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Corrosion at the Metal-Glass Interface in HIPed Nuclear Wasteforms

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A common approach to the immobilisation of nuclear wastes produced in the nuclear fuel cycle is to incorporate them in a borosilicate glass and dispose this "wasteform" within a geological repository. These glass-based wasteforms are known to corrode in groundwater in the repository over thousands of years and thus research has focused on investigating the mechanisms of glass dissolution and corrosion to understand and predict the stability of the radionuclides in the glass structure. ANSTO has developed hot isostatic pressing (HIP) to consolidate nuclear waste into an appropriately designed wasteform to significantly reduce storage volumes and to minimise the formation of secondary waste streams and this technology can be applied to glass. In this process, the liquid waste and glass forming additives are mixed and then dried to produce a powder that is melted at high temperatures in a specially designed metal canister which is compacted using high pressure argon gas. However, corrosion may occur at the contact zone between the glass and the stainless-steel HIPing container and this may impact the stability of the waste form structure in the long term within the repository. Therefore, further understanding of the effects of temperature and pressure during the HIPing process on the corrosion of the glass in the contact zone with the stainless-steel container is required. This is of particular importance since this interface is potentially the first exposure point to groundwater in a geological repository.

This collaborative project between ANSTO and UNSW investigated the corrosion and stability of the glass-stainless steel interface of three HIPed nuclear waste glass compositions. The compositions that were used include International Simple Glass (ISG) which is a benchmark for glass corrosion experiments, UK Mixture Windscale Glass (MW), and French R7T7 Glass (SON68) which are used internationally. The glass frits were prepared by mixing, drying, and calcining of the appropriate precursor powders, and subsequently converted to simulant wasteforms by both melting in a furnace and HIPing. The glass compositions and the resultant interface with the HIP container was characterised using scanning electron microscopy (SEM) to determine the microstructural characteristics and homogeneity and energy dispersive spectroscopy (EDS) to determine the elemental distribution. Corrosion experiments were performed on sections of the HIPed samples by placement in water at 90°C over time periods ranging from 7 to 60 days to accelerate the corrosion. Similar microstructural analyses of the interfacial regions were conducted on the corroded samples and then compared with the uncorroded control samples. The outcomes from the research will provide critical data on stability of different glass compositions after HIPing in steel containers which can help to assess the safety of HIPed nuclear waste glass storage underground for long time periods >1000 years.

Speakers Gender

Rather not state

Travel Funding

No

Level of Expertise

Student

Do yo wish to take part in the poster slam

Yes

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