**Enhanced double structure model for expansive clays. Isothermal formulation and application to homogenization test.**

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**ABSTRACT**

Expansive clays play a key role in many scenarios of the deep geological disposal of nuclear waste. They provide the sole or main component for the construction of engineered barriers surrounding the nuclear waste placed either in horizontal drifts or in vertical boreholes. Expansive clays are also one of the main constituents of the sealing systems required to close access tunnels and shafts.

Several constitutive models for these geomaterials have been postulated on the hypothesis of explicit consideration of two pore levels. The expansive clay fabric is identified as a mixture of macroparticles (clay aggregates) formed by clay platelets. These mathematical models are formulated in terms of classical plasticity and generalized plasticity [1], [2], [3].

In this work, an enhanced version of the precedent constitutive models is presented. The new features are: i) A critical reflection on the concepts of pore volume fractions and macro- and micro-porosities is done, in order to overcome some imprecise definitions in previous formulations, ii) The hypothesis of no structural changes at pure elastic behaviour generates couplings, which are dependent on the selection of constitutive variables and iii) The possibility to deal with an unsaturated micro-structural level (clay aggregates). In a general case, non-equilibrium of the hydraulic state between both structural levels leads to delayed water exchanges.

The model is formulated in the space of stresses and suction; and has been implemented through an explicit scheme in a finite element code.

The capability of the model is proven through a series of single element tests that follows several stress-paths. The evolving structure of the expansive clays is analysed through the modelling of the hydration of bentonite block/pellets specimens. Changes on the hydration condition on a homogenization test lead to different time evolutions of structure and of swelling pressure.

**REFERENCES**