

C/ORNL99-0543

**CRADA Final Report
For
CRADA Number ORNL99-0543**

**Bottoms-Up In-Situ Vitrification
Of Hard-to-Treat
Buried Mixed Wastes**

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Abstract

This Phase I project was designed to demonstrate feasibility of in situ waste destruction and vitrification technology as a means of remediating hard-to-treat buried radioactive and hazardous wastes and focused on proving viability of the concentric graphite arc melter technique as a robust, safe, and economic tool for use as the IWDV process heat source. Oak Ridge National Laboratory provided technical support to Montec Research including the volatile behavior of elements during silicate melting operations and temperature viscosity modeling of silicate melts. Further research will be needed to develop this technology into a competitive remediation technique.

Statement of the Objectives

The purpose of the CRADA was to assist with the development of a safer technique for the in situ vitrification of radioactive soil and wastes than the previously developed top-down method of in situ vitrification (ISV) using joule heating. The previous ISV top-down technique has experienced significant problems with melt expulsions during processing of containerized waste and in soils with excessive moisture contents. This Phase I project (sponsored by a DOE Small Business Technology Transfer Program Grant to Montec Research) was designed to demonstrate feasibility of in situ waste destruction and vitrification (IWDV) technology as a means of remediating such hard-to-treat wastes and focused on proving viability of the concentric graphite arc melter (CGAM) as a robust, safe, and economic tool for use as the IWDV process heat source. IWDV using the CGAM offers a potential novel, robust, safe, bottoms-up in situ vitrification process to destroy and/or permanently stabilize hard-to-treat buried radioactive and mixed wastes, i.e., wastes that are deeply buried, highly radioactive, heterogeneous, and/or located in high moisture content soils.

The technical objectives of this Phase 1, STRR project are:

1. Demonstrate feasibility of the in situ waste destruction and vitrification technology as a viable means for remediating hard-to-treat wastes; and
2. Prove viability of the concentric graphite arc melter as a robust, safe, and economic tool for use as the process heat source.

Benefits to the Funding DOE Office's Mission

The investigated technology, IWDV, is directly applicable to DOE mixed and radioactive buried waste and contaminated soil included in B&R codes EW 40 90 10 0 and EW 20 10 30 1. The proposed technology addresses specific buried waste scenarios which are difficult to vitrify using currently established technologies. The successful development of IWDV should make waste site remediation cheaper, faster, and safer.

Technical Discussion

ORNL technical support to Montec Research included:

1. The identification and transmittal of published information on volatile behavior of elements and radionuclides during various vitrification processes and technologies including previous work with traditional ISV performed at ORNL over the past ten years.
2. The transmittal of various unpublished technical material on buried waste container effects with conventional top-down ISV melt bodies to aide Montec Research in designing tests of IWDV with included waste containers.

3. The application of a geochemical silicate melt properties model to various soil elemental compositions to predict melt viscosity versus melt temperature for processing and modeling using the CGAM heat source. Specifically, the MELTS model (Ghiorso and Sack 1995) was installed on an ORNL UNIX platform computer and various soil elemental compositions modeled for temperature-viscosity relationships. However, the model was not applied to any soil tested by Montec Research during this project.

Inventions

The ORNL subtask of this CRADA did not produce any inventions or patents due to the nature of the technical advisory role.

Commercialization Possibilities

The commercial application of in situ waste destruction and vitrification include the remediation of buried mixed wastes throughout the DOE complex and at military sites. The process has niche application for the remediation of buried hazardous wastes at numerous industrial sites.

Plans for Future Collaboration

A follow-up application for an SBIR/STTR, Phase II, funding was not submitted due to the difficulty of a small business like Montec Research to pioneer applications of this promising remedial technique at DOE sites because of the numerous technical challenges and uncertainties, unique to each DOE site application, which restrict its selection over already established and more expensive technologies even with the huge potential cost savings of IWDV. However, collaboration between ORNL and Montec Research was continued in another technical area with submission of a collaborative proposal entitled, "In Situ Analysis of Total Soil Carbon Using Plasma Torch Combustion," to the DOE Office of Science in February 2000.

References

Ghiorso, Mark S., and Sack, Richard O. (1995) Chemical Mass Transfer in Magmatic Processes. IV. A Revised and Internally Consistent Thermodynamic Model for the Interpolation and Extrapolation of Liquid-Solid Equilibria in Magmatic Systems at Elevated Temperatures and Pressures. *Contributions to Mineralogy and Petrology*, 119, 197-212.

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