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Evaluation of Bentonite Engineered Barrier Performance Under Repository Conditions: Diffusion of Np(V) Through Montmorillonite

Diffusion of Np(V) and tritium through compacted montmorillonite clay was studied under repository conditions at elevated temperatures of 25, 50, and 80ºC for the purpose of deep geological nuclear waste storage. Experiments were conducted under atmospheric conditions in 100 mM NaCl. This experimental design is based on batch sorption experiments indicating sorption of Np(V) to montmorillonite increases with increasing temperature and increasing pH. Stainless steel diffusion cells were constructed with load cells, allowing the inside pressure to be monitored and the porosity of the system to be controlled. As the temperature was increased, the tensioning screws on the diffusion cells were decreased to maintain a constant porosity across the temperature range. Effective diffusion coefficients at various dry bulk densities were extracted for each temperature of interest. These trends revealed a faster transport of Np(V) through the lower dry bulk densities and lower temperatures. Post-analysis was performed by sectioning the clay plug and identifying areas of concentrated radioactivity using autoradiography. Then solid samples were extracted for electron microscopy to determine the potential formation of nanoparticulate phases.