Effect of stress on water retention of needlepunched geosynthetic clay liner

Geosynthetic clay liners (GCLs) are placed at the bottom of waste disposal facilities where they hydrate from the subsoil and eventually from a hydraulic head on geomembranes (GMs) defects. Predicting hydration behavior of GCLs requires knowledge of the water-retention properties of the GCL along wetting paths. Given that GCLs could be subjected to different ranges of vertical stresses that are induced by the weight of the supported waste, the confining stress could affect water-retention properties of GCLs and should be investigated. To do so, a laboratory methodology to establish the water-retention curves (WRCs) of needlepunched GCLs under stress was undertaken. Various constant vertical stresses corresponding to different weights of the supported waste were applied to GCL specimens placed in controlled-suction oedometers. Suction values were selected so as to mimic a wetting path from the initial dry state to zero suction. Suction was controlled by using controlled suction techniques with controlled humidity imposed by a saturated saline solutions and using the osmotic technique with polyethylene glycol (PEG) solutions. Measurements were undertaken on oedometer systems as to apply confining stresses and have been complemented by standard saturated oedometer swelling tests. The data obtained confirm that increasing the stress on to the GCL results in less, albeit faster, water uptake, which could emphasize on recommendations about rapidly covering GCLs after they are placed at the bottom of a waste disposal facilities. Finally, the potential validity of the state-surface concept, which was developed in unsaturated soil mechanics, is discussed using van Guenuchten's and Fredlund and Xing's equations for water retention curves.

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