Effect of straining on gas advective flow of a needle-punched GCL

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Abstract: Although geosynthetic clay liners (GCLs) have gained advantage over compacted clay liners regarding the ability to withstand large differential settlement in cover systems, the ability of strained GCLs to mitigate gas flow is still not known. A series of gas permeability tests on partially hydrated GCLs subjected to straining is presented in this paper. Tests were performed on partially hydrated needle-punched GCLs subjected to straining (up to 30% of area strain). The GCL samples were strained either before hydration or after hydration. It was found that the gas flow rate through the strained GCL depended on GCL moisture content and straining conditions. The tensile strain seemed to have no adverse effect on dry GCL (straining before hydration) as long as the geotextile components were able to maintain their functions, and the mass of bentonite per area was preserved. However, in the case of straining (up to 15% area strain) after hydration, tensile strains possibly induced tension cracks in the bentonite component, providing preferential gas flow paths and higher gas flow rate than that of an unstrained GCL. At higher degree of area strain (15 % < epsilon < 30%), the gas flow rate was found to be similar to the flow through an unstrained GCL, particularly at high moisture content (MC > 90%). Poiseuille's equation for laminar flow of fluid through space between parallel solid planes can be used to describe the flow of gas through cracks in the hydrated bentonite component.

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