CLAY BEHAVIOUR UNDER THERMAL GRADIENTS ELASTIC AND PLASTIC STRAINS

Xavier Pintado, Jorma Autio, Olli Punkkinen

B+TECH Oy, Laulukuja 4, FI-00420, Helsinki, Finland (xavier.pintado@btech.fi)

The nuclear waste repositories will generate strong temperature gradients at the clay barrier (Gens *et al.*, 2009). The heat and water transport generate volume change in the clay. An experimental work is proposed here. The clay reference is the MX-80 (Dueck, 2004).

The test device imposes a fixed heat flow in one side of the sample and maintains constant the temperature on the other side. Two samples are tested for symmetry. The samples are unconfined and the total mass of water remains constant. This situation creates a strong thermal gradient in the samples. The final radial strains in some places of the sample, the total vertical strain and the water content distribution will be measured just at the end of the test and some weeks later in order to distinguish the elastic strains from the plastic strains.

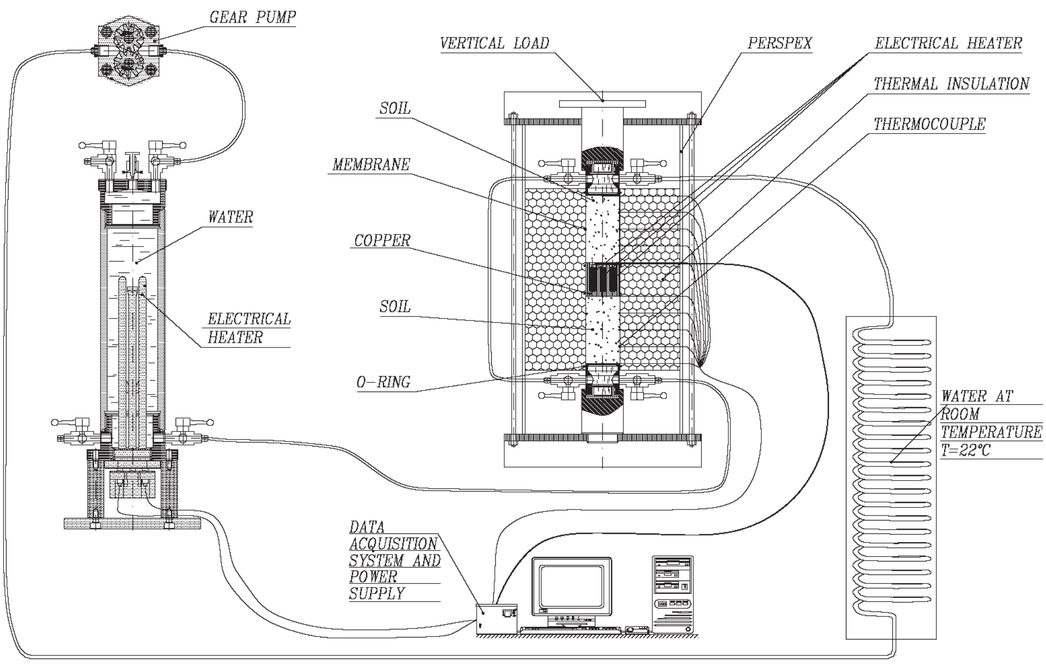

Figure 1: Test device.

The test period mustn't be longer than two weeks because a large quantity of water loses through the rubber membrane and the heads of the sample. The maximum temperature reached in the cooper is 90 degrees because with higher temperature, the rubber membrane is damaged.

This test is already simulated by a numerical code. Thermal, thermo-hydraulic and thermo-hydro-mechanical analyses are being done. These analyses allow studying the different fluxes inside the sample and its quantification. In the Figure 2, water content distribution is compared with the water content calculated from the reference parameters in the clay.

The water distribution and the change of diameter after the test will also be studied. This experimental work will allow to know what is the percentage of the strains elastic or plastic and check the mechanical model. In the Figure 3, the experimental diameter change is compared with the diameter change calculated from the reference parameters of the clay.

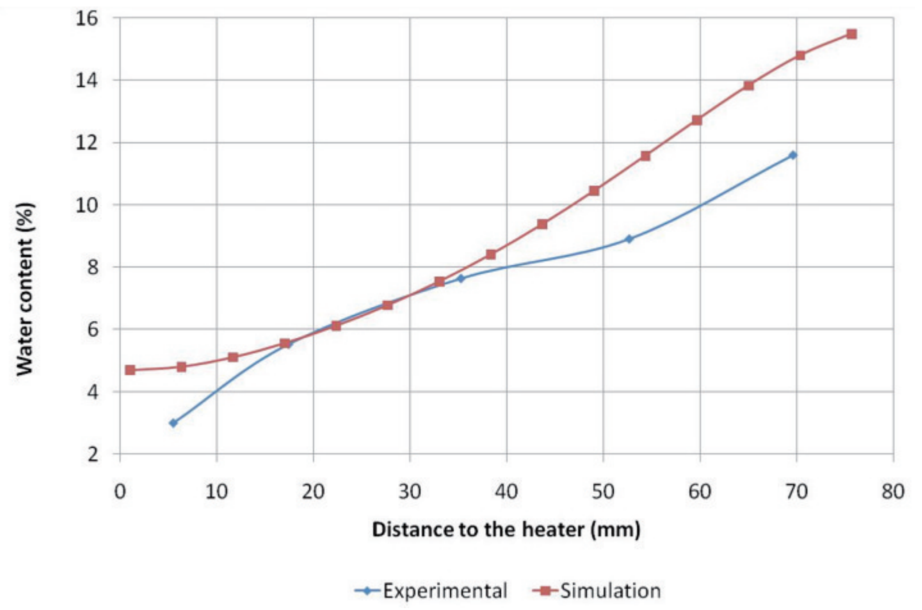

Figure 2: Water content in 12 days.

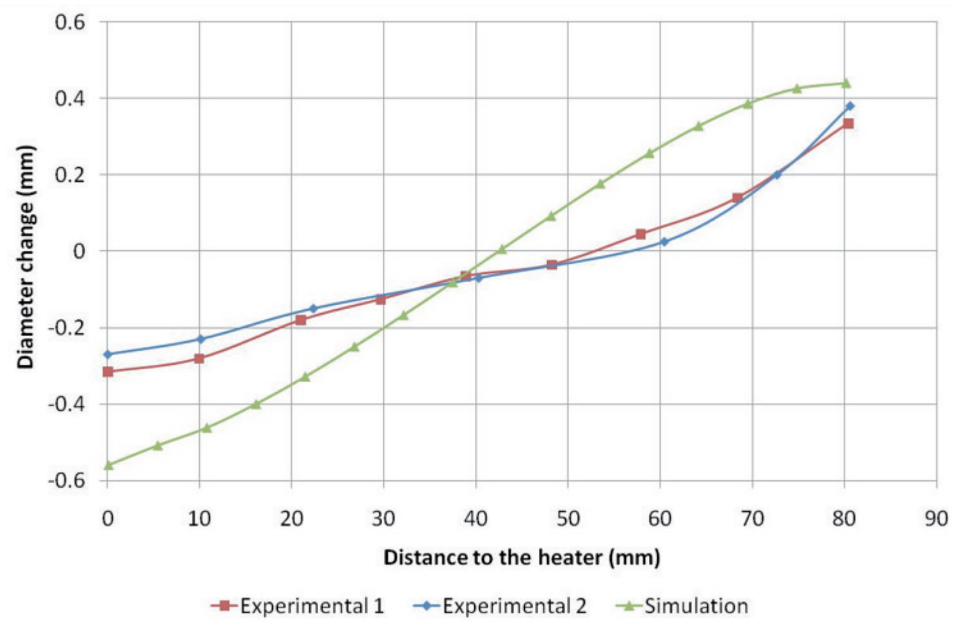

Figure 3: Diameter change in 12 days.

References:

Dueck, A., 2004. Hydro-mechanical properties of a water unsaturated sodium bentonite. Thesis. University of Lund, Sweden.

Gens, A., Sanchez, M., Guimaraes, L. Do, N., Alonso, E., Lloret, A., Olivella, S., Villar, M.V., Huertas, F., 2009. A full-scale in situ heating test for high-level nuclear waste disposal: observations, analysis and interpretation. Géotechnique 59(4): 377-399.

Pintado, X., Ledesma, A., Lloret, A., 2002. Backanalysis of thermohydraulic bentonite properties from laboratory tests. Engineering Geology 64: 91-115.