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SOLIDIFICATION OF LOW-LEVEL RADIOACTIVE WASTE AT THE SAVANNAH RIVER SITE

by

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CEMENT SOLIDIFICATION OF LOW-LEVEL RADIOACTIVE WASTE AT THE SAVANNAH RIVER SITE

C. A. LANGTON

INTRODUCTION

Research on cement solidification of low-level radioactive waste has been carried out at the Savannah River Site since about 1980. As a result of these efforts, aqueous-based process waste from the Defense Waste Processing Facility, Separation Effluent Treatment Facility, and the Fuel Production Facility and sludge from the Manufacturing Facility settling basin, are currently being solidified in inorganic cement-based wasteforms. In addition, cement stabilization of SRS mixed wastes, such as F006-low-level electroplating sludge and incinerator ash and TRU wastes has been proposed.

In general, wastes considered for cement stabilization at SRS are relatively well defined with respect to composition and volume. For example, the three major process waste streams contain about 30 wt% sodium salts of which sodium nitrate is the primary constituent. Spent ion exchange resins and contaminated organic liquids, charcoal, and reactive metals, such as aluminum, are currently not solidified in cement at SRS. In addition, disposal of low-level radioactive waste at SRS is also well defined and will consist of direct or containerized emplacement into engineered vaults (except TRU wastes) starting in 1992. This disposal method is consistent with the Final Environmental Impact Statement issued on groundwater protection and waste management activities at SRS[1] and the DOE Record of Decision for the EIS[2].

Consequently, performance criteria for all SRS cement wasteforms can be generalized as follows: Contain contaminants so that groundwater quality at the landfill boundary is maintained; prevent landfill subsidence; and prevent direct disposal of liquids.

DISCUSSION

Waste Characterization

Waste streams considered for cement stabilization are characterized with respect to bulk composition, pH, activity, and metal and organic concentrations. Physical properties which will affect processing such as specific gravity, temperature, rheology, and solids content are measured. Properties of any precipitated solids are also determined including solubility over the pH range 5 to 14. In addition, the EPA hazardous characteristics, toxicity, ignitability, reactivity, and corrosivity are evaluated prior to developing specific pre-treatment and solidification processes.

Cement Wasteform Preparation and Testing

Sample mixing is carried out to simulate actual process mixing. At SRS, high volume, high speed mixing is used for the DWPF saltstone process, whereas, in-drum paddle mixing is used for the FPF saltstone process. These are simulated by Waring blender and Hobart mixer preparation of laboratory samples. The resulting slurries are tested for rheological properties, set time, and free liquid. Specifications are determined for each process.

Samples are cast for evaluation of EPA hazardous characteristics, compressive strength, ANS 16.1 leach testing and waste cement compatibility (soak test). Adiabatic temperature rise is also measured for each wasteform. In addition to calculating a leach index or effective diffusion coefficient from the ANS 16.1 test, information on the mechanism of stabilization for each contaminant of concern is also obtained.

Field Testing

Field testing of three 30 ton monoliths and several 1000 pound monoliths in lysimeters has been in progress since 1985. In addition, 55 gallon drums of DWPF saltstone were tested at Brookhaven National Laboratory as part of the scale-up process from laboratory to full scale operations. Results of these intermediate size experiments track the bench top studies. The lysimeters, in particular, have been useful for testing and supporting performance modeling predictions for the saltstone disposal landfill.

SUMMARY

Aqueous-based process waste and other small volume wastes including basin sludge and incinerator ash will be solidified in cement-based wasteforms at SRS. A variety of inorganic solidifying agents are used depending on the chemistry, contaminants, and processing characteristics of the waste. In some cases, pre-treatment of the waste is used to reduce the activity of the waste and/or to remove the hazardous characteristics of the waste.

In the case of DWPF saltstone, pretreatment is used to reduce 137 Cs and 90 Sr concentration to Class A levels and in-situ treatment (chemical reactions between the cementitious solids and waste) is used to remove the toxic metal characteristic of the waste. Chemical reduction of the Cr^{+6} to Cr^{+3} and subsequent precipitation of $Cr(OH)_3$, (low solubility) occurs as the result of reactions between the cementitious raw materials and the waste liquid.

In summary waste treatment and solidification used at SRS is designed to meet both South Carolina and Federal requirements for maintaining the quality of the groundwater at the disposal site boundary.

REFERENCES

1. U.S. Department of Energy, Final Environmental Impact Statement: Waste Management Activities for Groundwater Protection Savannah River Plant Aiken, South Carolina, U.S. Department of Energy (December 1987).

2. U.S. Department of Energy, Waste Management Activities for Groundwater Protection, Savannah River Plant, Aiken, South Carolina; Record of Decision, Federal Register, V. 53, No. 48, page 7557, Wednesday, March 9, 1988.

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May 23, 1989

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