Considering the heterogeneity of argillaceous rock microstructure in a hydromechanical coupled double scale model

B. Pardoen[1,3], P. Bésuelle[1], J. Desrues[1], S. Dal Pont[1], P. Cosenza[2]
[1]Université Grenoble Alpes, Grenoble INP, Laboratoire 3SR
[2]Université de Poitiers, IC2MP
[3]Corresponding author: B. Pardoen, Email: benoit.pardoen@uclouvain.be

Abstract:

In the context of radioactive waste management, clay rocks are considered as favourable media for deep geological repositories. These rocks exhibit a complex multi-scale microstructure [1]. Questions have risen on how microstructural characteristics of heterogeneous rocks can enrich the constitutive behaviour at macroscale. Consequently, the modelling of the hydro-mechanical behaviour of a clay rock is considered by taking into account its microstructural characteristics. The purpose is to develop a numerical approach taking into account the multi-scale behaviour of clay rocks and its effect at the structural scale in order to predict the deformations and failure.

An approach is investigated for the modelling of the hydro-mechanical coupled behaviour of Callovo-Oxfordian claystone (COx), a potential host rock for deep repositories of radioactive wastes in France. The presented approach is a double-scale finite element method (FEMxFEM) using elementary areas (EA) to model the material behaviour at the microscale [2]. The global response of the microscale EA serves as a homogenised implicit numerical constitutive law for the macroscale [2]. The work focuses on the definition of the EA in a clay rock, in order to be both a realistic and simple representation of the material [3]. Experimental observations and characterisations of the rock's microstructure are considered to define the material in a realistic manner [1]. Moreover, double-scale computation results highlight the claystone behaviour at micro and macro scales with comparison to experimental data of compression tests [3]. An emphasis is put on the deformation processes at both scales.

References:

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