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The solubility of Ni(II) and Eu(III) in the presence of cement superplasticisers

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One of the illustrative disposal concepts considered by the NDA- RWMD (Nuclear Decommissioning Authority –Radioactive Waste Management Directorate) for the disposal of intermediate-level wastes and some low-level wastes is that of grouted waste packages surrounded by a cementitious backfill. The potential use of superplasticisers to improve flow properties of waste encapsulation grouts offers benefits in some applications, e.g. for infilling or self-levelling. However their impact on the post closure performance assessment of a geological disposal facility (GDF) needs to be considered.

First generation superplasticisers such as naphthalene formaldehyde and sodium lignosulphonate showed the ability to increase the aqueous concentrations of radionuclides. The observed effects were not consistent and the use of such additives was, in general, discouraged, however, the composition of modern superplasticisers ('comb' polymers) is better controlled than the composition of compounds used in the past. This suggests that their effects may be better understood and they may behave in a more predictable manner.

To determine whether the presence of comb superplasticisers will have an effect of the solubility of radionuclides within the near field of a radioactive waste repository, a study of the solubility of Ni(II) and Eu(III) in high pH (12-13.5) aqueous solutions of the superplasticiser ADVA Cast 551 was conducted. The solubility experiments were approached from oversaturation and were conducted in the following aqueous solutions: 95% saturated Ca(OH)₂, 0.1 mol dm⁻³ NaOH and cement equilibrated solutions containing Ordinary Portland Cement (OPC), Pulverised Fly Ash (PFA) or Blast Furnace Slag (BFS). ADVA Cast 551 was present at between 0 and 10% (w/v). Samples were taken at regular intervals over the period of 1 month and measured by Liquid Scintillation Counting or Gamma Spectrometry for Ni and Eu quantification respectively. Results for Ni(II) have shown that the concentration of Ni(II) measured in solution increases with the presence of the cement superplasticisers. The increase observed was greatest in the 95% saturated Ca(OH)₂ solution. Results observed in the cement equilibrated solutions were less significant with the solubility increase being within an order of magnitude even in the presence of 10% ADVA Cast 551. Results for Eu(III) will also be presented.

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Primary authors: Ms YOUNG, Amy (Loughborough University); Dr FELIPE-SOTELO, Monica (Loughborough University); Prof. WARWICK, Peter (Loughborough University)

Presenter: Dr FELIPE-SOTELO, Monica (Loughborough University)

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