Abstract Preview - Step 3/4

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Topic: 6 Hydromechanical and gas transport processes during the excavation, operational and post-closure phases

Title: MAVL galleries in Callovo-Oxfordian claystone: analysis of the hydromechanical interaction using a continuum approach

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Text: The disposal of radioactive waste in deep underground repositories has been studied for a long while (OECD/NEA, 1995). A multi-barrier solution ensures the isolation of the contaminants from the biosphere. Argillaceous rocks are good candidates to host the repositories because of their low permeability and the ability to absorb radionuclides. In the case of France the Callovo-Oxfordian argillite (COX) has been chosen by the national agency ANDRA to be the host rock to store the radioactive waste of the country.

During the previous years, the problem of gallery excavations in the COX host rock has been the case of study in Université de Liège; specially the simulation of the damaged zone (EDZ), which is created in the surrounding of the galleries during their excavation (Blümling et al. 2007). The problem, involving strain localization, is not well posed when modelled using classical mechanics theories; to overcome this, a microstructured model is used: local Second Gradient (Collin et al. 2006), this avoids the pathological mesh dependency by introducing an internal length that regularizes the problem.

At the present time, the constitutive models for the COX take into account several transverse anisotropies: in situ stress state, elastic moduli, saturated permeability and plastic, this is achieved by the use of a fabric tensor that influences the cohesion (Pietruszczak et al. 2002). Classic elasto-plastic models like Drucker Prager and Van Eekelen, with cohesion softening, are appropriate to model the evolution of the EDZ, but they fail at reproducing the long term convergence of the gallery. To solve that, a visco-plastic model, independent from the plastic model, has been added. The permeability changes with the damage of the host rock, increasing several orders of magnitude in the EDZ. The latest developments of the model allowed taking this into account by linking the permeability of the material to the plastic deformation, which is sensibly higher inside the strain localization zone (Pardoen et al. 2016).

The aforementioned model is used to evaluate the behaviour of the pillars between the galleries and, in particular, the evolution of the damage on those. The studied galleries concern the ones designed to host the medium activity long life waste (MAVL) with a diameter of 9-12m. The results of this work are intended to help to determine the optimal interaxis distance between the adjacent galleries. A series of parametric simulations at different interaxis distances are executed, in order to highlight the impact of the hydromechanical couplings on the EDZ evolution between the galleries.

References:

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