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摘要集

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目　录

A simplified analysis of a configuration of geosynthetic reinforcement in GRPS embankments

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Abstract: Geosynthetic-reinforced and pile-supported (GRPS) embankments are increasingly used in recent years to reduce the differential settlement and increase the bearing capacity of the embankments. A new theoretical model is proposed to calculate the tensile force distribution and cross-sectional configuration of the geosynthetic reinforcement used in the Geosynthetic-reinforced and flexible pile-supported GRRPS and Geosynthetic-reinforced and rigid pile-supported GRFPS embankments. The accuracy of the proposed methods is verified by the results from laboratory model tests, centrifuge model tests and theoretical models in the literature. It is found that the tensile forces along the geosynthetic are distributed unevenly both in GRRPS and GRFPS embankments with the maximum and minimum magnitudes located at the edge and centre of the pile cap, respectively. The soil arching effect contributes more to the bearing capacity of the GRPS embankment than the membrane effect. It is found through the analyses of the centrifuge and model tests data that the soil arching effect contributes 65–75% of the total load transfer efficiency.
Keywords: Geosynthetic, GRPS embankments, Flexible pile, Rigid pile, Tensile force

Internal erosion and permeability of Na CMC-treated and PAM-treated geosynthetic clay liners

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Abstract: This paper investigates the occurrence of internal erosion and the variation of the permeability of geosynthetic clay liner (GCL) with respect to its geotextile component, polymer type and polymer amount added to its bentonite component, hydraulic head, and subgrade material by performing extensive triaxial permeability tests on the GCL specimens. To do this, Na carboxymethyl cellulose (CMC) and polyacrylamide (PAM) were treated with the bentonite component of the GCLs. Then, the GCLs were placed over poorly graded gravel (GP) and poorly graded sand (SP). Consequently, they were tested with two different woven geotextile components under the hydraulics heads of 0.3 m and 10 m. Results showed that only GCLs tested with woven geotextile, having lower tensile strength, lower mass/area and lower thickness over the gravel at a hydraulic head of 10 m, experienced internal erosion. Critically, Na CMC and PAM treatment caused 2–2.5 orders of magnitude decrease in the permeability. Actually, 2% Na CMC and 1% PAM treatment by dry mass were found to be the optimum polymer contents. Both the environmentally friendly biopolymer Na CMC and the synthetic polymer PAM can effectively be treated with Ca bentonite to enhance the hydraulic performance of the GCLs.
Keywords: Biopolymer, Geosynthetic clay liner, Internal erosion, Na CMC, PAM, Permeability

Assessment of geomembrane strain from pond liner bubbles

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Abstract: Bubbles (a.k.a. whales) that develop from gas entrapped beneath a geomembrane in pond liner applications lead to localized increases in geomembrane strain that warrant evaluation. Results from three-dimensional, geometrically-nonlinear, finite-element analysis are presented to show how geomembrane stiffness, fluid depth, volume of entrapped gas, and interface friction affect the deformed shape of, and maximum strain in the geomembrane. It is shown that the deformed geomembrane follows a bell-shaped curve and that geomembrane strain increases as the fluid depth increases until the bubble is submerged. The extent to which the maximum strain increases with decreasing geomembrane stiffness and increasing volume of entrapped gas are quantified. Design and operation charts are presented to provide a practical means of assessing strain in existing geomembrane bubbles or identify maximum fluid depths to limit geomembrane strain to a target value.
Keywords: Geosynthetics, Geomembrane, Bubble, Whale, Pond, Reservoirs, Strain

Diffusion of volatile organic compounds (VOCs) through elastomeric bituminous geomembranes (BGMs)

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Abstract: Diffusion of volatile organic compounds (VOCs) through a 4.1 mm elastomeric bituminous geomembrane (BGM) is investigated using a dilute aqueous solution of four aromatic hydrocarbons: benzene, toluene, ethylbenzene, and xylenes (BTEX). Due to the very different diffusion characteristics of the BGM components, double-compartment diffusion experiments are separately conducted on the bituminous and non-bituminous components of the BGM to assess their diffusion parameters. A two-layer computer model is developed to obtain the diffusion parameters of the BGM that correlates with the 890-day laboratory diffusion test data obtained for the multicomponent BGM and allows the modelling of transient diffusion. Using contaminant transport modelling, the BGMs performance as a diffusive barrier for different applications is evaluated and compared to different polymeric geomembranes (GMBs). It is shown that using BGM as part of the cover system for a hydrocarbon-contaminated soil landfill or as a vapour barrier below concrete building foundations can decrease the BTEX mass flux through the cover system and the peak concentration of contaminant in the indoor air compared to monolayer polymeric GMBs. It is also predicted to reduce the impact on the aquifer when modelled as a part of the composite liner without holes for a hypothetical solid waste landfill.

Keywords: Geosynthetics, Bituminous geomembrane, Diffusion, Volatile organic compounds, Barrier system, Vapour barrier

Reinforcement effect and mechanism analysis of dredged sludge treated by alternating prefabricated radiant drain vacuum preloading method

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Abstract: The vacuum preloading method is widely applied in dredged sludge reinforcement, however, prefabricated vertical drain (PVD) clogging affects the effectiveness of ground reinforcement and leads to significant uneven settlement. To alleviate these deficiencies, this paper proposed an alternating prefabricated radiant drain vacuum preloading (APRD-VP) method considering the advantages of the alternating vacuum preloading (A-VP) method (delaying clogging) and prefabricated radiant drain vacuum preloading (PRD-VP) method (combining horizontal drainage and alleviating uneven settlement). The laboratory model experiments were conducted to explore the treatment effect of APRD-VP method, and the particle image velocimetry technology was employed to observe clogging range surrounding PVD. The experimental results demonstrate that APRD-VP method displayed a better reinforcement effect than the traditional method by analysis of water discharge, settlement, pore water pressure, water content, and vane shear strength. By investigating the clogging formation development for APRD-VP method, the maximum clogging range on both sides of the drainage board has been reduced by 3.15% and 14.02%. In addition, the empirical relationship between clogging range and settlement was established to can better judge and predict clogging range, which can lay the foundation for establishing the theory of computation of soft soil ground design suitable for APRD-VP method.
Keywords: Vacuum preloading, Soft ground, Reinforcement effect, Clogging mechanism, Alternating prefabricated radiant drain

Shear strength of HDPE smooth geomembrane/bentonite-polymer geosynthetic clay liner interface

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Abstract: This study investigated the impact of polymer elution on the interface shear strength between a smooth geomembrane (GMB) and two types of bentonite-polymer (B–P) geosynthetic clay liners (GCLs) containing linear and crosslinked polymers. Tests were also conducted with sodium bentonite (Na–B) GCLs as a control. Interface shear tests were conducted with dry, two-stage, and free hydration conditions with varying normal stresses. The results showed that under dry conditions, the displacement at peak strength and shear strength envelops of GMB/Na–B GCL and GMB/B–P GCLs were similar. However, the displacement at peak strength of GMB/B–P GCLs was higher than that of GMB/Na–B GCL under two-stage and free hydration. Meanwhile, the peak shear strength of the GMB/B–P GCLs showed a greater reduction than that of GMB/Na–B GCLs when transitioning from a dry condition to a free hydration condition at the same normal stress, particularly at higher normal stress. Loss on ignition (LOI) tests confirmed that there was a decrease in polymer loading of B–P GCLs after the shearing test, indicating polymer elution occurred during the shearing test. The result suggests that polymer elution had a significant effect on the GMB/B–P GCL interface shear strength, especially at higher normal stress.

Keywords: Geosynthetic clay liners (GCLs), Bentonite-polymer (B–P), Interface shear strength, Polymer elution, Lubrication effect