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目　录

Impact of temperature on the pullout of reinforcing geotextiles from unsaturated silt

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Abstract: This study investigates the thermal soil-geosynthetic interaction mechanisms of reinforcing geotextiles confined in compacted silt that may be encountered when using mechanically stabilized earth (MSE) walls as geothermal heat sinks. A thermo-mechanical geosynthetic pullout device was used that incorporates standard components for geosynthetic pullout or creep testing but also heating elements at the top and bottom of the soil box to apply boundary temperatures and dielectric sensors embedded in the soil layer to monitor distributions in temperature and volumetric water content. Two test series were performed: the first involves monotonic pullout of woven polypropylene geotextiles after reaching steady-state conditions under different boundary temperatures without a seating load, and the second involves monotonic pullout of woven polyethylene-terephthalate geotextiles after reaching steady-state conditions under different boundary temperatures with a seating pullout load. The results indicate that the pullout resistance of both geotextiles decreased with increasing temperature. Although heating led to drying of the unsaturated silt-layers as expected, measurements from the second test series indicate accumulation of water at the silt geotextile interface. An effective stress analysis considering thermal softening of soils indicates that the increase in effective saturation at the silt-geotextile interface was the cause of the decrease in pullout resistance with heating.

Keywords: Geosynthetics, Thermo-mechanical pullout device, Unsaturated soil, Nonisothermal behavior, Geotextiles, Thermal softening

Compaction behavior of nonwoven geotextile-reinforced clay

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Abstract: This paper presents a series of compaction tests for investigating the compaction behavior of nonwoven geotextile-reinforced clay and the effects of permeable geotextiles on improvements in the density of reinforced clay. Specimens were compacted by varying the compaction energy, number of geotextile layers and compaction lift thickness. The compaction test results were analyzed from the pure soil between the reinforcement layers without including the thickness of embedded reinforcement layers. The test results indicate that the density of reinforced clay increased with the number of geotextile layers without significant changes in the optimum moisture content (OMC). Due to the reinforcing effect, up to 50% standard compaction energy could be saved when compacting the reinforced clay to achieve the same density as that of unreinforced clay. When the degree of saturation of soil was over 90%, water absorption in the reinforcement layers increased sharply, improving the effects of permeable geotextile on dissipation of the pore water pressure in the soil of the reinforced specimens. When the water content of reinforced soil was 6.7% higher than the OMC, the water absorption of the reinforcement layers reduced the void ratio of reinforced specimens under standard compaction energy by 4.5–5.5%.

Keywords: Geosynthetics, Reinforced clay, Compaction, Void ratio

GCL self-healing: fully penetrating hole/slit hydrated with RO water and 10 mM Ca solution

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Abstract: The self-healing of fully penetrating artificial defects (circular holes and rectangular slits) in geosynthetic clay liners (GCLs) on full hydration in deionized water and 10 mM calcium chloride ($CaCl_2$) solution under 2 kPa overburden stress are compared. Circular holes with diameters up to 41 mm self-healed in deionized water but with an indentation of about up to 2 mm deep remaining at the center of the larger self-healed zones for holes of 30 mm diameter and larger. Holes of up to 35 mm diameter completely closed-up in 10 mM $CaCl_2$ solution, but with an indentation of about up to 6 mm deep remaining at the center of the larger self-healed zones for holes of 30 mm diameter and larger. A fully penetrating 15 mm wide × 120 mm long single slit in the center of a GCL specimen completely closed up in deionized water but not in 10 mM $CaCl_2$ solution. Even in deionized water, the slit does not fully close when 25 mm (or more) wide. Double parallel silts 15 mm wide × 240 mm long closed up in deionized water, but not in 10 mM $CaCl_2$ solution when there was a 20 mm-wide strip of undamaged GCL between the slits, but did not fully close up when the undamaged GCL strip between the slits was reduced to 10 mm or 5 mm. The difference in self-healing based on the hydrating fluid chemistry is discussed.

Keywords: Geosynthetics, GCL, Self-healing, Hydration, Cation exchange

Hydraulic compatibility of geotextile-compost systems in landfill covers

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Abstract: Landfill covers are required by federal regulations to cap municipal solid waste and prevent leachate formation. The use of compost as part of a vegetative layer in landfill final covers is one way to improve the sustainability of landfills. In order to successfully use compost in landfill cover applications, hydraulic compatibility of the compost and underlying geotextile filters must be adequate. The hydraulic compatibility of various composts and geotextiles have been explored through laboratory long-term filtration (LTF) tests. Upon completion of the LTF tests, particle size analyses, permittivity tests, piping measurements, and image analyses were conducted to evaluate clogging and retention performances. When the clogging ratios and piping measurements were considered, all compost-geotextile combinations yielded acceptable clogging and retention performance. A parametric study was conducted to determine if different characteristic pore sizes and grain sizes influenced the laboratory clogging ratios and showed no apparent relationship. Existing filter selection criteria successfully predicted the observed retention behavior but failed to predict the clogging behavior. Based on limited LTF data, compost is not likely to promote clogging in geotextiles; however, additional soil-geotextile filtration tests are necessary to propose a new filter criterion for clogging.

Keywords: Geosynthetics, Geotextile, Compost, Permittivity, Physical clogging, Landfill

Modelling of geosynthetic-reinforced barriers under dynamic impact of debris avalanche

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Abstract: This paper deals with geogrid-reinforced artificial barriers used as mitigation works against debris avalanches. Deformable Geosynthetic-Reinforced Barriers (DGRB) can be made of coarse-grained materials reinforced by high tenacity polyester (PET) geogrids, wrapped around the facing and arranged in layers. The peak dynamic impact pressure is here calculated as the sum of a landslide velocity-related component and a static component dependent on landslide height. Dynamic analyses are carried out through the commercial Finite Differences Method code (FLAC, Itasca) capable of adequately reproducing small and large displacements of the impacted barrier. The soil is modeled as elastic perfectly-plastic non-associative granular soil, the geogrids are simulated as traction-resistant, and the iron mesh framework is modeled as beam elements resistant to both traction and bending. Frictional interfaces are considered at soil-geosynthetic contacts. The displacements of specific control points and the global behaviour of the barriers are computed versus time. Tensile stresses in the geosynthetics are evaluated for different combinations of materials. Out of three geometries of the barrier, the more massive with the steeper impact front is outlined as the best choice. More deformable geosynthetics appear to be more effective in dissipating the impact energy inside the barrier.

Keywords: Geosynthetics, Landslide, Impact, Barrier, Geogrid, Finite difference

HDPE geogrid-residual soil interaction under monotonic and cyclic pullout loading

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Abstract: The understanding of soil-geosynthetic interaction under cyclic loading conditions is essential for the safe design of geosynthetic-reinforced soil structures subjected to repeated loads, such as those induced by road and railway traffic and earthquakes. This paper describes a series of large-scale monotonic and multistage pullout tests carried out to investigate the behaviour of an HDPE uniaxial geogrid embedded in a locally available granite residual soil under monotonic and cyclic pullout loading. The effects of the pullout load level at the start of the cyclic stage, cyclic load frequency and amplitude, number of cycles and soil density on the load-strain-displacement response of the reinforcement are evaluated and discussed. Test results show that the cumulative displacements measured along the length of the geogrid during cyclic loading increased significantly with the pre-cyclic pullout load level and the load amplitude. In contrast, the cumulative cyclic displacements were found to decrease with increasing frequency and soil density. In medium dense soil conditions, the geogrid post-cyclic pullout resistance decreased by up to 20%, with respect to the value obtained in the comparable monotonic test. However, for dense soil, the effect of cyclic loading on the peak pullout forces recorded during the tests was almost negligible.

Keywords: Geosynthetics, Pullout tests, Cyclic loading, HDPE uniaxial geogrid, Granite residual soil, Frequency, Amplitude

Evaluation of effectiveness of geotextile in reducing subgrade migration in rigid pavement

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Abstract: Pumping in rigid pavements is defined as the migration of subgrade soil into the overlying layers, redistribution of materials under the slabs, and ejection of materials through joints. Pumping can compromise pavement performance. This study evaluated geotextiles as separation and filtration solutions to mitigate pumping and reduce the resulting pavement joint faulting. A one-third scale Model Mobile Load Simulator (MMLS3) was used to simulate cyclic loading on a scaled rigid highway pavement that has experienced some loss of load transfer. The results from four tests were compared to assess the effectiveness of geotextile in reducing pumping. The four experiments had identical configurations, except that a geotextile was placed at the subgrade-subbase interface in two tests. Non-plastic saturated silt and partially saturated aggregate were used as the subgrade and subbase, respectively. Using a geotextile at the subgrade-subbase interface substantially reduced pumping. More fines accumulated in the subbase beneath the approach slab than the leave slab, which resulted in faulting of the slabs. However, the magnitude of this faulting was more pronounced for the cases without geotextile. Reductions of 71% and 52% occurred in the magnitude of subgrade migration and faulting, respectively, when using geotextile. To conclude, geotextile can be effective in mitigating pumping, leading to longer-lasting pavement systems.

Keywords: Geosynthetics, cyclic loading, faulting, geotextiles, MMLS3, pumping, rigid pavement, subgrade fines migration