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Sensitivity Analysis of Chemical Evolution of Tank Closure Cementitious Materials Model at the Savannah River Site

DR. MERILENT KALLO, PHD[1], JONATHAN AUSTIN[1], ANDRAS PAKSY[1], LIAM ABRAHAMSEN-MILLS[1] AND GREGORY FLACH[2]

[1]National Nuclear Laboratory
[2]Savannah River Mission Completion
Presenting Author: merilent.kallo@uknnl.com

36 million US gallons of nuclear radioactive waste is stored in large underground carbon steel tanks at the Savannah River Site (SRS). The tanks are emptied to the maximum extent practicable but residual waste will remain. Existing concrete barriers and tank-fill grout emplaced after bulk waste removal are utilized for safe containment of the residual radionuclides inside primary and secondary steel liners. These structures are intended to function as physical and/or chemical barriers to waste release for a very long time. Due to environmental exposure and material aging, the incorporated concrete/grout material is going to evolve chemically with time. Chemical modelling is utilized for performance assessment of degradation of cementitious/grout material over hundreds, thousands and tens of thousands of years.

The chemical models focus on pH, Eh and mineral set evolution of the system over a long time frame. The models developed, the parameters used and the assumptions made represent the best estimate under pessimistic settings. However, there are uncertainties and assumptions in the models. For example, the composition of the groundwater of the region may vary. Also, the composition of the concrete/grout material may vary and the extent to which the material hydrates when in contact with groundwater.

This study estimates and quantifies the impact of the aforementioned uncertainties and their combination on the model's results. More specifically, sensitivity analysis was undertaken by coupling the chemical speciation programme, PHREEQC and the probabilistic simulation software, GoldSim. A Monte Carlo approach was used to vary model variables by random distribution sampling from realisation to realisation. It was found that the final state of the system remains unchanged with varying parameters but the timing of occurring phenomena varies. A sample result of how the amount dissolved of carbon dioxide in groundwater could affect the pH of the system as a function of pore volume (PV) is shown below.

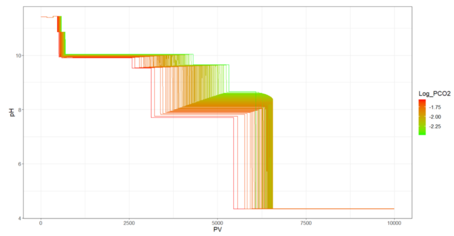

Figure 1: pH evolution of cementitious material when in contact with groundwater of varying amount of dissolved carbon dioxide.