

Optimizing Melt Processed Phosphate Glass Waste Forms via Composition-Property-Structure Correlations

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ABSTRACT:

The proposed study on composition-property-structure correlations of phosphate glasses is aimed to further optimize current generation of waste forms by pushing the limit of salt loading while targeting high chemical durability and easy processing with existing melter technologies. To compliment the work conducted on glass waste forms at the national laboratories sponsored by the DOE-NE program, overall specific objectives are: 1) investigation of Fe:P ratio and waste loading relationship of iron phosphate glass waste forms; 2) investigation of modified iron phosphate glass waste forms by adding various glass modifiers (SnF_2 and BaO); and 3) advance fundamental scientific understanding of composition-property-structure relationship of phosphate glasses. Starting from the iron phosphate glass compositions with different waste loading, the PIs will systematically explore addition of BaO , SnF_2 and a combination of these two on glass formability, waste loading, and chemical durability. The project will develop highly durable and easily processable phosphate-based glass waste forms to immobilize the dehalogenated salt streams. Specific deliverable includes the production of multiple, 20-gram monolithic waste form test samples that would be provided to the DOE National Laboratories for further testing beginning no later than 15 months into the effort. The result can be used to influence waste form design as well as separations processes of interest to DOE.

This project uses the complementary skills from three diverse groups of researchers at one University and one National Laboratory. Each group brings critical expertise to the project to understand how to develop highly durable and easily processable phosphate-based glass waste forms to immobilize the dehalogenated salt streams. Ming Tang at the Clemson University is responsible for the development of the phosphate glass waste forms, microstructural analysis by advanced electron microscopy and diffraction techniques, and chemical durability test. Kyle Brinkman at the Clemson University is responsible for the characterization of thermophysical and thermodynamic properties of glasses and spectroscopy analysis. Brian Riley at the Pacific Northwest National Laboratory will be responsible for providing project support available through the DOE complex to help guide the successful completion of this project, specifically on waste form formulation design and performance testing.