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Borosilicate glass dissolution in the presence of cementitious waste forms

YELENA KATSENOVICH[1], **VADYM DROZD**[1], LEONEL LAGOS[1] AND MATTHEW ASMUSSEN[2]

[1]Florida International University
[2]Pacific Northwest National Laboratory
Presenting Author: drozdv@fiu.edu

The study investigated the dissolution behavior of a representative borosilicate glass used for radioactive waste immobilization in the presence of cement-based materials (commonly referred to as grout in the USA). If glass and cementitious materials are both present in a disposal facility it is possible that the presence of the cementitious material will significantly influence the mechanisms and rate of glass dissolution. It is assumed that the alkaline water resulting from contact with the cementitious materials may enhance the dissolution rate of the glass waste forms. A grout-contacted (GC) water was used to probe this influence which had elevated pH (~12) and contained many dissolved species from the grout (e.g., Si, Al, Ca, K) that may impact glass dissolution rates through common ion effects or precipitation reactions. This research indicates that the presence of Ca in the GC-solution suppresses borosilicate glass corrosion in short term tests. Normalized dissolution rates for boron and rhenium, used as a surrogate for technetium, were significantly lower in both Ca- and GC solutions compared to pH 12 buffer solution.

The study introduced the concentration profiles of major elements, acquired through Energy Dispersive X-ray Spectroscopy (EDS) cross sections in various alkaline aqueous solutions. This approach showed the distribution of elements as a function of distance from the edge of a glass coupon. Treatment of glass in GC and Ca^{2+} amended solutions resulted a comparatively milder impact on the glass surface alteration, with enrichment in Ca at a lower depth compared to pH 12 solutions.

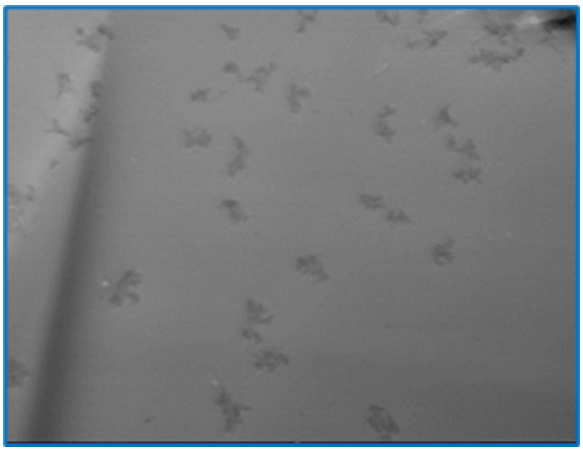

Figure 1. SEM images of the glass particles used in the static corrosion test. Left: deep corrosion pockets on glass treated with pH 12 buffer solution. Right: minor corrosion pits observed on glass surface exposed to GC solution.