TRANSITION METAL SORPTION ON BENTONITE AND BEHAVIOUR OF THE BENTONITE/COPPER/GLASS BARRIER SYSTEM

JÁNOS OSÁN[1,*], ISTVÁN TOLNAI[1], MARGIT FÁBIÁN[1]

[1]Institute for Energy Security and Environmental Safety, HUN-REN Centre for Energy Research, Konkoly-Thege M. út 29-33., H-1121 Budapest, Hungary

** Corresponding author email: osan.janos@ek.hun-ren.hu*

In Europe, the final disposal of high-level radioactive waste is planned in deep geological repositories. Their long-term safety is guaranteed by natural and engineered barriers, preventing radionuclides from entering the biosphere. An important element of the engineered barriers is the backfill material surrounding the waste packages. Due to their beneficial physico-chemical properties and high cation exchange capacity, bentonites are considered as a potential backfill material in several waste storage concepts. Selected materials of the engineering barrier system of the deep geological repository were examined on a macro, micro and nano scale. The radionuclide retention capacity of B75 bentonite (Czechia) was evaluated for Ni^{2+} and Co^{2+} ions, by recording sorption and desorption isotherms on powdered samples suspended in synthetic pore water. Experiments were performed in the equilibrium concentration range of 10^{-7}–10^{-3} M using inactive Ni^{2+} and Co^{2+} ions and extended to 10^{-9} M for Ni^{2+} using ^{63}Ni radiolabelling. Concentrations in the liquid phase were determined using ICP-OES. Comparison of the obtained sorption and desorption isotherms indicate irreversibility of sorption for both Ni^{2+} and Co^{2+} ions at the highest concentrations. This behaviour was supported by modelling considering an 80% Ca-montmorillonite content. The experimental isotherm was underestimated for high concentrations indicating and additional uptake mechanism through formation of a new phase. Based on the results, the B75 bentonite binds Ni^{2+} and Co^{2+} ions to a similar extent as the Boda claystone (Hungary) tested as a natural barrier, contributing to the retention of cationic radionuclides. The interaction of the backfill material (bentonite), waste barrels (copper) and the conditioned radioactive waste (borosilicate glass matrix) was monitored in a 9-month experiment, keeping the bentonite/copper/glass model system in conditions close to those expected in a real repository (80°C temperature, pore water chemistry). The corrosion behavior of glass and copper was investigated in a bentonite environment, focusing on the interfaces to obtain information on the chemical evolution of the solid phase composition at a microscopic scale. Electron microscopy (SEM/EDX) investigations revealed a slight corrosion on the copper surface, mainly Cu_2O was detected as a corrosion product. Only minor changes were observed in the elemental composition of the borosilicate glass surface. In the simulated geological conditions, the components of the bentonite/Cu/glass engineered barrier system do not exert a significant influence on each other, individually preserving their integrity.

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