Operation of a Bushing Melter System Designed for Actinide Vitrification (U)

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A document prepared for WASTE MANAGEMENTY 1996 at Tucson from 02/25/96 - 02/29/96.

DOE Contract No. DE-AC09-89SR18035

DISCLAIMER

0421

WSRC-MS-95-~~XXX~~
Keywords: Pu Disposition,
Waste Management, Actinides,
Melters

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Extended summary of paper proposed for presentation and publication in the proceedings of the Waste Management International Conference, Tucson, AZ, February 25-29, 1996

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Extended Summary of a Paper Proposed for Presentation at WM'96 in Tucson, AZ.

Introduction

The Westinghouse Savannah River Company is developing a melter system to vitrify actinide materials. The melter system will used to vitrify the americium and curium solution which is currently stored in one of the Savannah River Site's (SRS) processing canyons. This solution is one of the materials designated by the Defense Nuclear Facilities Safety Board (DNFSB) to be dispositioned as part of the DNFSB recommendation 94-1. The Am/Cm solution contains an extremely large fraction (>2 kilograms of Cm and 10 kilograms of Am) of the United States's total inventory of both elements. They have an estimated value on the order of one billion dollars - if they are processed through the DOE Isotope Sales program at the Oak Ridge National Laboratory. It is therefore deemed highly desirable to transfer the material to Oak Ridge in a form which can allow for recovery of the material. A commercial glass composition has been demonstrated to be compatible with up to 40 weight percent of the Am/Cm solution contents. This glass is also selectively attacked by nitric acid. This allows the actinide to be recovered by common separation processes.

Another commercial technology - a bushing melter - has been selected as the melter system to process the Am/Cm into glass. Bushings are standard technology developed by the fiber glass industry. This particular adaptation is very similar to a "drain bushing". Drain bushings (1 to 3 nozzles) are used to regulate flow from large glass tanks to the fiber drawing bushings (up to 2000 small nozzles. Initial tests with a bushing melter at SRS indicate the system to be compatible with both actinide glasses and remote processing. A physical description of the bushing melter, its processing characteristics and limitations, and the status of the Am/Cm melter system is provided in this paper.

Physical Description

The SRS bushing melter is a small 6.35cm x 25cm x 25cm platinum-rhodium alloy box. A small sloped bottom leads to the drain tap. The unit is heated conductively. Copper buss bars are connected two sides of the melter and electricity is driven into the Pt/Rh via the buss. The bushing is fed low voltage (3-5 volts), high amperage (up to 5000 amps) to process 2-5 kilograms of glass per hour. Refractory insulation is provided on four sides plus the bottom to retain heat and give structural support to the unit. The refractory on the initial bushing is a high alumina castable material.

Processing Characteristics

The Am/Cm glass requires on the order of 1400°C for melting. At this temperature the glass is extremely fluid (10 poise).The bushing melter drain tip was designed to extend below the body of the melter in order to allow for maximum control of pour (The tip temperature is often 100°C cooler than the melt temperature. The initial melt tests were made using dry frit. Melt rate tests with frit and water are underway. The ultimate limitation to the melt rate (production capacity) will be determined by the amount of

power which can be placed on the copper/platinum connection. Production rates in the 4 kilogram per hour range appear fairly comfortable - but not close to the upper limit.

Am/Cm Melter Status

Currently, the melter system (feed equipment and melter off-gas equipment is being evaluated. The final processing input will be made to the equipment design team by June, 1996, and a workable system will be demonstrated by November, 1996, The equipment to process the actual Am/Cm will be tested June, 1997, and then "mock-up" - or skid placement and Canyon connectors will be constructed. The Am/Cm production runs will begin in the first quarter, 1998.

Conclusions

A melter system is being tested for vitrification of americium and curium. Commercial glass and melter technology is being adapted for the processing of these highly radioactive, and highly valuable elements. The unique features of the bushing melter appear compatible with remote operations and with the chemistry of the actinide elements. It is also strongly possible that the geometrically favorable dimensions of the bushing would allow for safe vitrification of fissile material such as plutonium.

Acknowledgment

Work performed under Contract No. DE-AC09-89SR18035 with the U.S. Department of Energy and Task Technical Plan SR14 sponsored by the U.S. Department of Energy - Office of Technology Development.

DUPCHECK-ID-NUMBER: 96001550506 PERMANENT-DOCUMENT-NUMBER: M96006491 000

<013> DATE-COMPLETED 960521
<014> DATE-OF-RECORD-ENTRY 960305
<015> DATE-RECEIVED 960305
<016> COPIES-RECEIVED 2
<020> DOCUMENT-TYPE R
<022> MEDIUM-CODE H
<030> CLASSIFICATION-CODE Uncl
<040> LITERARY-INDICATOR K
<050> GPO-SUPERINTENDENT-OF-DOCUMENTS Y
<072> PERSONAL-AUTHOR-AND-AFFILIATION Ramsey, W.G.
<080> SPONSORING-ORGANIZATION-CODE DOE/EM
<110> TITLE-ENGLISH
Operation of a bushing melter system designed for actinide vitrification
<150> PRIMARY-REPORT-NUMBER WSRC-MS--95-0421
<210> SECONDARY-REPORT-NUMBER CONF-960212--50
<240> CONTRACT-NUMBER-DOE AC09-89SR18035
<241> ABBREV-CONTRACT-NUMBER-DOE SR18035
<242> AWARDING-OFFICE-CODE 09
<243> BUDGET-REPORTING-CODE ?
<245> LEGIBILITY-CODE 0
<246> DOE-INITIATING-OFFICE-CODE SR
<247> MICROFICHE-DISTRIBUTION-CODE 4
<248> VENDOR-ID-CODE 228160-0001-X
<249> VENDOR-NAME WESTINGHOUSE SAVANNAH RIVER CO
<251> REPORTING-REQUIREMENT AZ
<276> DUPCHECK-BYPASS-FLAG N
<291> PACKED-PRIMARY-REPORT-NUMBER WSRCMS950421
<293> PREFIX DE
<295> INDEX-DOCUMENT-NUMBER M96006491
<370> PUBLICATION-DATE [1996]
<376> REPORT-TYPE-CODE-AND-FREQUENCY C/02/96
<390> PAGES-BIBLIOGRAPHIC 6
<400> REPORT-DISTRIBUTION-CODE A
<421> LANGUAGE-CODE EN
<425> AUDIENCE-CODE 01
<426> LIMITATION-CODE UNL
<449> CONFERENCE-NUMBER 960212
<510> DISTRIBUTION-CATEGORY M -2000
<520> PROJECT-STATUS P
<530> ANNOUNCEMENT-CODE EDB;ERA;ETD;INS;NTS
<540> EDB-SUBJECT-CATEGORIES 052001
<550> SOURCE-OF-BIBLIOGRAPHIC-INPUT TIC
<560> COUNTRY-OF-INTELLECTUAL-ORIGIN US
<570> COUNTRY-OF-PUBLICATION US
<600> INIS-TYPE R
<610> INIS-CATEGORIES E5100
<686> DOCUMENT-STATUS-CODE 000
<700> CORPORATE-CODE 9525316
<801> SUBJECT-DESCRIPTORS
CERAMIC MELTERS;VITRIFICATION:Q1;AMERICIUM;CURIUM;PLUTONIUM;RADIOACTIVE WASTE MANAGEMENT; GLASS;ACTINIDES:T1
<805> INIS-DESCRIPTORS
ACTINIDES:T1;AMERICIUM;CERAMIC MELTERS;CURIUM;GLASS;PLUTONIUM;RADIOACTIVE WASTE MANAGEMENT; VITRIFICATION:Q1
<931> AVAILABILITY-CODE OS;NT;IN
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