CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

TRIP REPORT

SUBJECT: Attendance at the 105th Annual meeting & Exposition of the American Ceramic Society
Charge Number 20.06002.01.081; AI Number 06002.081.312

DATE/PLACE: April 26–30, 2003, Nashville, Tennessee

AUTHOR: V. Jain

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PERSONS PRESENT: V. Jain, CNWRA

BACKGROUND AND PURPOSE OF TRIP:

The 105th Annual Meeting & Exposition of the American Ceramic Society was held April 26–30, 2003 in Nashville, Tennessee. Conference attracted about 1,800 delegates and more than 1,300 technical papers were presented.

Symposium on Ceramic Science and Technology for the Nuclear Industry at the meeting was devoted to the presentations and discussions on the high-level waste vitrification technology and melter disassembly, glass waste formulation and testing, Hanford tank waste treatment, durability testing and modeling, and alternative waste forms and processes. Approximately fifty papers were presented in the symposium. The proceedings will be published as Ceramic Transactions by the American Ceramic Society. The summary provided in this report is based on authors' attendance at selected sessions and brief notes taken during presentations on topics relevant to the high-level waste program.

SUMMARY OF PERTINENT POINTS:

Chemical Durability

W. Ebert from Argonne National Laboratory presented a paper entitled The Effects of pH vs Iron on the Glass Dissolution Rate. In this paper, the presenter compared his results to the study conducted at the Center for Nuclear Waste Regulatory Analyses (CNWRA) to evaluate the effect of iron corrosion products on glass dissolution rate. His data indicated that the effect of iron on the forward reaction rate, that is considered very conservative, is not significantly different compared to glasses that were tested in solutions containing no iron. Forward reaction rate measured by Dr. Ebert was higher than the reaction rate measured in a three day test at the CNWRA. This is expected because forward reaction rate measurement is more aggressive compared to tests conducted at the CNWRA. In the second paper entitled Corrosion of Glass-Bonded Sodalite and Metal Waste Forms in an Unsaturated Environment, Dr. Ebert indicated that the dissolution rate of uranium from glass-bonded sodalite and metal waste forms is bounded by current TSPA-SR model for the dissolution of vitrified high-level radioactive waste form. The glass-bonded sodalite and metal waste forms have been developed to immobilize salt and metal wastes from the electro-metallurgical treatment of sodium-bonded spent nuclear fuel. Carol Jantzen from Savannah River Site in an invited talk entitled An Assessment of High-

Level Waste (HLW) Glass Durability Modeling presented an overview of various models used for predicting high-level waste glass durability. She cited recent work from Penn State that showed formation of reaction layers similar in composition to the bulk glass could be important to explain shifts in the glass dissolution rate with time. Remaining papers in this session were devoted to durability aspects of the Hanford low-level waste glasses.

Immobilization Program Status and Success

In this session six papers were presented. R. Palmer of West Valley Nuclear Services presented a paper entitled Completion of the Vitrification Campaign at the West Valley Demonstration Project. In his presentation, Dr. Palmer pointed out that West Valley Demonstration Project has successfully produced 275 canisters of high level radioactive glass and ceased vitrification operations after more than six years of continuous operation. There are no plans to conduct post-examination of the melter components to determine their performance. D. Bickford of Savannah River Site presented results from examination of the Defense Waste Processing Facility melter at the Savannah River Site after 8 years of operations. He indicated that most of the melter components were in good shape after 8 years of operations. Boroscope used to view glass melting inside the melter was most effected while some bowing was observed in Alloy 690 electrodes. A. Cozzi of Savannah River Site presented analysis of glass samples retrieved from various locations from the melter. C. Musick of Bechtel Hanford gave three back to back presentations on Hanford program. These presentations provided overviews of Hanford vitrification program, high-level waste vitrification facility, and low level waste vitrification facility. Construction of the vitrification facility is underway and major challenges are being met to stay on schedule. Lessons learned as well the resources from other high-level waste facilities are being used to develop the technologies needed to vitrify Hanford wastes. The Hanford high-level waste canister is 14 feet high and will contain about 2970 kg (6,600 lb) of glass. R. DeQuang from COGEMA, France gave an overview presentation on the vitrification program in France. As of March 2003, France has produced 12,440 canisters of vitrified high-level waste containing 4,902 tonnes of glass using two step induction melting process. France is now testing cold crucible melter concept for the next generation of high-level radioactive waste vitrification melter. They are also looking into vitrification of high molybdenum spent nuclear fuel.

Glass Property Modeling

Current research on vitrification of the Hanford high level radioactive wastes was the focus of this session. I. Pegg of Catholic University of America gave a presentation on glass formulation studies for vitrification of the Hanford high level wastes. He cited challenges in developing glass compositions because waste compositions in 177 tanks at Hanford are significantly different from each other. Studies have been focused on increasing the amount of waste loading by developing new glass compositions. All compositions are expected to meet regulatory and processing requirements. One percent increase in waste loading could save over 100's of millions of dollars in lifecycle costs. J. Vienna from Pacific Northwest National Laboratory presented a paper entitled Formulation of High Waste Loaded Hanford HLW Glass for Advanced Melters. His study was focused on glass formulations for induction-heated, cold crucible technology and joule-heated ceramic meters. S. Annamalai from Catholic University of America presented data that showed incorporation of rhodium in spinel structure. This could help incorporate higher amounts of rhodium in waste glass without impacting electrical resistivity of the melt. W. G. Ramsey of Mississippi State University in his presentation entitled

Thermal Processing Optimization for Simulated Hanford Waste Glasses (AZ 101) described development of t-t-t diagram and measurement of chemical durability for the Hanford high-level waste glasses. N.S. Kulkarni of Oak Ridge National Laboratory provided a status of the thermodynamic database for nuclear waste glasses.

Melter Processing and Melting Rate

In this session 14 papers were presented. P. Hrma of Pacific Northwest National Laboratory in his invited talk entitled Laboratory Measurements of Glass Melting Rate discussed the role of various elements in determining glass melt rates. He also stressed the need to develop new compositions that can accommodate higher waste loadings. In another paper entitled Analyses of Feed Melting Processes, Dr. Hrma studied, using various methods, the melting chemistry of glasses and suggested that low viscosity melts destabilizes foam under the cold cap and can assist in enhancing melt rates. C. Jantzen of Savannah River Site discussed the development of redox model for feeds containing high concentrations of organic carbon. High carbon is expected in the next batch of high level waste for vitrification at the Savannah River Site. There were several papers presented by Savannah River Site staff on studies conducted to develop new frit composition to improve melt rate. Savannah River Site is focusing their research to improve melt behavior and rate to reduce operating time. Melt rate studies using laboratory scale melts and mini-melter operations showed that the new Frit 320 has substantially higher melt rate compared to melting rate of frit currently in use. W. Lee of University of Sheffield, UK, presented a paper on waste-glass interactions. Work was conducted at the Immobilization Science Laboratory which was established at the University of Sheffield last year to focus on research for British nuclear waste program.

Gary Smith presented a paper for S. K. Sundaram of Pacific Northwest National Laboratory on the millimeter wave monitoring for detecting foaming in high-level waste glass melters. Millimeter wave technology, developed by Pacific Northwest National Laboratory, has been proven to successfully determine real-time viscosity, temperature, and melt height. In this paper, data was presented to show that technology can be used to determine foaming excursions in the melter. This system is now packaged into a compact unit.

Alternative Processes and Waste Forms

In this session 11 papers were presented. R. Spence of Oak Ridge National Laboratory presented a paper entitled A Review of I-129 Stabilization. In this presentation, Dr. Spence reviewed waste forms that are good host for iodine immobilization.

C. Muscik of Bechtel gave an invited overview presentation on the supplemental technologies that are being evaluated for the Hanford River Protection Project Potential Mission Acceleration Project. This program was initiated in 2002 to accelerate cleanup of the entire Hanford site. In 2003, four technologies were selected for further development. These included sulfate removal by precipitating sulfate in a strontium nitrate solution, containerized grouting, bulk vitrification, and steam reforming. J. Vienna of Pacific Northwest National Laboratory presented the status of bulk vitrification technology. This technology has been developed by AMEC and uses concepts similar to *in-situ* melting. C. Jantzen of Savannah River Site presented the results of Hanford fluidized steam reforming product. This technology produced stable mineral phases that retained anions such as sulfate and Re (subtitute for Tc) when co-fired with clay.

C.C. Herman of Savannah River Site reviewed the cold crucible melting tests conducted at two Russian institutes for Idaho National Environmental Engineering Laboratory and Hanford. L. Vance of Australian Nuclear Science and Technology presented a paper in which they tested direct vitrification of Idaho National Environmental Engineering Laboratory calcines in a cold crucible melter. D. Day of University of Missouri-Rolla gave a presentation on iron phosphate glasses. Iron phosphate glasses are alternate choice for the immobilization of radioactive waste. Hanford is currently exploring the use of these glasses.

American Ceramic Society Activities

Dr. Jain completed his 3-year term as the Trustee for the Nuclear and Environmental Technology Division and attended several Society leadership meetings. Specifically, participated in a town-hall type meeting with other leaders to discuss the future of the Society. In 2004, Dr. Jain will be the Technical Program Chair for the 2004 Annual Meeting of the American Ceramic Society.

CONCLUSIONS:

The meeting was very useful in keeping current with the ongoing worldwide advancements in waste forms for the disposal of radioactive wastes. The participation at the meeting was a good opportunity to gather information and generate discussion on the nuclear waste forms and processing technologies. Participation in committees contribute to the visibility and recognition among peers.

PROBLEMS ENCOUNTERED:

None.

PENDING ACTIONS:

None.

RECOMMENDATIONS:

Participation in future meetings is highly recommended.

SIGNATURES:

Vijay Jain

Vijay Jain
Corrosion Science & Process Engineering, Element

5/6/03
Date

CONCURRENCE:

Budhi Sagar
Technical Director

5/7/2003
Date

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