Geochemical modelling of leaching tests data on cementitious barrier materials as basis for long term release prediction

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Recently validated leaching test methods for assessing release from stabilised waste and cementitious products have been applied to reference materials prepared in the context of the Cementitious Barriers Partnership (CBP supported by US DOE). These comprise amongst other vault concrete, backfill grout mortar and stabilised waste. The test results have been used as basis for geochemical speciation modelling to obtain chemical speciation fingerprints (CSF) to be used in subsequent reactive transport modelling. The dynamic tests in the laboratory tool set (monolith leach test and percolation test) are used to verify the suitability of the reactive transport models based on CSFs as basis for predictive release modelling. The modelling considers mineral precipitation/dissolution, incorporation into solid solutions, ion exchange on clay surfaces, sorption onto hydrated iron oxide surfaces, particulate and dissolved organic matter. The first step in the process is to obtain a good match between the multi-element release description covering all of these competing phases and the test results from the pH dependence test. In the multi-element model run a prediction at low liquid to solid ratio is included as starting point for the assessment of porewater conditions in both percolation conditions and monolith leaching. Gaps in the available thermodynamic data set can be readily identified to focus research needs. The release prediction for the dynamic tests – monolith leaching and percolation – make use of the CSF as basis for the chemistry of the system in addition to representative model descriptions to capture relevant mass transport processes like dual porosity and radial diffusion in percolation. The modelling results for concrete and stabilised waste leaching will be presented in context with experiences on a wider range of nuclear and hazardous waste applications.

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