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Sorption properties and behaviour of ¹³⁷Cs and ⁹⁰Sr on bentonite clays and magnox sludges

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Within the nuclear industry, waste management and disposal issues, both within the plants themselves and in the surrounding areas, are complex and problematic. This is partially a result of many decades of discharges within the storage site. A major problem is in determining the nature and distribution of contamination within the environment, be this on site in surrounding host rock, or determining whether migration has occurred to such an extent that contamination has breached the boundaries of the site and reached the public domain, or whether contamination has been released to atmosphere, for example.
It has been suggested that there may be significant quantities of contaminated land arising from breaches in radionuclide storage. Therefore, an understanding of the transportation of radionuclide waste in the environment around storage ponds and silos on waste sites, as well as an understanding of the behaviour within the ponds, is essential in future waste remediation strategies.
One area of significant interest is the migration of 137Cs and 90Sr radionuclides in contaminated clay soils, as migration has been shown to be significantly faster than expected in some areas. Although exact figures are not known, information provided by a UK operator suggests that 137Cs and 90Sr are progressing through the surrounding area quicker than the expected annual rate of 6 cm/year, for this type of material.
Sorption studies carried out using 137Cs and 85Sr have returned promising results. 85Sr was used in place of 90Sr as it is easier to work with, yet still exhibits the same behaviour in terms of sorption. Although some previous studies have looked at the sorption properties of these two radionuclides within the two environments studied most have focussed on only one or two variables. In these studies conducted at Loughborough University, numerous variables including pH, ionic strength and the effect of competing ions being present in the system have been investigated, while all the time keeping the remaining contributing variables, (all of those not being specifically investigated, plus contact time, solid-to-liquid ratio etc) constant. This has provided data which will be extremely valuable as any changes in behaviour can be directly associated with the altered variable and results can be directly compared with those previously obtained.
The rheology of clays and clay minerals plays an important role in the transport of these key radionuclides. A key area of the repository LTP (Life Time Plan), for research and development is to be able to link the transport in the materials studied to rheology and organic content. Specific clays of interest are bentonite and montmorillonite, as well as the mineral brucite. A final goal of being able to inhibit transport, either by chemical speciation or barrier systems is an aim of this project.

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