UNITED STATES DEPARTMENT OF COMMERCE
National Bureau of Standards
Gaithersburg, Maryland 20899

December 11, 1985

Mr. Everett A. Wick
Division of Waste Management
Office of Nuclear Materials Safety
and Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Wick:

Re: Appendix D of Draft Report Entitled "Repository Environmental Parameters Relevant to Assessing the Performance of High-Level Waste Packages in Basalt, Tuff, and Salt," NUREG/CR-4134, by H. C. Claiborne, A. C. Groff, J. C. Greiss, and F. J. Smith, ORNL

We have reviewed Appendix D of the subject draft report and offer the following comments.

Page D-3, Table D.1., third column, "Maximum credible repository concentration range (mg/L)" -- It is not clear to the reader where these numbers come from, i.e., the reference is not complete.

Page D-5, third line from bottom of page -- "were either absorbed or precipitated in secondary phases" is confusing. Please clarify.

Page D-11, Paragraph 2, sentences 2 and 3, "...sensitization of 304L stainless steel that will occur at this temperature. An earlier suggested limit (RUSSELL 1979) of 375 °C seems more reasonable...." -- We disagree. If the available data are extrapolated to times of the order of 100 to 1000 years, which is a relevant time in relation to alloys in a repository, much lower temperatures would be expected to result in sensitization. See the review by Fox and McCright (UCRL-15619, Lawrence Livermore Laboratory, 1983). From Figure 4 of this later reference, one may observe that sensitization can occur at a temperature as low as 250 °C at a time of 300 years.

This review is provided in response to your request for short-term technical assistance within the scope of FIN-A-4171-5. Those who reviewed the appendix are Michael Kaufman and Robert Shull.

Sincerely,

Charles G. Interrante

Charles G. Interrante
Program Manager
Corrosion Group
Metallurgy Division

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THE EFFECT OF VARIOUS LEAD SPECIES ON THE LEACHING BEHAVIOR OF BOROSILICATE WASTE GLASS

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ABSTRACT

A borosilicate nuclear waste glass was static leached in pure water, silicate water, and brine solution. Three different forms of lead were included in specified corrosion cells to assess the extent to which various lead species alter the leaching behavior of the glass. Weight loss data indicated that Pb_m and PbO greatly reduce the weight loss of glass when leached in pure water, and similar effects were noted in silicate and brine. Si concentrations, which were substantial in the glass-alone leachate, were reduced to below detection limits in all pure water cells containing a lead form. Lead concentration levels in the leachate were controlled by lead form solubility and appeared to be a significant factor in influencing apparent leaching behavior. Surface analysis revealed surface crystals, which probably formed when soluble lead in the leachate reacted with dissolved or activated silica at the glass surface. The net effect was to reduce the release of some glass constituents to the leachate, although it was not clear whether the actual corrosion of the glass surface was reduced. Significantly different corrosion inhibiting effects were noted among lead metal and two forms of lead oxide.

INTRODUCTION

Encapsulation of radioactive waste in borosilicate glass has received much attention [1-4] and appears to be one of the most viable disposal techniques due to the ability of borosilicate glasses to successfully sequester a wide range of radioactive elements. One glass encapsulation technique, developed by Savannah River Laboratories (SRL), involves the mixing of borosilicate glass frit and radioactive waste in aqueous slurry form. The slurry is dried and melted in a unit melter and cast directly into stainless steel canisters, which will be buried in a suitable repository location [5].

Although the mechanisms and factors influencing waste glass corrosion have been widely studied, Buckwalter and Pederson [6] were the first to observe the interesting effect of reactive metal containers on the corrosion rate of waste glass. Their work demonstrated that copper, tin, and titanium had little effect on the glass corrosion behavior and that aluminum reduced leaching by an order of magnitude. The most pronounced effect was exhibited by lead which appeared to completely inhibit glass leaching. In another study [7] iron was noted to precipitate as a silicate on the glass surface.

Since lead metal appears to greatly reduce the leaching rate of borosilicate waste form glasses, incorporation of lead into waste package design appears to be an attractive possibility. However, the effects of the physical or chemical state of the lead, i.e. pure metallic, alloy, oxide, crystalline or amorphous, oxidation state, etc., are unknown; and the mechanism responsible for the reduction in leaching rates of borosilicate waste glass in the presence of reactive metals requires additional elucidation. Consequently a study was initiated to investigate the effect of lead under varying corrosion environments and with several chemically different forms of lead.

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