Monday 3/13/2017

2–3:30 p.m.

Geosynthetics Testing

Chairs: Huabei Liu, Huazhong University of Science and Technology; Rob Swan, Drexel University

Soil/geosynthetic Interface Strengths from Torsional Ring Shear Tests

Timothy D. Stark and Rodrigo Fernandez, University of Illinois at Urbana-Champaign

Torsional ring shear tests were conducted to investigate Soil/Geosynthetic Interface Strengths of various geomembranes. A selection of seven smooth and three textured geomembranes (10 total) that can be factory fabricated were sheared against two soils to investigate the range of soil/geosynthetic interface strengths. The two soils are: (1) a clayey glacial till and (2) Ottawa fine sand. Smooth PVC and both smooth and textured HDPE geomembranes were also tested so the fabricated geomembrane interface strengths could be compared to previously published interface strengths and commonly used geomembranes. The effect of texturing and material properties on shear strength and soil interaction are presented herein and compared with existing interface strength values. To facilitate the testing, programmable video cameras were used as a data acquisition system.

Evaluation of Geotextile Performance for the Filtration of Fine-grained Tailings

Patricia Dolez and Eric Blond, SAGEOS/CTT Group

Geotextile filters are an interesting solution to dewater tailings as they can be installed on existing ponds or be deployed during operation. However, filtration of the fine-grained tailings that are encountered in the oil sands and other mining industries raises several issues: blinding or clogging of the geotextile by the fine particles, or piping. Since the hydraulic conductivity of fine-grained tailings is generally too low for the ASTM D5101 standard test method for soil/geotextile system filtration compatibility, a test setup has been specifically developed and used to study the filtration behavior of needle-punched and heat-bonded nonwovens with various types of oil sands tailings. The permittivity of the geotextile/tailings systems was always several orders of magnitude lower than the water permittivity of the geotextile. On the other hand, no clogging or blinding was observed over more than 100 days. These results show that geotextiles offer great promise for the filtration of fine-grained tailings.

A Preliminary Study of Self-healing of Fully Penetrating Hole in GCLs on Full Hydration

Tikang Li and Kerry Rowe, Queen's University

The self-healing capacity of 25.4, 30.2, 34.9, 41.3 and 50.8 mm-diameter circular fully penetrating holes in geosynthetic clay liners (GCLs) under 2 kPa applied stress is compared after full hydration using deionized water and 10 mM $CaCl_2$ solution. In deionized water, holes with diameters up to 41.3 mm self-healed but with an indentation about 1~2 mm-deep at the center of the larger self-healed zones. The hole with a diameter of 50.8 mm self-healed but the hole was filled with a layer of bentonite slurry with a 4~6 mm-deep indentation. Submerged in 10 mM $CaCl_2$ solution, holes with diameters less than 34.9 mm self-healed with a 1~6 mm-deep indentation. The 41.3 mm-diameter hole did not close up, leaving a 26.5~28.5 mm-diameter hole. This study shows the importance of the hydrating fluid on the potential for self-healing.

Temperature-Dependent Shear behavior of Geosynthetic Clay Liners

Shahin Ghazizadeh and Christopher Bareither, Colorado State University

The use of geosynthetic clay liners (GCLs) in barrier systems for waste containment can expose GCLs to different internal stress conditions and elevated temperatures. Thus, evaluation of the internal shear strength of GCLs as a function of normal stress and temperature is important to the design and integrity of barrier systems. In this study, internal shear strength of GCLs was evaluated in stress-controlled shear tests at a range of temperatures from 20 °C to 80 °C and under 20, 40, and 60 kPa normal stress. Horizontal shear deformation increased with increasing temperature, but decreased with increasing normal stress. Increased deformation with increasing temperature was attributed to reduced tensile strength of the needle-punched reinforcement fibers. The ratio of shear-to-normal stress at failure decreased from approximately 1.5 to 1.2 with an increase in temperature from 20°C to 80°C, and was independent of normal stress.

Numerical Evaluation of Boundary Effects on Interaction between Geosynthetic Reinforcement and Backfill

Yan Jiang and Jie Han, University of Kansas

Geosynthetics have been extensively used to reinforce soil structures, such as embankments, slopes, walls, foundations and roads. Proper evaluation of the interaction between geosynthetic reinforcement and backfill is important to understand the mechanisms of geosynthetic-reinforced soil (GRS) structures. Pullout tests have proven to be an effective way to study such interaction. In a pullout test, a geosynthetic reinforcement layer is buried in backfill within a test box. Vertical pressure is applied on top of the backfill to simulate the normal stress on top of the geosynthetic reinforcement in a GRS structure. The geosynthetic reinforcement is then pulled out from the backfill through an opening in the front wall of the box. The pullout test results are influenced by boundary conditions due to the thickness of the backfill, as well as the roughness of the interface between the backfill and the walls of the pullout box. This paper discusses the results of a numerical study performed to investigate the boundary effect on pullout test results. A two-dimensional numerical simulation was conducted using a finite differential method program, FLAC, using the Mohr-Coulomb model to describe the behavior of the backfill. The geosynthetic reinforcement was modeled as a linearly elastic and perfectly plastic material. The numerical model was calibrated and verified against pullout tests of geogrids. Boundary conditions, such as backfill thickness, and the roughness between the bottom of the backfill and the wall of the pullout box, and how these affect pullout test results are analyzed and discussed. The numerical results show that the pullout forces at the large pullout displacement calculated from the numerical simulation with the fixed bottom were closer to the measured pullout forces than those with the free bottom.