INCREASING THE TEMPERATURE OF THE CANISTER SURFACE TO 150°C: EFFECT ON THERMO-HYDRAULIC PROCESSES IN THE BENTONITE BARRIER

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In the context of the EURAD-HITEC project, CIEMAT performed two thermo-hydraulic tests in cells in which the conditions of a bentonite barrier in a repository were simulated. The buffer material (Wyoming-type bentonite) was simultaneously submitted to thermal and hydraulic gradients inside a 10x10 cm cylindrical cell that was heated on one end at 150°C (simulating the canister surface), while water was supplied on the other end (simulating groundwater inflow, saline and glacial). Similar tests had been performed in previous research with the heaters set at 110°C. The cells provided online information of temperature and pressure. Hydration under thermal gradient could progress even under very low water injection pressure. Relevant swelling stresses –associated to the increase in water content– were recorded during saturation, higher when diluted water was used instead of saline one. The values were lower than expected for room temperature. After 2.5 years of hydration the cells were dismantled and the bentonite analysed. Significant gradients in the water content and dry density distributions had developed in the bentonite, with higher water contents close to the hydration surface, where the dry density was lower. These gradients were steeper in the cells tested under higher temperature. Overall, the same processes observed at lower heater temperature took place, but some of them were enhanced, such as the movement of soluble species or the decrease of specific surface area in the dried areas. Testing at higher temperature was challenging, given that high vapour pressures developed inside the cells and their hermeticity was damaged, particularly in the cell hydrated with saline water. Vapour leaks caused by insufficient tightness of the sensors' inlets, and consequent oxygen access to the bentonite, enhanced corrosion around sensors, but this is considered to be an artefact that would not be paralleled in the actual repository.

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