixed waste to acceptable criteria and to provide design and reliability data to EM-30 and EM-40 within the required schedule to support the implementation of mixed waste treatment technologies.

For further information contact:

Paul Hart
DOE Mixed Waste Program Manager
(301) 903-7456

Jan Berry
Mixed Waste Integrated Program
Coordinator
(615) 574-6907

Selected Past Accomplishments

Completed construction and installation of a pilot scale microwave melter which provides an 80% volume reduction over present cementation process.

Designed prototype of molten salt mixed waste processing system.

Demonstrate microwave vitrification of Rocky Flats sludge.

Completed bench-scale testing of a silent discharge plasma unit to destroy hazardous volatile organic compounds contained in gas streams generated by primary treatment technologies. For example, this technology holds significant value for use with small volume incinerators and other thermal treatment methods to aid compliance with increasingly stringent clean air requirements. It is an effective technology for hazardous organics which are a significant portion of the DOE's waste streams, and has been used successfully in the destruction of other hazardous materials including nerve agents.

Completed plasma arc proof-of-principle treatment showing both the destruction of organic compounds as required to down-classify the waste from the mixed waste category and the resulting production of a highly durable, leach resistant waste form.

Completed design, fabrication and EPA Superfund innovative technology evaluation program on DOE / Industry / EPA plasma arc furnace.

Completed pilot-scale testing of a plasma furnace, and began testing on an arc plasma pilot unit for treating buried and stored mixed waste. Both the furnace and arc plasma units not only destroy organic compounds but also melt mixed waste into solid, stable forms which will satisfy regulatory compliance issues and provide for safe, cost-effective long term storage.

The plasma arc furnace successfully demonstrated destruction of hazardous organic contaminants and immobilization of toxic heavy metals from the Clark Fork Superfund site.

A versatile plasma arc process has been shown to destroy organics in surrogate Rocky Flats compacted drum waste and to effectively vitrify buried waste soils initial tests with surrogate wastes have produced a stable glass waste form. This technology provides alternate treatment to incineration.

Determined final disposal methods for hexane tank waste at Hanford and procured commercial services for hexane disposal.

Installed microwave drying and vitrification system at Rocky Flats.

Initiated effort for a fluidized bed unit with off-gas capture at Rocky Flats.

Initiated examination of cement mixtures for immobilizing heavy metals at Rocky Flats.

Developed a national program designed to meet the requirements of the regulatory community.

Initiated development of a national strategy for mixed waste disposal in collaboration with users (EM-351 MWTP).

1993 Accomplishments/Objectives

Identification, evaluation and selection of technologies to establish a baseline for comparison in subsequent trade off analyses.

Conducted bench-scale demonstrations of the production of enhanced waste forms for the vitrify-to-dispose effort.

Conducted life-cycle cost analysis of plasma hearth and alternative waste treatment technologies.

Developed risk assessment strategy/methodology and completed preliminary hazards assessments on plasma hearth system and vitrification system.

1994 Objectives

A plasma hearth process will be tested at bench scale for destruction and stabilization of surrogate mixed waste sludge streams.

The commercial status of and RD needs for closed treatment systems will be evaluated.

Conduct system feasibility assessments to support national and site-specific treatment process flow sheets.

Initiate inclusion of off-gas treatment and monitoring technologies into thermal treatment demonstrations.

Initiate testing of biological treatment methods.

Identify and select characterization, instrumentation, sorting, handling and feed preparation technologies for testing.

Support collaboration with States/EPA/stakeholders to support decision making on mixed waste technologies.

1995 Planned Objectives

Evaluate the feasibility and test data to provide down selection of competing technologies.

Organize technologies for treatment various generic waste streams into systems as engineering data becomes available.

Identify knowledge gaps which will become the basis for testing in treatment systems descriptions.

Complete pilot-scale testing of plasma treatment on cold surrogate mixed waste and permitting process to enable initiation of bench-scale testing on radioactive mixed waste.

Perform hot (radioactive) tests with the plasma arc unit.

Conduct pilot-scale vitrification with surrogates for the vitrify-to-dispose effort.

Conduct pilot-scale off-gas treatment demonstration with surrogates coupled with thermal treatment technology.

Initiate testing of characterization, instrumentation, sorting, handling and feed preparation technologies for mixed waste.

Accelerate development of alternatives to incineration technologies. Initiate development of closed loop thermal treatment systems. Examine several alternative designs for closed loop thermal treatment systems.

Initiate an accelerated waste forms performance criteria effort linked to performance assessment of the waste form in hazardous waste disposal sites.