SRNL
SAVANNAH RIVER NATIONAL LABORATORY
TM

Factsheet

Glass Waste Forms and Vitrification Process Development

Laboratory tests are performed to define important glass and melt variables.

FASTfacts

- Glass technology provides a versatile method for safely managing a variety of wastes
- SRNL has studied the behavior in glass of nearly every element in the Periodic Table

U.S. DEPARTMENT OF ENERGY

Overview

Converting waste materials into a stable glass form is a highly effective way of treating and disposing of many types of waste, including some hazardous and radioactive wastes. Vitrification - the immobilization of a material in glass - is usually accomplished by mixing it with specially formulated glass forming materials consisting of sand and/or similar materials, and heating the mix to very high temperatures.

Because the hazardous components of the waste are bonded within the glass structure, vitrification produces very durable waste forms that are environmentally stable for thousands of years. Vitrification can greatly reduce the volume of the waste, and for some waste materials, can result in a reusable material.

In addition to waste disposal, glass has numerous other uses uses including application in the energy and medical fields.

The Savannah River National Laboratory's highly skilled and internationally recognized glass scientists and ceramics experts have developed processes and technologies for the vitrification of a variety of materials. In the course of this work, they have conducted extensive analysis, documenting the behavior in glass of nearly every element in the Periodic Table. They have developed special expertise in applying glass science and technology to a wide range of uses:

- Immobilization of highly radioactive wastes by incorporating the radioactive elements as an integral part of the glass structure at the molecular level
- Hazardous waste management and immobilization
- Hydrogen storage
- Medical applications

Areas of Technology Leadership

- Development of glass and other ceramic waste forms for the immobilization and/or disposal of a variety of radioactive and hazardous materials
- Durability testing and performance assessment of glass and ceramic waste forms, including international field testing of simulated glass waste forms
- Assessment of radiation damage in glass and ceramic materials
- Flowsheets for processing solids, sludges and liquids in glass and ceramics
- Development of accurate models for specific use, incorporating viscosity, melt temperature, liquidus, volatility, melt corrosivity, and glass solubility
- Remediation of off-gases from glass processing facilities
- Exploration of potential recycle and reuse markets
- Contamination removal from equipment and enclosed spaces
- Technologies and technical support to enhance operations of vitrification facilities
- High temperature processing and melter technologies, including joule

Glass Waste Forms and Vitrification Process Development

SRNL researchers like former American Ceramic Society President Dr. Carol Jantzen, have studied the behavior in glass of nearly every element in the Periodic Table.

heating, plasma heating, and advanced melter technologies such as:

- Cylindrical Induction Melter, a compact, high temperature glass melter utilizing an induction heated platinum vessel. The melter's compact size allows it to be installed inside a glovebox and/or hot cell, and provides criticality safety for vitrifying fissile materials.
- Cold Crucible Induction Melter (CCIM), developed in partnership with Russian researchers. The CCIM is an innovative glass melter technology that utilizes the glass feed as the melt vessel (i.e., skull). This minimizes melt vessel corrosion and allows for higher temperature operation with a net result of higher throughput.
- Hybrid microwave technologies for remediation and vitrification of hazardous wastes, recycling tires, disposition of excessed electronics and weapons components, disposition of medical wastes, ceramic joining, etc.

- Leadership of the International Commission on Glass - Technical Committee on Nuclear and Hazardous Waste Vitrification, which includes representatitives from the U.K., France, Germany, Spain, Portugal, Italy, Poland, Russia and the U.S.

Largest Radioactive Waste Vitrification Plant

SRNL developed the key technologies and processes used in the Savannah River Site's Defense Waste Processing Facility (DWPF), the largest radioactive waste glassification plant in the world. Since its startup in 1996, the DWPF has produced over 9 million pounds of glass, immobilizing over 2 million gallons of radioactive sludge. In this process, a sand-like borosilicate glass called "frit" is mixed with the waste, then heated to nearly 2,100 degrees Fahrenheit in the plant's 65-ton steel and ceramic melter. This molten glass-waste mixture is poured in a pencil-thin stream into stainless steel canisters to cool and harden. The result is a durable, stable solid glass waste form suitable for disposal in a federal radioactive waste repository.

In addition to developing the flowsheets needed for initial startup, SRNL has continued to provide technology support to enhance and improve DWPF operations. Enhancements developed by SRNL researchers allowed the original melter to continue successful operations two to four times longer than its expected service life, saving millions of dollars in replacement costs. Also, the laboratory has developed technologies to significantly improve the amount of waste processed through the DWPF by dramatically increasing the percentage of waste that can be contained in each canister of glass and improving melt rate, significantly reducing both the time needed to process the site's inventory of waste and the overall cost.

Related SRNL Research and Development

In addition to glass, SRNL has internationally recognized expertise in the development and application of other ceramic materials, including cement and grout materials for waste disposal, and advanced ceramic materials, such as sol-gel (including application of sol-gel materials in sensors) and crystalline ceramics.

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