《Geosynthetics International》

（国际土工合成材料）

<双月刊>

2023年第30卷第5期

摘要集

中国土工合成材料工程协会秘书处

目　录

Repairing expansive soil channel slope with soilbags

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Abstract: Shallow slope failure often occurs in expansive soil channel slopes because of the strong swelling–shrinkage behaviour of expansive soils and well-developed fissures. In this paper, a repair method for expansive soil channel slopes using soilbags is proposed. Model tests were carried out to illustrate the effect of this repair method. The test results indicate that the assembly of soilbags arranged on the slope limits the deformation of expansive soils after water absorption and reduces infiltration and evaporation during the drying–wetting cycle process. A method for analysing the sliding stability of the repaired slope was suggested and a case study of the repair of a 65 m test expansive soil channel slope with soilbags in the South-to-North Water Transfer Project in China was presented. The monitoring of vertical and lateral displacements of the testing slope demonstrates the effectiveness of using soilbags to repair expansive soil channel slopes.

Keywords: Geosynthetics, Soilbag, Expansive soil, Slopes, Shallow slope failure, Repair

Measurement methodology and characteristics of interfacial resistance in electro-osmosis

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Abstract: The electro-osmosis technique can be used for rapid dewatering and consolidation of deep soft foundations. Considering the abnormal volt-ampere characteristics of soil at the initial stage of electro-osmosis using electrokinetic geosynthetics (EKG) electrodes, the hypothesis that the interfacial resistance between electrode and soil is related to current was formulated. A new method was used to distinguish the soil resistance and interfacial resistance, and an experiment was designed to verify them. The results show that the soil resistance does not change with the changing current in the circuit, but the interfacial resistance is closely related to the current. The interfacial resistance decreases as the current increases and is approximately a power function of the current. This relationship applies to aluminium, copper, iron and EKG electrodes. In addition, a design for the field application of electro-osmosis was developed focusing on power supply and efficiency. The calculation results show that the proportion of soil effective potential is closely related to the potential gradient imposed by the power supply. The experimental results reveal the relationship between the potential gradient and the efficiency of electro-osmosis, which provides a theoretical basis for the determination and optimisation of electric power in electro-osmosis system design.
Keywords: Geosynthetics, electrokinetics, interfaces, ground improvement

Seismic performance of near-fault geosynthetic-reinforced pile-supported embankment

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Abstract: The seismic performance of embankments is an important consideration for the design and construction of high-speed railways (HSRs) in near-fault areas. Incorporating geosynthetics into embankment soil can improve seismic resistance. However, the effect of different reinforcement methods on the seismic performance of embankments is not well understood. In this study, two 1:20 scaled embankment models (full- length- geosynthetic-reinforced pile-supported embankment (FRPE) and turn-back-geosynthetic-reinforced pile-supported embankment (TRPE)) were tested on a shaking table to compare their seismic performance and failure characteristics. The results show that under near-fault bidirectional seismic excitation, the pile foundations of both embankments exhibited bending deformation, with the largest bending moment in the middle of the pile body. The TRPE reduced the vertical dynamic response of the embankment slope but exhibited a more remarkable horizontal dynamic response than the FRPE. Furthermore, the embankment deformation and excess pore water pressure of the TRPE were generally larger than those of the FRPE. Nonetheless, the TRPE has potential application in practical engineering as it ensures earthquake resistance, with higher economic benefits.
Keywords: Geosynthetics, Earthquakes, Reinforcements, Embankments

Stresses and strains in a flexible pipe buried in geosynthetic reinforced soil

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Abstract: Geosynthetics have been used to reinforce soils for over four decades. They can also be used as reinforcement in buried pipe installations to reduce stresses and strains in the pipe, as well as the consequences of pipe explosions. This paper investigates the use of geosynthetic reinforcement to protect a flexible buried pipe from the effects of a localised surcharge on the soil surface. Large scale tests were carried out on an instrumented PVC pipe buried in a rather loose sand. Different types and arrangements of the reinforcement layer were investigated. The results obtained address the relations between stresses on the pipe, pipe strains and pipe deflections and show that the presence of the reinforcement can reduce significantly vertical and horizontal stresses on the pipe as well as pipe deformations. An elastic solution for the prediction of strains at the pipe crown was employed, whose predictions compared well with the experimental results.
Keywords: Geosynthetics, reinforcement, buried structures, pipes and pipelines, stress, strain

DEM investigation of shear mobilisation during tyre strip pull-out test

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Abstract: This paper presents an evaluation of the pull-out behaviour of tyre strip-reinforced granular soil. The three-dimensional discrete element method (3D DEM) and laboratory testing were used to systematically calibrate the soil particles and the tyre strip based on their stress-strain relationship, tensile stiffness, and interface shear strength. Particle shapes were considered during sand calibration. The scaled pull-out resistance was found to match that of the experimental data. Contributions of the sectional interface shear force to the total pull-out resistance were calculated to explain the progressive failure mechanism mobilised at the tyre-sand interface. The shear force along the tyre strip was not uniformly distributed but higher in the middle portion of the tyre strip. It gradually extended towards the front end of the tyre strip before global interface slipping failure occurred. Comparing the pull-out behaviour of extensible and inextensible tyre strips, the elastic deformation of the tyre strip delayed the occurrence but not the magnitude of peak pull-out force. Micro-mechanical interactions between tyre strip and sand during shear mobilisation were discussed, and induced anisotropy was revealed. The experimental and DEM investigation results in this study provide researchers with an improved understanding of tyre-soil interaction under pull-out loads.

Keywords: Geosynthetics, rubber tyre strip, 3D Discrete Element Method (DEM), pull-out behaviour, shear mobilisation, micro-analysis, UN SDG 12: Responsible consumption and production

Consolidation of soft soils improved by composite piles considering clogging effect

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Abstract: Composite pile with a stiffer core and gravel shell is a newly emerging column technology to improve soft soil by combining the advantages of accelerating consolidation and increasing loading bearing capacity. In practice, the composite piles may be constructed into various forms with different cross-sectional shapes. Moreover, soft soil particles may be transferred along with the seepage and intrude into the gravel shell and thereby clog them. In this paper, by converting the noncircular cross-sectional composite pile into a hollow cylindrical unit cell and considering the time-dependent clogging effect, an analytical model for the consolidation of composite ground stabilized by composite piles is proposed. Analytical solutions are then obtained for instantaneous loading and multi-stage instantaneous loading under the equal-strain condition. Moreover, the variation of the stress with depth caused by surcharge loading is also incorporated in the analysis. The feasibility of the solutions is verified by degenerating them to some previous solutions. Furthermore, the solutions are applied to a laboratory test to investigate consolidation. The predicted results are compared to the measured data and a good agreement is observed between them. Finally, a parametric study is conducted to investigate the influence of several parameters on consolidation behavior.

Keywords: Geosynthetics, clogging effect, consolidation, composite pile, hollow cylindrical unit cell, UN SDG 9: Industry, innovation and infrastructure

Gas permeability of geosynthetic clay liners overlap seams

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Abstract: This paper examines the gas flow performance of needle-punched geosynthetic clay liners (GCLs) overlap seams over a range of gravimetric moisture content, including the effect of vertical stress and unevenness of the overlaps. The gas permeability of the GCL overlapped seams was higher than that of intact GCLs, especially at higher gravimetric moisture content, as the intactness of the overlapped areas was challenging to maintain due to the GCL swelling process. The gas flow rate of uneven overlapped GCLs was greater than that of a flat overlap (even seam) irrespective of the vertical stress. This paper highlights the importance of factoring in the possibility of the unevenness of the GCL panels overlaps when assessing gas migration through cover systems.
Keywords: Geosynthetics, geosynthetic clay liners, overlaps, gas permeability

Effects of freeze–thaw cycles on the properties of polyethylene geomembranes

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Abstract: High-density polyethylene (HDPE) geomembranes (GMs) are frequently used as fluid barrier components of cover systems for mine site reclamation in regions that are prone to freeze–thaw cycles (FTCs). However, HDPE GMs are more susceptible to stress cracking than linear low-density polyethylene (LLDPE) GMs. Hence, LLDPE GMs are increasingly considered as alternatives to HDPE GMs in cover systems. Nevertheless, little information is available on LLDPE compared to HDPE GMs. Moreover, little is known about the changes in the fluid barrier properties (the equivalent hydraulic conductivity and the oxygen sorption and diffusion coefficients) for these two materials with FTCs. The purpose of this study is therefore to compare the effects of FTCs on the tensile, hydraulic, and oxygen sorption and diffusion properties of HDPE and LLDPE GMs. To do so, GM sheets were subjected up to 300 FTCs. Mechanically, both GMs got stiffer and their tensile break properties increased with increasing number of FTCs. However, although the GM fluid barrier properties changed with FTCs, the equivalent hydraulic conductivity and the oxygen permeation coefficient remained within an order of magnitude of 10^{-14} m/s and 10^{-13} m^2/s, respectively. Up to 300 FTCs would therefore have no adverse effects on HDPE and LLDPE GMs.
Keywords: Geosynthetics, Geomembranes, HDPE, LLDPE, Freeze–thaw cycles, Mine site reclamation, Cover system

Large-scale model test studies on a double-layer rubber dam

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Abstract: A new rubber dam with two layers of dam bodies anchored together into a rigid concrete base was proposed to improve the water-retaining capacity of a traditional rubber dam. A series of large-scale model tests was conducted to evaluate the static behaviour of a double-layer rubber dam under conditions of different internal and external water heads, anchoring distances and cross-sectional perimeters. It was found that the maximum tensile force of the Layer-1 dam is located at the anchoring point but that of the Layer-2 dam is located at the extruded free section. The optimal cross-sectional perimeter ratio was concluded as 0.8 with an optimal anchoring distance of 0.06 L_1 and an internal water head in the upstream dam and in the downstream dam of 0.40 L_1 and 0.36 L_1, respectively, where L_1 is the cross-sectional perimeter of the upstream dam.
Keywords: Geosynthetics, rubber dam, weir, flood control, groundwater management