

# New Technology for America's Electric Power Industry

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## Vitrification of Low-Level and Mixed Wastes

### *Opportunity*

The U.S. Department of Energy (DOE) and nuclear utilities have large quantities of low-level and mixed wastes that must be treated to meet repository performance requirements, which are likely to become even more stringent. The DOE is developing cost-effective vitrification methods for producing durable waste forms. However, vitrification processes for high-level wastes are not applicable to commercial low-level wastes containing large quantities of metals and small amounts of fluxes. New vitrified waste formulations are needed that are durable when buried in surface repositories.

### *Description of Work*

The Nuclear Waste Management Section in Argonne National Laboratory's Chemical Technology Division is developing a class of vitrified waste forms—glassy slags—that can contain up to 80% metal oxides. The slags do not require fluxes so expensive additives are not required. By using contaminated soils in the formulations, 100% waste loading can be achieved. Proper proportioning of feed materials make both phases highly durable. Stable crystal phases can be produced that sequester toxic and radioactive elements.

### *Benefits*

A wider variety of low-level and mixed wastes can be treated and immobilized by glassy slags than would be possible with borosilicate glasses. The waste forms produced should meet the most stringent requirements for low-level waste repositories. Essentially 100 percent waste loading can be achieved with proper blending of the waste streams. The need for expensive glass-forming additives is eliminated. Organic materials can be burned and toxic organics can be destroyed in the vitrifier.

### *Design Concept*

Metal-oxide phases that crystallize from glasses containing large amounts of fluxing components cause the glass matrix to be less stable and more susceptible to dissolution in the groundwater. The result is a more rapid re-

lease of radioactive and toxic elements. By carefully tailoring the glass composition, this problem can be avoided and two-phase, crystalline-amorphous structures can be produced that are very durable in surface repositories.

### *Current Status*

Argonne is evaluating glassy slags as part of the DOE program. The long-term durability of vitrified products under repository conditions is being determined through a suite of corrosion tests combined with detailed microscopic characterization of the corrosion products. These techniques are based on the experience gained in the high-level glass programs. Testing has demonstrated that properly formulated glassy slags are more durable than the best high-level waste glass.

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