Characterization of bentonite reacted with cementitious materials for 10 years

SHINGO YOKOYAMA, MISATO SHIMBASHI, DAISUKE MINATO AND YASUTAKA WATANABE

Central Research Institute of Electric Power Industry, Abiko 1646, Abiko, Chibe 270-1194 Japan (shingo@criepi.denken.or.jp)

The Cement-Clay Interaction (CI) Experiment is carried out at the Mont Terri underground research laboratory to understand the influence of cement on Opalinus Clay (OPA) and bentonite (MX). A previous study reported on the alteration of MX that reacted with cementitious materials (OPC or LAC) for 4.9 years. In the case of OPC, alteration of bentonite was characterized by dissolution of cristobalite and montmorillonite, precipitation of calcite and Mg-bearing phases and an increase in extracted Ca and Mg [1]. In the current study, the core samples of the OPC- and LAC- MX interface that interacted for 10 years were analysed to evaluate the resulting mineralogical alteration of bentonite and to understand the kinetics of the reactions involved. Furthermore, the comparison between previous 2D reactive transport modeling [2] and the obtained analytical results will be discussed in the presentation.

Two main features were observed in both LAC-MX and OPC-MX interface regions. First, cristobalite near the interface dissolved after reacting with the cementitious materials. The amount of montmorillonite contained in MX near the interface in OPC-MX slightly dicreased. Although both minerals dissolved, the distance from the interface at which dissolution occurred was almost the same after 4.9 and 10 years. Second, an increase in extracted Ca and Mg near the interfaces was caused by (1) dissolution of new precipitates (e.g. calcite and Mg-bearing phases) during extraction using 1M NH_4Cl solution and by (2) Ca and Mg exchanged on montmorillonite. This also occurred at the same distance from the interface after 4.9 and 10 years. Therefore, it is inferred that the alteration was relatively fast (< 4.9 y), and thereafter the reaction rates slowed down.

To predict the long-term alteration of bentonite for the safety assessment of radioactive waste disposal, it is necessary to perform both short- and long-term tests to determine when and how alteration occurs in the cement-clay interfaces.

[1] Yokoyama et al. (2015) Book of abstracts for Clay Conference 2015.
[2] Yokoyama et al. (2017) abstracts for Goldschmidt 2017.