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Thermal-hydrodynamic-geochemical models of engineered clay barriers

J Samper, A. Mon, L. Montenegro, A. Naves, and B. Pisani
ETS Ingenieros de Caminos. Universidad de A Coruña. 15192 Coruña. Spain (jsamper@udc.es)

Unsaturated compacted bentonite is foreseen as a backfill and sealing material in radioactive waste repositories. The evaluation of the long-term performance of the Engineered Barrier System (EBS) requires the use of thermal (T), hydrodynamic (H), mechanical (M) and chemical (C) models. Most of the THC modeling work performed in recent years was carried out within the context of performance assessment purposes. There is a clear need to test the models used in performance assessment with laboratory data. The main aim of the PEBS project (Long-term Performance of the EBS) is to evaluate the sealing and barrier performance of the EBS with time, through the development of a comprehensive approach involving experiments, model development and consideration of the potential impacts on long-term safety functions. Here we present THCM models for the clay barriers of the EBS which account for two types of waters and pores (dual porosity), the mechanical and geochemical couplings to account for changes in the porosity caused by swelling phenomena and thermal and chemical osmosis. The model results of heating and hydration experiments performed on FEBEX bentonite indicate that the geochemical results improve when changes in porosity caused by swelling are considered. The model reproduces the measured cumulative inflow of the FEBEX mock-up test during 14 years. The fit of relative humidity data, however, shows some discrepancies.

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