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Advanced Glass Formulation Saves Money and Shortens Schedule

Current efforts in nuclear waste glass formulation and melter process technology are creating a new paradigm for vitrification; shifting from the traditional Edisonian model, or "cook and look" approach, to an advanced materials-by-design approach. This change to more advanced approaches have increased the waste loading for high aluminum and chromium, and in turn, reduced the amount of glass that needs to be produced at Hanford by nearly 50 percent. These advancements not only decrease the cost of production, storage, transportation, and disposal, but also increase options for successful waste processing. Likewise, increasing the loading of low-activity waste (LAW) in glass will reduce the supplemental LAW treatment capacity needed.

Advanced glass formulations for waste vitrification

The Problem

Nuclear waste vitrification has been successful due to the invention of the liquid-fed ceramic melter (LFCM) and the formulation of robust glass formulations for the West Valley Demonstration Project, the Defense Waste Processing Facility, and the Hanford Waste Treatment Plant. Despite the proven success of the technology, significant opportunities remain to improve the efficiency and reduce the risks of tank waste cleanup. The projected rate of high level waste glass processing varies by over eight fold depending on melter feeds. The fluctuation in processing rates is not well understood and cannot be easily predicted. Better understanding of chemical reactions and heat and mass transport properties is needed to allow for improved control and optimized throughput rates. Current glass formulations do not cover the full range of waste compositions projected at reasonable waste loadings. There is a critical need to provide the scientific and technical underpinnings necessary to define the exact waste loading limits while maintaining low risk of melter process upset and providing waste forms that are acceptable for disposal.

Limits of Current Practice

The Edisonian approach to the vitrification process and glass waste form optimization is expensive and requires significant time to complete. Applying modern scientific methods is necessary to reduce the cost and time required to develop optimized vitrification processes, improve the ultimate system efficiency, and support changing flowsheets and waste compositions.

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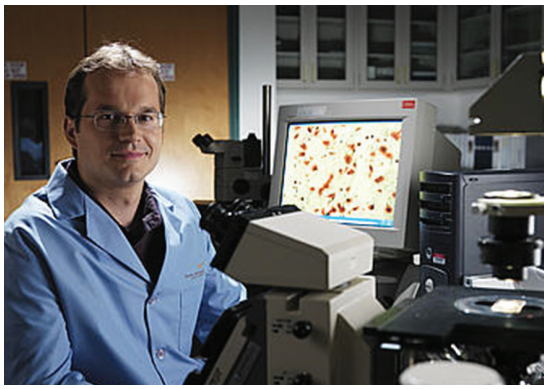
New Approach

Two significant technical advancements are providing new methods for formulating glass waste forms.

First, scientifically-based bounding conditions that help directly avoid undesired phenomena, for example pour spout blockage by crystal precipitation, are being quantified to improve traditional property limits, such as liquidus temperature or chemical durability test response. Second, an advanced materials-by-design approach is being used to optimize glass formulations.

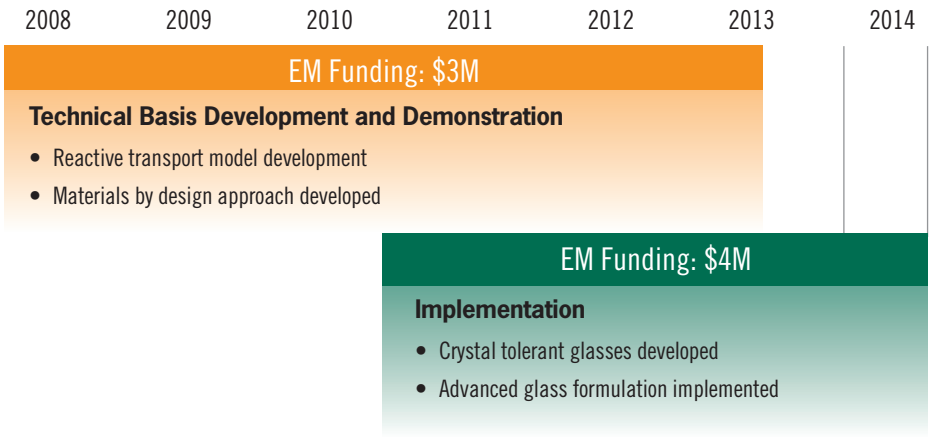
These new approaches are providing significant improvements in our scientific understanding of complicated processes/interactions and enabling more accurate estimations of waste loadings. Recent impacts include:



Analyzing performance for glass used in waste treatment

- Development of a one-dimensional, cold-cap reactive transport model
- Development and application of materials-by-design to high level waste glass formulation optimization
- Development of crystal tolerant glasses that allow for significant increase in waste loading, with reduced risk of melter failure
- Demonstration that advanced glass formulations can provide significant reduction in the projected volume of immobilized Hanford HLW and LAW

Advanced Glass Formulation Strategies Timeline Return on Investment $6 Billion



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