《Geosynthetics International》

（国际土工合成材料）

<双月刊>

2020年第27卷第5期

摘要集

中国土工合成材料工程协会秘书处

目　录

Influence of fibre morphology on the integrity of geofibre-reinforced soil barriers

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Abstract: Landfill cover barriers are susceptible to flexural distress due to the differential settlements caused by biodegradation and heterogeneous composition of the underlying waste. The effect of discrete fibre inclusions on the flexural distress of landfill cover barriers was studied using centrifuge model tests. Three types of fibres were used: polyester (PET), polypropylene-tape (PP-T) and polypropylene-fibrillated (PP-F). For unreinforced barriers (UB), the crack initiation and water breakthrough were observed at low distortion levels compared to identical fibre-reinforced barriers(FB). The strain at crack initiation and strain at water breakthrough for FB was 2.36 times and 2.76times higher than identical UB, respectively. Also, suppression of the cracks and improved water tightness was observed due to the overburden pressure in both UB and FB. PET fibre-reinforced barriers were found to be superior in maintaining the water tightness of the barrier compared to PP-T and PP-F fibres used in the present study. Propagation of cracks penetrating through the thickness of the soil barrier was significantly restrained by the fibres irrespective of the fibre type. Scanning electron micrographs of exhumed fibres indicated that the fibres in the present study were distorted and participated in taking tension due to differential settlements.

Keywords: Geosynthetics, Fibre reinforced soil, Flexural distress, Centrifuge tests, Tensile cracking, Waste containment systems

Strength and swelling properties of a waste tire textile fiber-reinforced expansive soil

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Abstract: Expansive soils are problematic for their relatively low load bearing capacity and extensive swelling-shrinkage deformations. Therefore, treatment of such soils is often considered to be necessary prior to construction. This paper investigates the potential of reusing waste tire textile fibers (WTTFs), a byproduct of the treatment process of end-of-life tires (ELTs), as reinforcement materials for treatment of expansive soils. To that end, mechanical reinforcement of sodium bentonite by WTTF inclusion has been evaluated through a set of standard compaction, direct shear, Unconfined Compressive Strength (UCS), California Bearing Ratio (CBR), and swelling-consolidation tests. Six different WTTF contents – that is, fc= 0%, 0.5%, 1%, 2%, 3%, and 4% were used and investigated. It was proven that WTTFs can improve the shear strength and UCS parameters. Swelling deformations of the soil were demonstrated to reduce by as much as 44%. At low WTTF contents, CBR was enhanced marginally. However, this parameter decreased at high WTTF contents. Therefore, it can be concluded that WTTFs can be used as economical reinforcement materials in expansive soils to enhance the strength parameters, mitigate the swelling properties, and address an environmental concern regarding WTTFs.

Keywords: Geosynthetics, Expansive soil, Reinforcement, Swelling, Waste tire textile fiber (WTTFs)

Laboratory testing and numerical modeling of geomembrane electrical leak detection surveys

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Abstract: Laboratory tests were conducted to evaluate the influence of the positions of positive and negative electrodes on the electrical response of a leak in the geomembrane. A numerical evaluation was performed to model the laboratory conditions and to investigate the effect of dipole spacing, excitation voltage, and impoundment resistivity on the leak detection sensitivity. The results of laboratory tests show that leaks cannot be identified when the positive electrode is very close to the leak and the electrical response of a leak in the geomembrane is independent of the position of the negative electrode. The results from the 3D finite element model indicate that leak detection sensitivity improves nonlinearly as the dipole spacing increases, and it tends to be stable after the dipole spacing exceeds 5% of the length of the survey line. The results also indicate that there is an almost linear increase in the leak detection sensitivity with increasing excitation voltage. Substantial improvement was obtained in the leak detection sensitivity for a greater impoundment resistivity. The numerical results indicate that 90% of leaks in a geomembrane liner can be effectively detected and accurately located for the 3D finite element model of a geomembrane lined earth-rock dam.

Keywords: Geosynthetics, geomembranes, electrical leak detection, laboratory test, numerical modeling

Performance of anchor in sand with different forms of geosynthetic reinforcement

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Abstract: This article investigates the uplift resistance of a model anchor embedded in sand by varying its density at four embedment depths (L/D = 1, 2, 3, and 4). Such different configurations of geosynthetic reinforcement as single-layer planar, double-layer planar, geocell, and geocell with basal reinforcement were used and the results were compared. The inclusion of reinforcement in all configurations led to greater values of the peak and residual pullout load than the anchor in sand at different densities. Of the reinforcement configurations used, a geocell placed at the top of the anchor was the most efficient. The shape of the uplifted soil mass by the anchor is a frustum of a cone with an apex angle approximately equal to ϕ' of sand both in the sand bed without and with a geocell-encapsulated layer, except for the enlarged size of the uplifted mass for the anchor in the geocell-reinforced bed. The enlarged size is attributed to the wide slab response of the combined geocell composite anchor system. The hyperbolic stress–strain relation was used to predict the pre-peak phase of the load-displacement response and the relation thus obtained compared well with experimental data irrespective of the embedment ratio and relative densities of the sand bed.

Keywords: Geosynthetics, model tests, anchors and anchorages, reinforced soils, sands

Back-analysis of the water retention curve of a GCL on the wetting path

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Abstract: A new approach is presented to obtain the water retention curve of a geosynthetic clay liner (GCL) on the wetting path (i.e. when it is hydrating). This approach is based on a back-analysis process using data from a hydration test. The back-analysis method was validated by comparing it to conventional experimental measurement techniques such as vapour equilibrium, chilled-mirror dew point and osmotic techniques as well as published data. This approach is shown to be a viable alternative to quickly identify the retention properties of a GCL on the wetting path.
Keywords: Geosynthetics, GCL, Water retention curve, Wetting path, Bentonite

Centrifuge study of reinforced soil walls with different backfill compaction densities

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Abstract: Backfill relative density can have a significant influence on the performance and stability of reinforced soil retaining walls, as reflected in the form of minimum compaction requirements in current design guidelines. However, the quantitative influence of backfill relative density on the construction and serviceability performance of reinforced soil walls has not been examined adequately. In this study, centrifuge tests were carried out on two model walls with different backfill relative densities, and their measured performances were compared against those calculated using available empirical methods. Results of the study show that maximum displacement of the model with inadequate compaction (i.e. Dr= 65%) was 30% greater than that of the Dr= 95% model and exceeded the value predicted by one of the design methods examined. The foundation pressure underneath the wall showed increased magnitudes under the facing and a nonlinear decrease with distance from the facing along the backfill. Additionally, the model with Dr= 95% developed larger reinforcement loads and mobilized soil-reinforcement interface coefficient values relative to the model with Dr= 65%.

Keywords: Geosynthetics, Relative density, Backfill compaction, Reinforced soil retaining walls, Centrifuge modeling, Wall displacement, Vertical earth pressure, Mobilized soil-reinforcement interface coefficient

Model tests on drainage of pipes wrapped with woven and nonwoven geotextiles

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Abstract: Drainage through pipes plays an important role in tailings pond projects. Reductions in drainage capacity and even clogging of drainage pipes are common issues, especially in tailings projects. To address these clogging issues, a drainage pipe with a replaceable porous-foam filter core (referred to as DPRF) is proposed. This paper studied the drainage characteristics of DPRF wrapped with a woven geotextile and traditional drainage pipes wrapped with a nonwoven geotextile (referred to as DPNG) in fine tailings sands with a reduced scale model test. The results showed that the woven and nonwoven geotextiles could successfully retain fine tailings sand; however, the woven geotextile easily clogged as the experiment progressed. For the DPRF wrapped with a woven geotextile, the larger the aperture of the woven geotextile, the higher the drainage rate of the pipe. The average drainage rate of the DPNG was larger than that of the DPRF wrapped with the woven geotextile. It can thus be inferred that the DPRF wrapped with the woven geotextile is not a good solution to prevent physical clogging. Alternatively, it is suggested that the DPRF wrapped with the nonwoven geotextile can be used to alleviate chemical clogging problems.

Keywords: Geosynthetics, replaceable porous-foam filter core, nonwoven geotextile, woven geotextile, drainage pipes, drainage characteristics, model tests

Mechanical and osmotic consolidation of geosynthetic clay liners: a laboratory study

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Abstract: This study aims to assess the effect of pore water salinity (sodium chloride (NaCL) solution) on the consolidation behaviour of GCLs (geosynthetic clay liners) using one-dimensional oedometer test apparatus. The experiments include two testing conditions: (1) an investigation of mechanical consolidation of GCL specimens saturated with water having different salinity levels, and (2) an investigation of the effect of pore water salinity on the volume change of GCL specimens under different constant vertical stress levels (i.e. osmotic consolidation). The mechanical consolidation test results indicated that the compression and swelling indices decrease as the liquid salinity increases, whereas an elastic hysteresis volume change behaviour was observed in the osmotic consolidation test results. The results of this study also show that the compression and swelling indices, and the hydraulic conductivity of a GCL specimen are almost reversible when it is subjected to an osmotic cycle.
Keywords: Geosynthetics, Geosynthetic clay liners, Consolidation, Bentonite, Salinity