Numerical Simulation of the Soil Desiccation Process

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ABSTRACT

Desiccating soils experience shrinkage and eventually cracking. This process involves several Thermo-Hydro-Mechanical phenomena and includes complex soil-atmosphere interactions. Modelling this process considering all phenomena and interactions is a difficult task and it is currently an ongoing research.

The objective of this paper is to simulate the results from a laboratory experiment involving the desiccation of a soil specimen in an environmental chamber where relative humidity and temperature is controlled [1]. The size of the specimen was 40 cm in diameter and 10 cm in height. It was placed in the chamber for 45 days, imposing a temperature of 35ºC and a relative humidity of 40%. The total weight of the specimen was continuously measured, as well as suction at several points inside the soil mass. Pictures from the top were recorded as well and a crack was observed on the perimeter of the specimen, in the contact between the soil and the container walls.

The analysis of the experiment has been carried out by means of code "Code_Bright", an in-house finite element programme, solving the THM equations in the context of porous unsaturated media [2]. The evolution of the main variables in the experiment depends largely on the boundary conditions considered in the analysis. The actual evaporation from the soil surface is very sensitive to air velocity, due to the effect of removing water vapour from the soil surface. Several options for that boundary condition have been considered in order to reproduce the measurements. The perimeter crack may imply a change in the boundary conditions, not only from the mechanical point of view, but also with respect to evaporation through the crack sides. Comparison between numerical simulations and experimental results suggest that inside the crack, the boundary condition applied at the top of the specimen cannot be used, as there is a particular atmosphere different from the air in the environmental chamber. This work shows how numerical simulations are useful to understand the mechanism of soil-atmosphere interaction in cracked soils.

REFERENCES

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