HEAT-TREATED (HT) VS. NON-HEAT TREATED (NHT) GCLS

IMPACTS ON PEAK AND RESIDUAL SHEAR STRENGTH

Geosynthetic Clay Liners (GCLs) have seen increased use in applications such as mining and municipal solid waste containment, which can place extreme stresses on geosynthetic material when they are under high normal loads. As a result, GCLs used in these types of applications are typically required to have a high residual sheer strength. The high residual shear strength forces the failure plane outside of the GCL and moves it externally to the interface between adjacent material.

To achieve higher internal shear strengths, two different manufacturing processes are typically used. The first is a heat treatment (HT) process, also referred to as thermally locked, that involved melting bundles of the needle-punched fibers that protrude from the carrier geotextile into pills. This effectively locks the reinforcing fibers in place and prevents them from pulling out of the carrier geotextile. This process typically involves lower density needle-punching. The second process uses high density needle-punching and leaves the fibers entangled rather than using a heat treatment. This non-heat treated (NHT) process results in longer fibers in the finished product.

Colorado State University analyzed these two manufacturing processes and their impact on internal shear strength. In one set of tests, both HT and NHT GCLs tested had similar ASTM D6496 peel strengths (740–790 N/m). The GCLs were tested at normal loads between 80 kPa and 500 kPa. Per Figure 9[1], HT GCLs have a peak internal shear strength that occurs at a relatively low horizontal displacement (~10 mm). This was attributed to brittle failure of the fiber pills, which is followed by a rapid post peak loss in strength. NHT GCLs have a much larger displacement at peak internal shear strength (20–25 mm) as the fibers gradually pullout or rupture, which allows for higher peak and large displacement strengths.

These results support the use of NHT GCLs in applications that require greater shear strength at larger horizontal displacements.

References:

[1] Bareither, C. A., Soleimanian, M. and Ghazizadeh, S. (2018). Direct shear testing of GCLs at elevated temperature and in a non-standard solution. Geosynthetics International, 25, No.3, 350–368.

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