Characterisation of vapour transfers in non isothermal conditions at cavities wall using convective drying tests

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Introduction
The ventilation of the cavities excavated for radioactive waste disposals could give rise to a desaturation process of the rock mass. It could influence the development of an EDZ around the galleries. It emphasizes the need of correct heat and flow boundary conditions for modelling in order to deduce the capillary pressure distributions around the cavities. This problem can be related to the drying of an unsaturated porous medium, which is a process of moisture removal from materials. First drying tests are performed on a sandy silt, in order to adjust the procedures.

Convective drying tests

Kinetics of drying processes
Continuous weight measurement of cylindrical soil samples submitted to the convection of a humid air (controlled in temperature, relative humidity and velocity)

Drying curve: \( \frac{dM}{dt} = -w \)

Drying flow rate (g/s)

Water content w (kg/kg)

Drying rate (kg/s)

Drying curves for different drying temperatures - Air RH=1% and v=1 m/s

Drying test results
First tests on Awans silt cylindrical samples (H=14 mm – R=8.5 mm) with different drying temperatures

Drying tests modelling
• TH coupling – Axisymetrical modelling
• No mechanical influence (small shrinkage, no cracking)
• Fluid flow = Darcy’s law for unsaturated case + diffusion of water vapour (Fick’s law)
• Heat transport = conduction + convection + evaporation

Conclusions
Assuming the influence of the desaturation of the boundary layer on the mass transfer coefficient allows a good reproduction of the kinetics of drying. The overestimation of the drying rate is avoided, which is not the case when the capillary pressure at the boundary is numerically imposed to the ambient suction. Such modelling allows the validation of the proposed formulation for the coupled flow and heat exchanges occurring at ventilated cavities wall. New series of drying tests on Boom clay are currently performed.

References:

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