EFFECTIVENESS OF ELECTRO-OSMOTIC DRYING OF AN UNSATURATED CLAYEY SOIL

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Abstract

The paper presents an experimental study on the effect of cracks on the continuity of the electric field during desiccation of clays by electro-osmotic flow. The material is a kaolinite initially prepared as a saturated slurry with a water content equal to 1.5 times its liquid limit (w_L = 40%).
The experimental device consists of a transparent PVC tube containing the sample 40 mm in diameter and 100 mm long. Two graphite circular electrodes of 40mm in diameter are in contact with the ends of the sample via filters. This optimized shape allows the application of a homogeneous electric field in the sample. The cathode is pierced at its base to allow the drainage of the interstitial fluid towards a precision flowmeter.
The results show that a steady state (constant flow) is established as soon as the electric field is applied and this regime remains as long as the material remains continuous. Due to the appearance of the first cracks in the material due to desiccation on the cathode side, this continuity is no longer assured and the electric current vanishes and with it, the electro-osmotic flow. The coefficient of electro-osmotic permeability is of about Ke ~ 1.2 to 4.3 10^{-9} m^2 / V.s.
The fact that the cracks appear on the cathode side where the degree of saturation remains 1 rather than on the anode side, where the degree of saturation falls to about 65%, seems at first to be in contradiction with the appearance of the shrinkage cracks during desaturation. This could be explained by the fact that the desaturation of the material generates internal attraction capillary forces due to suction. This suction tends to densify the material on the anode side, as shown by the variation in the void ratio, which decreases from about 1.2 to 1. The material being initially continuous, these attraction forces are transmitted to the whole of the material, in particular to the saturated part on the cathode side, which is sliding towards the anode upstream. Nevertheless, the friction with the mold on the diametrical periphery slows down this movement, hence the appearance of tensile cracks, first close to the cathode, and then propagating progressively towards the anode

Key Words: *clay; desiccation; suction; cracking; electro-osmotic flow; unsaturation*

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