



# DIAL

## Diagnostic Instrumentation & Analysis Laboratory

P.O. Drawer MM, Mississippi State, MS 39762-5932

---

### ***DIAL/WSRC Refractory Lifetime Study Aids in Selection of Refractory Material for LLMW Vitrification Using a Plasma Arc Vitrifier***

One of the critical components necessary for insuring a viable vitrification process for low level mixed waste (LLMW) is a refractory liner for the treatment vessel that will maintain its integrity when subjected to the harsh environment found inside a plasma arc vitrifier. Both the melt and the off-gas can be highly corrosive to refractory materials at the high temperatures necessary for vitrifying this type of waste stream.

The Diagnostic Instrumentation and Analysis Laboratory (DIAL) at Mississippi State University and Westinghouse Savannah River (WSRC) Company performed joint tests to evaluate the durability of 33 samples of refractory materials that were considered as candidates for use in plasma arc vitrification of LLMW. WSRC has expertise and experience with refractory materials as well as being well versed in vitrification processes. DIAL has two hollow electrode plasma torch systems, including a 250-kilowatt vitrification system, and experience in operation and maintenance of these system. In addition, DIAL has developed several optical diagnostic instruments which are useful in monitoring of vitrification processes. The two facilities were a good match for successfully performing and analyzing the results of these refractory tests.

The 33 refractory samples were mounted inside a graphite crucible in a way that allowed them to be partially submerged in the molten glass for testing of below and above as well as at the critical melt line. A composition which simulated a typical LLMW was chosen by WSRC as a feed material for producing the melt. The study was comprised of two separate tests. The first test was a multiple cycle test in which the "waste material" and refractory samples were alternately heated and allowed to rapidly cool to near ambient temperature. During the heating cycle the waste material was held in a molten state for approximately four hours. The second test was a continuous operation test. A new crucible

with refractory samples partially under the melt was tested in the vitrifier for an extended period of time.

There were only a small number of the refractory samples that survived either test, as can be seen in the before and after photographs of the samples inside the crucible. For the first test, aluminum nitride, high chromium fused cast refractories and a silicon nitride sample survived. Only high chromium and one aluminum nitride sample survived the second test.

Additional technical information is available in:

*Corrosion Assessment of Refractory Materials for Waste Vitrification.* James C. Marra, James W. Congdon, Andrea L. Kielpinski, Ray F. Schumacher, Amy Applewhite-Ramsey, John Etheridge and Robert Kirkland. 97th Annual Meeting of the American Ceramic Society, Cincinnati, OH, 1995.

*Testing of Refractory Materials for Plasma Vitrification of Low-Level Mixed Wastes.* A.L. Kielpinski, J. Etheridge, R. Kirkland, J.C. Marra, R.F. Schumacher, and J. Congdon. Waste Management 95, Tuscon AZ, 1995.

*Refractory Lifetime Testing for Westinghouse Savannah River Company.* John Etheridge and Andrea Kielpinski. Diagnostic Instrumentation and Analysis Laboratory, Mississippi State University. DIAL 10575 TR 95-3.

Inquiries about DIAL are welcomed and may be addressed to:

Diagnostic Instrumentation and Analysis Laboratory  
Post Office Box MM  
Mississippi State, MS 39762-5932  
Phone: 662-325-2105  
FAX: 662-325-8465  
email: dial@dial.msstate.edu

