Gas permeability of partially hydrated geosynthetic clay liners

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Abstract: A series of gas permeability tests were performed on four partially hydrated geosynthetic clay liners (GCLs) (GCL1, GCL2, GCL3, and GCL4). All GCLs consisted of essentially dry bentonite (powder or granular) sandwiched between geotextile layers. The geotextiles were held together as a composite material by needle-punching, except GCL-4, which was stitch bonded. GCL-2 had a special characteristic, which consisted of a cover nonwoven geotextile layer impregnated with powdered bentonite. The gas permeability was found to be very sensitive to the change of moisture content and volumetric water content. The results also highlighted the. effects of the GCL structures (bentonite impregnation, needle punching, and stitch bonding) and bentonite forms (granular and powdered) on the gas permeability. The needle punched GCLs tended to have lower gas permeability than the stitch bonded GCLs, and the GCLs containing granular bentonite tended to have higher gas permeability than the GCLs containing powdered bentonite. The bentonite impregnation of the nonwoven geotextile also contributed to lower gas permeability. For comparable conditions, these effects resulted in a reduction of up to three orders of magnitude of gas permittivity from one GCL to another. However, the effect of the differences between the GCLs on gas permeability, at high volumetric water content (>70%), was overridden by the presence of the overburden pressure during hydration. Furthermore, the overburden pressure also had an important role in the reduction of gas permeability, which implies that the GCL should be subjected to confinement at the time of installation or hydration in order to obtain a low gas permeability.

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