《Geosynthetics International》

（国际土工合成材料）

<双月刊>

2021年第28卷第4期

摘要集

中国土工合成材料工程协会秘书处

目　录

Influence of soil density on performance of geocell-reinforced vertical anchor in sand

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Abstract: Influence of soil density on the performance of geocell-reinforced vertical plate anchors was studied through a series of model tests and numerical analyses. It is observed that the geocell-induced performance improvement is present over a wide range of relative density, varying from 30%(loose) to 95% (very dense). However, increase in load bearing capacity and stiffness of the anchor bed continues to increase with increase in density of the soil mass. Moreover, compared to the unreinforced case, the increase in anchor capacity due to increase in soil density tends to be greater with geocell reinforcement. This is attributed to the dilation-induced volume expansion that tends to mobilise enhanced resistance from the geocell reinforcement. In addition, the size of the rupture surface was found to increase with the increase in density of the fill soil, which indicates that, at higher density, a larger volume of soil mass has participated in sharing the anchor load, leading to the enhanced performance of the system. Numerical analysis using the computer program Fast Lagrangian Analysis of Continua was carried out. The computed results were found to be in good agreement with the observed ones.

Keywords: Geosynthetics, vertical plate anchor, sand, relative density, geocell reinforcement, model studies, numerical analysis

Unsaturated behaviour and cation self-diffusion of geosynthetic clay liners in Antarctica

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Abstract: The impact of time-dependent unsaturated behaviour of virgin and the impact of cation self-diffusion on the time-dependent unsaturated behaviour of exhumed geosynthetic clay liner (GCL) specimens were investigated using a chilled mirror hygrometer. Total suction values (after 7 weeks' water homogenisation) are reported for ten virgin (six different bentonites) and one GCL exhumed after exposure to the thermo-hydro-mechanical (THM) conditions in Antarctica. The time-dependent unsaturated responses of four different virgin GCLs 1 day and 1 week after hydration are compared with the results at homogenisation and the implications discussed. For the suction (0.1–300 MPa) and water content range (5–140%) examined, the post-water homogenisation water retention behaviour of the GCLs is affected by bentonite characteristics. At a given gravimetric water content, the total suction of GCLs increased with increasing smectite content and total soluble salt content and decreased with increasing total bound cation content in the bentonite. Cation self-diffusion also increased the total suction in the GCL exhumed after exposure to Antarctic THM conditions. It is concluded that the impact of cation self-diffusion on the unsaturated behaviour of a GCL during its time in service before exposure to pollutants needs to be considered in designing hydraulic and gas barriers.
Keywords: Geosynthetics, GCLs, Water retention, Extreme environment, Self-diffusion, Geotextiles, Cations

Multivariate adaptive regression splines model for reinforced soil foundations

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Abstract: In this study, a multivariate adaptive regression splines (MARS) model has been developed to predict the settlement of shallow reinforced sandy soil foundations (RSSFs). The potential of the MARS model is validated comparatively with four other robust artificial intelligence/machine learning regression models, namely extreme learning machines (ELM), support vector regression (SVR), Gaussian process regression (GPR), and stochastic gradient boosting trees (SGBT). The pertinent data retrieved from previously published well-established scientific studies have been used to calibrate and validate the data-driven intelligent machine learning models. The predictive strength of all the modelling tools mentioned above were assessed via several statistical indices. Moreover, the predictive ability and reliability of the developed models were also corroborated with ranking criteria and external validation analysis. The results as obtained have shown that the MARS modelling technique attains the superior veracity in predicting the settlement of reinforced foundations.

Keywords: Geosynthetics, Settlement, Reinforced foundation, Data-driven modelling, Artificial intelligence, MARS, SVR, ELM, GPR, SGBT, Prediction

Swelling prediction for green stabilized fiber-reinforced sulfate-rich dispersive soils

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Abstract: Sulfate-rich dispersive soils are a major concern due to their high susceptibility to erosion and heave, related to high amounts of adsorbed Na+ ions and the formation of expansive minerals derived from reactions involving sulfates and calcium, respectively. In this sense, the development of alternative treatments to overcome such problems must be sought, since the application of lime and/or Portland cement by themselves has proven to be ineffective. Thus, the present paper proposes a binder composed of carbide lime and ground glass waste combined with fiberglass reinforcement to stabilize such soils. The efficiency of the proposed alternative towards reduction of swelling was assessed through 3-D volumetric swell tests carried out on compacted soil-binder-fiberglass blends molded with multiple different dosages. The results have shown that the porosity and the amount of carbide lime influenced the volumetric strain (ε_v) of the tested specimens greatly. The influence of porosity was inversely proportional, while the influence of the amount of carbide lime was directly proportional. The addition of fiberglass was shown to be ineffective. Thus, the ε_v was successfully correlated to the adjusted porosity/lime index (η/L_{iv}), proving the innovative character of the approach applied herein and enabling the prediction of the ε_v for different dosage options.

Keywords: Geosynthetics, Sulfate-rich dispersive soil, Soil stabilization, Pozzolanic reactions, 3-D volumetric swell test, Porosity/lime index, Swell potential

Chemical clogging and geotextile serviceability in subdrains adjacent to recycled concrete

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Abstract: The formation and deposition of tufa precipitate from the leachate of the recycled concrete aggregate (RCA) within fibers of a nonwoven geotextile, as can potentially occur in a transportation infrastructure drainage system, is simulated in a laboratory environment. Two sets of modified column tests were conducted in this study with cycles of wetting and drying for 1 year in order to study the rate of RCA tufa precipitation. Results of measured changes in the infiltration capacities showed that, even with precipitated tufa, the RCA/geotextile system serviceability remains similar to the virgin aggregate (VA)/geotextile system at the end of the 12-month testing. Evaluation of the deposited tufa precipitation within geotextile samples showed that RCA tufa is dominated by calcite and gypsum minerals. Estimated quantities of RCA tufa deposition by existing models developed for natural environments, showed that they either grossly overestimate the observed behavior (calcite model) or underestimate it (gypsum model). Image analysis technique and chemical calculations based on leached dissolved solids were utilized successfully to develop models to predict the precipitation of RCA tufa in macroscales during the service life of a subdrain.

Keywords: Geosynthetics, chemical clogging, modified column leach test, underdrain, RCA, serviceability, tufa precipitation

Geosynthetic performance against slope erosion caused by high intensity rainfall

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Abstract: Soil erosion can cause serious damage to the environment and significant economic losses since uncontrolled erosion processes have detrimental consequences for agriculture and may cause damage to existing civil infrastructure. Geosynthetic products to protect soils against erosion are available, such as geomats, geoblankets and geocells. This paper investigates the performance of geomats and geoblankets for the protection of slopes against erosion caused by intense rainfall by means of laboratory tests using a rainfall simulator. The influence of the presence of vegetation on the slope was also investigated. Two geomats and three geoblankets were tested. The results obtained showed that these products can provide efficient soil protection, but due attention must be paid to some factors such as the product's physical and hydraulic characteristics, good contact with the soil surface, soil cover ratio and endurance under high rainfall intensities. The results also showed that the presence of vegetation is beneficial against soil erosion, but the level of performance improvement brought by the vegetation will depend on geomat and geoblanket characteristics and properties.

Keywords: Geosynthetics, Erosion control, Geomats, Geoblankets, Slopes, Soil loss

Full-scale laboratory tests of geosynthetic reinforced unpaved roads on a soft subgrade

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Abstract: In this study, a large-scale laboratory test was developed to analyze the contribution of geogrid reinforcement to the improvement of unpaved roads. A detailed experimental protocol was established regarding the road base soil preparation, installation, and soil compaction procedure. Eight tests were performed under a circular plate load test in a box 1800 mm in width, 1900 mm in length, and 1100 mm in height. Under this configuration, three repeat tests were performed to verify the developed protocol. Furthermore, the plate load tests were used to compare different road base thicknesses and geogrid types. Once the developed protocol was confirmed, three tests, using the developed simulator accelerator of traffic (SAT), were performed. Indeed, the same road base configuration was tested, but this time it was placed in a box 5000 mm in length. The prepared road base was subjected to two different loadings: a specific plate load and a traffic load. The results showed the efficiency of the geogrids, the influence of the road base thickness, and the role of the loading type. Moreover, it demonstrated different mobilized mechanisms of the geogrid, depending on the type of product.

Keywords: Geosynthetics, Geogrids, Soft Subgrade, Unpaved Roads, Cyclic Load, Traffic Load