

Monthly Research Progress

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Task 1 Support of Oak Ridge Site Closure

Characterization of Corrosion for Closure of Oak Ridge Research Reactor

Due to lack of funds for the 2007 federal fiscal year, our Oak Ridge collaborators were unable to provide the support required to enable deployment into the Oak Ridge Research Reactor (ORRR) pool.

Task 2 Support of Hanford Single Shell Tank Waste Disposition

In-tank/At-Tank Characterization for Closure of Hanford Waste Tanks

Stereovision. Progress on the stereovision effort was significantly slowed during December by the unexpected departure of the graduate student working on this effort. The retroactive rescission of CA07 funds in May have prevented replacement of the graduate student. Lack of manpower significantly limits progress on this and other efforts. The literature review of recent stereovision research continued.

Fourier Transform Profilometry. The ICET Fourier Transform Profilometry (FTP) task has almost completed its efforts to incorporate corrections that address how FTP handles curved (non-perpendicular) background surfaces (such as a curved waste tank bottom). Efforts on procedures for how to best propagate height across stitched image boundaries are continuing. Efforts continue to explore the feasibility of utilizing a higher-resolution camera for FTP volume determinations in tanks.

Process Chemistry and Operations Planning for Hanford Waste Alternatives

Software for automating the ESP code has been completed. Testing against process runs already conducted will be performed in January. Details for parsing and separating the output files will be developed. Further discussions are in progress with CH2M Hill engineers concerning the retrieval schedule for the C-farm tanks. It is likely that the neural network will be expanded to include transfers to multiple double shell tanks to ensure that the coverage of the neural network encompass all of the transfer possibilities.

Discussions have been initiated with OLI System Inc. employees regarding database development for 2008. Of pertinent interest is the Na-SO₄-CO₃ system that could not be included in the first porting of the V7DBLSLT database to the MSE formalism and the incorporation of the zeolite database into MSE. This later compilation was developed by workers at SRNL and will have direct application to the Hanford waste. The zeolite database was originally developed for ESP version 6.5 and has not been updated. Preliminary calculations indicate that the database does not adequately describe the formation of aluminosilicates using ESP version 7.0 as had been observed in version 6.5.

Task 3 Disposition of Idaho HLW Calcine

Support of the CH2M-WG Idaho Calcine Disposition Project

The sixth pilot scale run was done in November with a formulation having a lower waste loading (20%). Below is the recipe.

20% Waste Loading		
Fly ash	37.7	pounds
Slag	37.7	pounds
Portland Cement	37.7	pounds
Simulant	56.7	pounds
Water	102.0	pounds
Sodium Sulfide	3.3	pounds
Total	275.0	pounds

Nine samples were picked. The compression test results are shown in the table below.

Compressive strength of cubes made during Pilot #6.		
Sample	Breaking Stress (psi)	Cure Time (days)
1A	661	38
2A	524	38
3A	483	38
1B	478	40
2B	542	40
3B	477	40
1C	523	40
2C	408	40
3C	587	40

A final report will be issued as a part of the last 2007 quarterly report.

Task 4 Support of SRS Salt Disposition and Other SRS Alternatives

Modeling and Experimental Support for High-level SRS Waste Disposition

Based upon discussions with workers at SRS and at Parsons regarding the re-precipitation of solids in the simulant used for testing the CSSX process, a test plan was designed regarding temperature stability studies on the CSSX simulant salt solution. Previous modeling of this solution demonstrated potential for sodium aluminum silicate formation due to the high aluminum, caustic and silicon present.

CSSX simulant salt solutions were prepared following receipt of chemicals and approval of a test plan. Three one liter batches of the simulant were prepared, two (1 & 2) containing 100% of the quantity of $\text{Na}_2\text{SiO}_3 \cdot 9\text{H}_2\text{O}$ reported and the remaining batch (3) prepared with 62.5% of the silicon compound. All batches were allowed to equilibrate over a set time at 25°C. After the equilibration period was completed, only the batches containing the full amount of the silicon compound contained solids. All three batches were filtered and the solids from Batch 1 and 2 were dried for further analysis. Each of the solutions was equally portioned into smaller vessels for temperature studies. Four portions of each batch were placed at 15, 25, and 35°C conditions. These solutions will be tested every three weeks for solids formation.

Process Improvements for the Defense Waste Processing Facility (DWPF): On-line Analysis

The dual pulsed laser system purchased from Big Sky Laser Technologies to improve LIBS system performance was received. This laser system contains two side-by-side laser heads and two integrated cooler and electronics, and a beam combiner module. The laser system has been installed in the laboratory and the basic test for each fully functional laser has been performed. This system will be integrated with the new broadband spectrometer purchased for next year field demonstrations at the Savannah River Site.

Process Improvements for the Defense Waste Processing Facility (DWPF): Improvement of Waste Throughput

Experiments examining the thermal behavior of the various frit/waste simulants combinations using Differential Scanning Calorimetry (DSC) and Thermogravimetric and Differential Thermal Analysis (TGA/DTA) have been inconclusive and have been discontinued.

A final report summarizing the work for CY2007 will be issued as a part of the October/November/December 2007 quarterly report.

Process Improvements for the Defense Waste Processing Facility (DWPF): Melter Monitoring

The Optical Port Assembly sent for use to the Cold Cap Evaluation Furnace is undergoing a performance evaluation. In case of satisfactory performance, ICET researchers have the ability to put together a couple more of the assemblies in short order, if needed.

Task 5 DOE Headquarters Support

DOE HQ Road Map

No reported activities.

Workshop on Heavy Metal Phytoremediation

This workshop has been rescheduled tentatively for early summer 2008. Progress will be reported next year.

HEPA and Regenerable Filter Performance Assurance

In December, the HEPA filter autopsy study was initiated based on methods developed in October and November. Flanders filter loaded at media velocities of 5 ft/min. and 7.5 ft/min. (no cyclone) were the first two filters disassembled. 8 of the 68 filter pleats were sectioned into 9 regions and the mass distribution of KCl deposited on select regions was determined gravimetrically. In addition, loaded media samples from selected regions were cyanoacrylate fumed or "frozen" to later be analyzed via Scanning Electron Microscopy.

Bio-availability Studies of Mercury and Other Heavy Metal Contaminants in Ecosystems of Selected DOE Sites

A manuscript entitled "Extractability and Bioavailability of Mercury Sulfide Contaminated Soil from Oak Ridge, Tennessee, USA" was prepared and submitted to Water, Air and Soil Pollution journal.

The manuscript summarizes the extractability, solubility, and bioavailability of mercury sulfide in Oak Ridge soils. Dynamics of the dissolution of mercury sulfide by various extractants, including acids and a chelating agent, have been investigated. After three seasons of planting, soil mercury sulfide is more easily dissolved by both 4 M and 12 M nitric acid than is pure mercury sulfide reagent. Dissolution kinetics of soil mercury sulfide and pure chemical reagent by nitric acid are different. Mercury release by EDTA from HgS-contaminated soil increased with time of reaction and soil mercury level. This chelating chemical increases the solubility of mercury in HgS-contaminated Oak Ridge soil. The results also show that mercury sulfide in contaminated Oak Ridge soils was still to some extent bioavailable to plants. The increase of bioavailability of soil mercury sulfide after three seasons of planting may be related to the recent increase of mercury levels in water of the Lower East Fork Poplar Creek (LEFPC) of Oak Ridge.

Phytoremediation and Long-Term Monitoring of Selected Heavy Metal and Radionuclide Contaminants

A new round of experiments with the homemade chambers has been started. These experiments were designed to investigate mercury uptake by leaves of Chinese brake fern from ambient atmosphere. The experiments will be finished in January.

Task 6 Technology Development

Development of New Technologies for DOE Site Applications

A novel sample introduction cell for mercury has been worked out in December. The potential vendors who manufacture this type of quartz aerosol injection chambers have been identified. Quotations are being generated. With this new sample introduction scheme, reproducible, high sensitivity detection of elemental mercury without using pre-concentration and special sampling procedures is expected to be tested with the OPO laser source.

The issue of the mirror contamination has been partially addressed by introducing a gas purge device in the front of each mirror surface with a small gas flow rate. For a side-deployable system, this purge gas portion has to be compact and has a low cost operation. Therefore, a recycling scheme has been proposed for the gas purge system that will have a compact size and low consumption of cleaning gases, such as argon or nitrogen. Before being incorporated into a site deployable ringdown system, this system will be tested with the laboratory ringdown system.

Development of Fiber Optical Sensor Technologies for DOE Site Applications

DOE reduced the FY 07 funding from \$5M to \$4M dollars for the Institute for Clean Energy Technology. With the reduction in funding, MSU management had to make hard decisions as to which tasks to continue. After a thorough examination of several factors it was determined that Task 6.2 Optical Sensors would be removed from the scope of work. This information has been conveyed to DOE

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