A fully coupled hydro-mechanical framework for expansive clays

Dieudonné, Anne-Catherine; Charlier, Robert

Publication date
2018

Document Version
Accepted author manuscript

Citation (APA)
Dieudonné, A.-C., & Charlier, R. (2018). *A fully coupled hydro-mechanical framework for expansive clays*. Abstract from Second International Workshop on the Finite Element Code LAGAMINE, Delft, Netherlands.

A fully coupled hydro-mechanical framework for expansive clays

Anne-Catherine Dieudonné, Delft University of Technology,
a.a.m.dieudonne@tudelft.nl
Robert Charlier, University of Liege, Robert.charlier@uliege.be

Abstract:

Deep geological disposal constitutes one of the most promising solutions for the safe isolation of high-level and intermediate-level radioactive wastes. While the concept of disposal differs from one country to another, the insulation of the radioactive wastes from the biosphere always relies on a multi-barrier concept in which bentonite-based materials play a central role. The objective of the bentonite barrier is to form a tight contact with the surrounding geological formation and to create a zone of low permeability able to limit water flow around the excavated galleries, thereby delaying the release of radionuclides to the biosphere.

In this paper, the problem is analysed in a systematic and progressive manner by considering increasing scales of interest. The hydration and swelling mechanisms of bentonite are first addressed at a microscopic scale. The effects of hydraulic and mechanical loading on the microstructure of bentonites are thoroughly analysed. Based on the interpretation of experimental data, a new model for the evolution of the microstructure is proposed. It is later used to represent the effects of the microstructure on the macroscopic material behaviour.

The constitutive modelling of bentonite behaviour is then addressed at a macroscopic scale. A classic hydromechanical framework for partially saturated porous media is progressively enriched to take into account the important multi-scale and multiphysical coupled processes observed in bentonites.

The developed models are implemented in the finite element code LAGAMINE and validated on different bentonite-based materials. They provide a new and better understanding of the material behaviour along hydromechanical stress paths.