IMPLEMENTATION OF A CHEMO-MECHANICAL MODEL TO PREDICT THE LONG-TERM EVOLUTION OF A BENTONITE-SAND SEALING COMPONENT

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The safety of the future deep geological disposal facility for radioactive waste, named Cigéo, is based on the implementation at the closure step of swelling clay seal cores to prevent the water from flowing into the galleries. Their main safety functions rely upon the development and the stability of a swelling pressure that is transferred to the surrounding materials. To predict long-term changes in the swelling pressure, thermo-hydro-mechanical models are typically used. This work is focused on the implementation of physico-chemical processes at the interface between the sealing component and the surrounding materials (concrete support bases, concrete liner, and the surrounding Callovo-Oxfordian claystone). The effects of chemically-induced swelling pressure changes at the full scale are explored here.

A 2D axisymmetric coupled chemo-mechanical model of the sealing system has been developed and implemented in iCP [1], considering water-saturation evolving conditions. The model accounts not only for reactive transport processes of the interaction between the different materials, but also for the mechanical response of the system under such geochemical changes. The mechanical behaviour of bentonite is based on the Barcelona Basic Model [2]. The chemo-mechanical couplings considered in the model include: (1) montmorillonite dissolution, (2) mineral precipitation/dissolution, (3) porewater salinity, and (4) composition of interlayer water (cation exchange reactions). These couplings relate chemical changes with the mechanical behaviour, mainly affecting the void ratio, material stiffness, total suction values and swelling pressure development. The model has been used to assess the chemo-mechanical evolution of the system over 10,000 years as a result of the geochemical alteration of the sealing component.

References

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