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Radionuclide Sorption Behaviour on Fresh and Aged Cementitious Materials: A Comprehensive Database with 25 Elements

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Cementitious materials are being widely used as solidification/stabilisation and barrier materials for a variety of radioactive wastes. The retention properties result from mineral phases in hydrated cement that (i) possess a high density and diversity of reactive sites for the fixation of radionuclides through a variety of sorption reactions (surface adsorption, incorporation and solid-solution formation), and (ii) buffer pH in the range 10–13. A quantitative database on the solid/liquid distribution behaviour ("sorption database") of 25 elements (Ag, Am, Be, C, Ca, Cl, Cs, H, I, Mo, Nb, Ni, Np, Pa, Pb, Pd, Pu, Ra, Se, Sn, Sr, Tc, Th, U, Zr) in hydrated cement systems is established on the basis of a consistent review and re-evaluation of literature data. Effects of geochemical evolution or ageing cements on sorption/incorporation processes are explicitly evaluated and quantified. In addition to recommended values, all underlying original experimental data and key experimental information are provided.

Summary

The database and the scientific underpinning of its derived sorption values will be of use to support the safe disposal of radioactive waste and other cemented industrial wastes. They are specifically useful for incorporation in safety assessment modelling using advective-dispersive transport models with incorporation of radionuclide retardation processes relevant for fresh and aged cement. Time-dependent sorption properties are required because the long-term degradation of engineered barriers and their containment capacity over time has to be explicitly assessed through scenario-modelling in any safety case.

Primary author(s) : Dr MALLANTS, Dirk (CSIRO)

Co-author(s) : Dr WANG, Lian (SCK); Dr OCHS, Michael (Arcadis)

Presenter(s) : Dr MALLANTS, Dirk (CSIRO)

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