June 2007

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 the 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 June by the unexpected departure in December of the graduate student working on this effort. The retroactive recision of CA07 funds in May have prevented replacement of the graduate student. Lack of manpower significantly limits progress on this and other efforts.

Fourier Transform Profilometry. Based upon the 20% retroactive recision of the CA07 budget, a revised CA07 workscope was developed and provided to our Hanford collaborators for their comments/suggestions. At the request of our Hanford collaborators, a PowerPoint overview of the status of our Fourier Transform Profilometry (FTP) effort was prepared and discussed with our Hanford collaborators during a bi-weekly conference call.

The ICET FTP effort is performing a multi-stage performance evaluation of the FTP technique in order to document the capabilities of this technique under simulated Hanford waste tank conditions; each stage imposes increasingly realistic conditions. As originally envisioned, the progressive stages were to be used to sequentially incorporate improvements/increased capabilities into the FTP software and instrumentation. One consequence of this approach is that a different FTP system would, in effect, be utilized for each of the stages, making comparison among the stages difficult. Therefore, the ICET FTP team decided it would be better (to the extent possible) to address immediately the technical challenges that had not yet been solved so that there would be more uniformity with regard to the FTP system used for the different evaluation stages. We inaugurated this approach by beginning to address questions relating to how FTP handles curved (non-perpendicular) background surfaces (such as a curved waste tank bottom).

Process Chemistry and Operations Planning for Hanford Waste Alternatives

Additional data was obtained on the $Al(OH)_3$ to AlOOH transition. Rapid conversion of Gibbsite to Boehmite is observed at 150^{o}C with somewhat longer times needed at 135 and then at 120^{o}C. The results, to date, were compiled and presented during one of the bi-weekly conference calls. At present, the reactions are concerned with the direct thermal reaction of the starting Gibbsite solid. All of the aqueous phase will evaporate during the experiment; consequently, a direct correlation to earlier high-temperature excursions in waste tanks was not evident. Means for performing the experiments without subsequent evaporation were under consideration.

Additional data and reference material was gathered for transmittal to OLI Systems, Inc. for database development.

Task 3 Disposition of Idaho HLW Calcine

Support of the CH2M-WG Idaho Calcine Disposition Project

A third run was made May 9. The size of the batch was increased to about 15 gallons and the mixing process was altered so that as the materials were being added, the mixing was continuous. The compressive strength after 14 days was 371psi. The other two samples were tested after about 40 days and had strengths of 340psi and 290psi.

The fourth run was designed to have about 10% less water in the batch in an attempt to increase the compressive strength. This was the largest batch tested so far. Feeding time for the powders was approximately 30 minutes. The mixing time (held constant over all four runs) was 20 minutes.

Nine samples were taken, 3 at the beginning (1A, 1B, and 1C), 3 in the middle (2A, 2B, and 2C), and 3 at the end (3A, 3B, and 3C). Results of the compression strength testing will be reported next month.

Task 4 Support of SRS Salt Disposition and Other SRS Alternatives

Modeling and Experimental Support for High-level SRS Waste Disposition

The new workscope and budget have been reviewed and approved by site personnel. Task one work began with collection of information on the HM/Purex sludge batch 5 composition and potential dissolution streams from 41H for blending. Preliminary modeling of the sludge has commenced on a sludge composition gleaned from earlier site work. Model results are in close agreement with available analytical results. Composition of Tank 25H has been determined by site engineers and should be released within two months for task two work.

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

DWPF has given us a new surrogate feed materials for testing LIBS, which contains Mg, K, Na, Ca, Fe, Ni, F, Al, Cr, Si, W, Zn, Ta. The reported limits of detection for Cl, F are relatively poor with LIBS comparing to other elements. Efforts were made to find the best experimental condition to detect these two elements. We have prepared new pellet samples with added NaCl and MgF. LIBS data of the new sample were collected under different laser energy, detection window, and lens-to-sample distance. The optimum experimental condition for these two elements was determined. Dr. Singh visited SRNL on June 6 to discuss the progress on this task and also meet with the Pu Project personnel to discuss the details of implementing LIBS into the plant design. This discussion is very helpful to perform the study that will be useful in designing or modifying our LIBS system for this practical application.

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

A new series of crucible-scale melts is being designed to study Sludge Batch 5. We received six plastic jars of SB5-2 SRAT Product (approximately 3600g) to be used as the waste simulant.

We will mix the waste simulant with four different frit compositions:

Frit ID	B2O3	CaO	Li2O	Na2O	SiO2	Total
503	14	0	8	4	74	100
517	17	0	10	3	70	100
519	20	0	9	3	68	100
521	10	1	8	6	75	100

Four different waste loadings, 35 wt%, 38 wt%, 41 wt%, and 44 wt%, will be studied. We have Frit 503 on hand from previous experiments, but will have to make our own frits for the other three.

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

Task 5 DOE Headquarters Support

DOE HQ Road Map

Workshop on Heavy Metal Phytoremediation

HEPA and Regenerable Filter Performance Assurance

This month the test stand was modified to test the CeraMem filters at 14 scfm. The modifications included adding 1-100 in. w.c. differential pressure gauges and rescaling the venturi flow meter used to calculate the flow rate through the filter.

A set of tests was performed to determine the optimum backpulse pressure. This set of tests was done at 100 psi and 75 psi. It was determined that the 100 psi back-pulse resulted in recovery of more differential pressure. The back-pulse testing consisted of a total of 12 tests. The upstream aerosol concentration was monitored by the SMPS and APS. The LPC and CPC were used downstream of the filter.

In addition, the relative humidity probe was sent back to the manufacturer for repairs, which delayed testing for 2 weeks.

Additional testing included monitoring residual water in the aerosol stream to determine what effect it had on the concentration measured by the SMPS and APS. A KCl aerosol was generated by varying the flow rate of the gear pump to see the effect it had on the particle size distribution measured by the SMPS and APS upstream of the filter.

Testing for July will consist of completing as many load/backpulse cycles for each of the CeraMem filters as possible.

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

During this month, the manuscript entitled "Bioavailability and Stability of Mercury Sulfide in Tennessee (USA) Soil" was revised and published in Proceedings of the 11th International Conference on Environmental Remediation and Radioactive Waste Management, 2007, Belgium.

Open Items (discuss any unresolved issues or items that require action by DOE or DIAL). None.

Status Assessment and Forecast (present analysis of program/project status, proposed solutions to problems, and future expectations regarding the project). We would like to continue summarization of the previous experiments and writing the manuscripts.

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

Approach Changes (description of any changes from the work plan, including technical changes, the explanation as to why these changes occurred, and what the impact on performance will be). None

During the month of June, we analyzed some of the plant tissue (both shoots and roots) and soil samples from previous experiments. We have also been processing data and preparing manuscripts for publication.

Task 6 Technology Development

Development of New Technologies for DOE Site Applications

Efforts during this month concentrated on optimizing the experimental optical configuration and examining the spectral background interference. The optical layout was adjusted to incorporate continuous monitoring of the wavelength by the UV Burleigh wavemeter during wavelength scans. Intense efforts were focused on alignment of the pulsed wavemeter. In addition, information was obtained and quotes generated to obtain a new controller for the monochromator.

Further measurements of C-H overtone spectra have been pursued in the NIR spectral region. During this month, a large organic compound, 2 methyl-1,3-butadiene, was measured in the prototype ringdown system. The C-H overtone spectra of this compound have been measured in a laboratory ringdown system before; the purpose of remeasuring this compound in the portable system was to validate the measurement accuracy of the portable system. The results show that the portable ringdown can measure C-H overtone in VOCs with a measurement uncertainty of 5-7%.

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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