Test and Evaluate HLW Vitrification System Improvements – Phase 2

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Presentation Outline

- **Project Description**
- **Technical Strategy/Approach**
- **Technical Results and Status**
- **Impact on High Risk/Cost Reduction or Avoidance**

Project Description

- Part A (September 2007 to September 2008)
  - *Enhance the processing rate of high-Al HLW glass formulations.*
  - *Verify processing rate on DM100 and DM1200 melters. DM1200 is 1/3 the size of the WTP HLW melter.*

- Part B (April 2008 to December 2008)
  - *Investigate viability of HLW glass formulations with higher crystal contents (and higher waste loadings) for waste processing.*
  - *Determine settling characteristics of crystals in HLW glass melts to assess its impact on bubbled melter operations.*
  - *Develop higher waste loading glass formulations for Hanford LAW compositions specified by ORP.*
  - *Measure high temperature properties (density, specific heat and thermal conductivity) of Hanford LAW and HLW glasses.*

Project Description – Technical Strategy/Approach

Part A – Enhance the processing rate of high-Al HLW glass formulation

- Start with 24 wt% Al_2O_3 HLW glass from Phase 1 work for ORP.
- Modify glass formulations to enhance processing rate using small-scale melter, and vertical gradient furnace tests to measure and compare processing rates.
- Prepare and characterize crucible glass melts.
  - *PCT, VHT, $T_{1\%}$ (temperature at which crystal content = 1 vol%), viscosity, electrical conductivity, etc.*
- Based on small-scale and crucible test results, select glass compositions for larger scale melter tests.
- Through melter tests, determine HLW feed processing characteristics, including glass production rate.

Technical Status and Results

Part A - Enhance the processing rate of high-Al HLW glass formulation

- Glass formulation work started with 24 wt% Al_2O_3 glass from Phase 1 work for ORP.
- Glass formulations were modified to enhance processing rate.
  - Changes in glass composition
  - Changes in glass former additives
- Glass formulations were screened for processing rates using small melter and vertical gradient furnace tests.
- Effect of $Al(OH)_3$ instead of Al_2O_3 as the aluminum source in the HLW simulant was determined.

Technical Status and Results (continued)

Part A - Enhance the processing rate of high-Al HLW glass formulation (continued).

- $Al(OH)_3$ feed processed at a rate of 700 kg/m^2/day at 1150°C as compared to 550 kg/m^2/day at 1150°C for the Al_2O_3 feed.
- Modified high-Al glass formulation with 24 wt% Al_2O_3 processed at a rate of 950 kg/m^2/day at 1150°C and 1500 kg/m^2/day at 1200°C. This compares to processing rate of 550 kg/m^2/day at both 1150°C and 1175°C for the old composition from 2007.
- HLW Pilot Melter test with the modified high-Al composition is scheduled for the end of July, 2008.

Technical Status and Results

Part B – Work to support Hanford HLW and LAW Vitrification

- Test plans for HLW and LAW glass formulation development and melter testing have been approved.
- HLW and LAW glass formulation, and crucible melt preparation and characterization are in progress.
- Set-up and calibration of equipment to perform high temperature property measurements are in progress.
- Set-up of equipment to perform crystal settling studies is in progress.

Project Impact

- Glass formulations with high aluminum loadings that process at fast rates have been developed for Hanford.

- The high-Al glass work is directly relevant to processing HLW at the Savannah River Site, and the high-Al calcine at Idaho.

- Melter tests with high-Al formulations were conducted using chemicals as glass former additives. For the SRS, melter tests with frit as glass former additive are needed to determine the processing characteristics of these types of feed in the DWPF melter. In addition, the glass formulations have to be modified to fit specific SRS HLW compositions.