THEORETICAL EFFECT OF BENTONITE MIGRATION ON CONTAMINANT TRANSPORT THROUGH GEOSYNTHETIC CLAY LINERS

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ABSTRACT: Since the introduction of geosynthetic clay liners (GCLs) to waste containment facilities, one of the major concerns about their use has been the hydraulic equivalency to a compacted clay liner. Field observations and laboratory test results show that the thickness, or mass per unit area, of hydrated bentonite can decrease under normal stress, especially around zones of stress concentration, such as a rock or roughness in the subgrade, a leachate sump, or wrinkles in an overlying geomembrane. This paper presents the results of steady water flux, steady solute flux, steady diffusion, and dispersion analyses that illustrate the importance of bentonite migration on contaminant transport. These analyses suggest that a GCL is hydraulically equivalent to a CCL (hydraulic conductivity of 10^{-9} m/s) in terms of steady water and solute flux even if the bentonite thickness decreases from 7 mm to 2 mm. However, a GCL is not equivalent to a CCL in terms of steady diffusion or mechanical dispersion even if the hydrated bentonite does not thin. Therefore, bentonite migration should be minimized to decrease the amount of diffusive and dispersive flux through the GCL. Suggestions for reducing contaminant transport and protecting hydrated bentonite from stress concentrations are presented. Possible solutions to eliminate or reduce the migration of hydrated bentonite include using a compacted clay liner, encapsulating the bentonite between two geomembranes to reduce the amount of hydration and decrease bentonite compressibility, installing multiple layers of GCL at known stress concentrations, eliminating stress concentrations in the subgrade by smoothing changes in geometry, reducing ruts and removing rocks, and/or installing geomembranes with a limited number of wrinkles.

KEYWORDS: Geosynthetic Clay Liners, Flow Rates, Fluid Barrier, Permeability, Shear Strength

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