BENTOMAT® DN GCL

CREEP SHEAR TESTING

Commercially available geosynthetic clay liners (GCLs) consist of bentonite that is either sandwiched between two geotextiles or is bonded to a single geomembrane. GCLs may be further categorized as unreinforced or reinforced. Unreinforced GCLs have no internal reinforcement and thus possess relatively low shear strength. Reinforced GCLs, by means of needlepunching, are designed to carry and transmit shear loads within their structure and are typically used on slopes greater than 10H:1V.

The creep shear strength behavior of BENTOMAT ST GCL was previously detailed by Trauger, et.al. (1997) (see BENTOMAT® ST GCL Creep Shear Testing technical reference). BENTOMAT ST GCL is a geosynthetic clay liner consisting of a woven geotextile on one side of the bentonite component and a nonwoven geotextile on the other side, reinforced with needlepunched fibers. Two large-scale constant-load (creep) shear testing devices were developed to evaluate the long-term shearing behavior of the GCL. One device was designed to simulate loading conditions that typically occur on a GCL deployed as a cover system. The other device was designed to simulate loading conditions that typically occur on a GCL used in a lining system. The results showed that BENTOMAT ST GCL had undergone relatively small shear displacements and that the shear displacement rates within the GCL and/or the test interface were continuously decreasing with time.

This program tested BENTOMAT DN GCL, a geosynthetic clay liner consisting of bentonite between two nonwoven geotextiles, reinforced with needlepunched fibers. Once again two large-scale constant-load shear-testing devices were utilized. High normal load testing is being performed on a sample initially hydrated in tap water for 120 hours under a normal load of 400 psf. Then the sample was consolidated and sheared at incrementally increased normal load and constant shear stresses while interfaced with a textured geomembrane. Low normal load testing was performed at a normal stress of 500 psf (24 kPa) and a constant shear load of 250 lbs. (110 kg). The entire test specimen was soaked in tap water for 120 hours under the normal load prior to applying the constant shear load. The entire specimen remained submerged throughout the entire test duration.

The BENTOMAT DN GCL high normal load shear testing reached the 5,600-hour mark before a mechanical failure (ruptured air bladder) ended the test. For the high normal load study, the total displacement at 5,600 hours was 0.329 in. (8.4 mm) and the displacement rate decreased over time to approximately 1.47 x 10-7 in/min. (3.8 x 10-6 mm/min). The BENTOMAT DN GCL total displacement and displacement rate are very close to those experienced by BENTOMAT ST GCL at the same time of its high normal load creep test.

The BENTOMAT DN GCL creep shear low normal load testing has passed the 10,000-hour mark. For the low normal load study, the total displacement at 10,000 hours was approximately 0.067 in. (1.7 mm) and the displacement rate decreased over time to approximately 2.7 x 10-8 in/min. (6.9 x 10-7 mm/min). Again, the BENTOMAT DN GCL total displacement and displacement rate are very close to those experienced by BENTOMAT ST GCL at the 10,000-hour mark of its low normal load creep test. The displacement at peak internal shear strength for BENTOMAT DN GCL at this low normal load is typically between 0.75 to 1 inch. Thus, BENTOMAT DN GCL appears to be quite stable with respect to constant-load creep shear.

References

Trauger R.J., Swan R.H. and Yuan Z., “Long-Term Shear Strength Behavior of a Needlepunched Geosynthetic Clay Liner”, Testing and Acceptance Criteria for Geosynthetic Clay Liners, ASTM STP 1308, American Society for Testing and Materials, W. Conshohocken, PA, 1997.

Geosyntec Consultants, Atlanta, GA, “Final Report – 10,000 hour Constant-Load (Creep) Shear Testing: Bentomat DN GCL Landfill Cover System Evaluation”, Project No. GLI3545, February 1, 2001.

Geosyntec Consultants, Atlanta, GA, “Interim Report – Multi-Step Constant-Load (Creep) Shear Testing: Bentomat DN GCL Landfill Lining System Evaluation”, Project No. GLI3545, February 1, 2001.

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