Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.7202

Diffusion of HTO and $^{36}Cl^-$ in kaolinite – montmorillonite mixtures at different compactions in context of radionuclide waste disposal

VLADIMIR A. LEKHOV, ANNA SEMENKOVA, PHD, ANNA ROMANCHUK AND STEPAN KALMYKOV

Lomonosov Moscow State University

Presenting Author: v.lekhov@gmail.com

At present, various mixtures consisting of kaolinite, montmorillonite and special additives (e.g. vermiculite, etc.) are currently under investigation for use in isolation of radioactive waste and for creation of engineering barrier during decommissioning procedure, for example uranium-graphite production reactors. These barrier materials have different transport, sorption, economic properties affecting the possibility of application in different geological conditions. The possibility of predicting expected properties and understanding transport mechanisms of barrier mixtures is still an unsolved objective.

This study investigates the effect of montmorillonite content on the effective diffusion coefficients and accessible porosity (diffusion-accessible). Diffusion of HTO and $^{36}Cl^-$ in compacted kaolinite-montmorillonite samples was studied using through-diffusion technique. The gradation of the montmorillonite content in the samples was about 20% from the almost complete absence in the sample (with 98 % of kaolinite) to 75 % of the montmorillonite content representing pure bentonite. The bulk dry density of the samples from 1200 to 1900 kg/m^3 was varied. Laboratory cells with almost no change in internal sample volume (1 cm thick and 3 cm diameter) were designed and constructed. Influence of ionic strength was not studied. Therefore, solution used for the experiments consisted of deionized water and non-sorbing tracers.

Increasing the bulk dry density and content montmorillonite of kaolinite-montmorillonite mixtures samples resulted in a decrease of both the effective diffusion coefficient and the accessible porosity for HTO and $^{36}Cl^-$. In addition, the effective diffusion coefficients, and accessible porosity for $^{36}Cl^-$ are smaller than for HTO. In the literature, this is described as an ionic exclusion effect (Donnan equilibria) [1, 2].Empirical relationships (similar Archie's law) between effective diffusion coefficient and accessible porosity for HTO and $^{36}Cl^-$ have good fit.

This work was supported by the Russian Science Foundation (project 21-73-20083).

References:

[1] Gimmi, T., Alt-Epping, P., (2018), *Geochim. Cosmochim. Acta* 232, 1–13.

[2] Van Loon, L.R., Glaus, M.A., Müller, W. (2007), *Appl. Geochemistry* 22, 2536–2552.