Glass durability under elevated pH conditions

Russell Hand*[1], Daniel Backhouse[1], and Claire Corkhill[1]

[1]University of Sheffield – Department of Materials Science Engineering, Sir Robert Hadfield Building, Mappin Street, Sheffield, S1 3JD, United Kingdom

Abstract

It is expected that vitrified nuclear waste will ultimately be disposed in an underground repository, where eventually groundwater will penetrate the multi-barrier system and interact with the glass. Under some repository scenarios this water may have an elevated pH due to the presence of significant cementitious material. Results from studies on a range of model glass compositions, including the international simple glass (ISG), and glasses that are representative of potential vitreous wasteforms, as well as basaltic glass used as a natural analogue, will be reported. These studies have included structural characterisation and durability measurements in both KOH and Ca(OH)2 solutions. The presence of calcium has a significant effect on performance as it leads to the formation of calcium silicate hydrate (CSH) gels which appear to limit the rapid dissolution that is otherwise seen in high pH conditions when calcium is not present. Distinct mechanistic differences were seen according to glass composition, with more rapid dissolution being seen for compositions that contain significant amounts of Al2O3 and/ or MgO than for compositions which do not. The phase evolution in the alteration layer was also significantly different between the different glasses studied. The implications of these compositional differences for the use of simplified glass compositions and natural analogues, especially ISG, as models for full waste loaded glasses will be discussed.

Keywords: Nuclear waste vitrification, glass durability

*Speaker