《Geosynthetics International》

（国际土工合成材料）

<双月刊>

2022年第29卷第1期

摘要集

中国土工合成材料工程协会秘书处

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Mechanical and hydraulic compatibility of RAP with geosynthetics used in MSE walls

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Abstract: Mechanical and hydraulic properties of recycled asphalt pavement (RAP) as backfill in mechanically stabilized earth (MSE) walls were evaluated. Woven and nonwoven geotextiles and uniaxial and biaxial geogrids were used as reinforcements. Results of interface direct shear tests showed that the interface friction angle (δ) of RAP-geogrid was higher than that of RAP-geotextile. On average, the δ for RAP-biaxial geogrid was 15% higher than δ for RAP-uniaxial geogrid. For geotextile reinforcement, the δ for RAP-woven geotextile was 20% higher than δ for RAP-nonwoven geotextile. Compaction of RAP at elevated temperatures only slightly affected δ. Pullout capacities of RAP uniaxial geogrid and RAP-woven geotextile are comparable to those of sand-uniaxial geogrid at different overburden pressures. The compacted RAP reinforced with uniaxial geogrid, however, exhibited significant creep strains at a range of sustained pullout forces that led to failure of the RAP uniaxial geogrid. Reducing the pullout capacity by 40% is recommended for design to reduce the potential of creep failure. Long-term filtration tests showed that in all cases RAP-geosynthetic systems were able to drain freely and this behavior could be predicted with the existing clogging criteria that have been previously developed for sands and gravels.

Keywords: Geosynthetics, Recycled asphalt pavement, Interface shear, Physical clogging

Factors affecting geotextile filter long-term behaviour and their relevance in design

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Abstract: Geotextile and granular filters are widely used in civil (e.g. earth dams, embankments, drainage trenches, etc.) and environmental (e.g. landfills, permeable reactive barriers, etc.) engineering works. Geotextile filters are considered to be an effective alternative to conventional granular filters whose function is to prevent the movement of fine particles from the base soil allowing the liquid to flow as freely as possible. The design of a geotextile filter requires the knowledge of the base soil–filter interaction that is a very complex process due to the large number of factors involved. In this paper, the complex cases of geotextile filter design in contact with internally unstable cohesionless soils and in critical/severe applications are analysed based on recent research also developed by the authors. Moreover, the influence of the main factors affecting geotextile/filter long-term behaviour which are generally neglected in current design criteria, such as vertical effective stress, partial clogging, flow conditions, type of contact at the interface and type of permeant, are examined. Furthermore, various performance tests to evaluate the long-term soil–geotextile filter behaviour and the reliability and limits of different design criteria for cohesionless soils are discussed.

Keywords: Geosynthetics, Blinding, Clogging, Long-term filtration test, Internal stability

Self-healing of laboratory eroded defects in a GCL on silty sand

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Abstract: The self-healing of five geosynthetic clay liners (GCLs) with laboratory simulated down-slope erosion defects (quasi-circular holes and linear slits where there is little or no bentonite) upon hydration from Godfrey silty sand subgrade with wfdn= 16% under an overburden stress σv= 20 and 100 kPa is examined. While there was an up to 9.6 mm reduction in hole diameter/slit width, none of the defects fully self-healed. The self-healing of these laboratory eroded specimens with a swell index of 10.2 ± 1.7 ml/2 g after hydration is generally smaller than that of the corresponding virgin GCLs. GCLs with powdered bentonite with an initial SI of 32 ml/2 g generally self-healed better and the intact specimens had a lower hydraulic conductivity than GCLs with granular bentonite with an initial SI of 24-26 ml/2 g. Higher mass per unit area of bentonite and overburden stress led to better self-healing. Ponding of distilled (DI) water above the GCL increased self-healing of GCL slightly more than simulated synthetic landfill leachate (SSL). The post-hydration hydraulic conductivity, k, of GCL specimens with holes/slits is shown to be about 1–3 orders of magnitude higher than that of the intact GCL specimen.

Keywords: Geosynthetics, GCLs, laboratory simulated down-slope erosion, self-healing, cation exchange, hydraulic conductivity

Numerical simulation of surface blast reduction using composite backfill

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Abstract: Underground protective structures are usually made of reinforced concrete at a certain depth below the surface that is covered with soil. Materials, layering and geometry of the composite backfill play important roles in damping the stresses caused by surface blasts. The current study used 3D modelling to investigate the characteristics of the composite backfill subjected to surface blast load. The results indicated that the application of geofoam as a geosynthetic isolator layer increased the percentage of pressure decay (PD) up to 61%. Comparison of the different materials used for pressure mitigation revealed that a 0.75 m thick layer of geofoam performed similarly to a 1.1 m thick layer of unreinforced concrete, a 0.75 m thick layer of reinforced concrete with a steel equivalent height of 0.06 m and a 0.37 m thick steel layer. The combined use of reinforced concrete and geofoam considerably increased the PD.

Keywords: Geosynthetics, numerical modelling, blast loading, composite backfill, percentage of pressure decay

Performance of laboratory geogrid-reinforced retaining walls under freeze-thaw cycles

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Abstract: To investigate the effects of freeze-thaw cycles on performance of geosynthetic reinforced earth retaining walls, two model tests of 1.0 m-high geogrid-reinforced retaining (GRR) walls without and with the loading plate and 10 kPa surcharge were carried out under five freeze-thaw cycles. In each freeze-thaw cycle, both freeze-temperature of −15°C and thaw-temperature of 35°C were maintained for 12 h alternatively. The test results showed that the temperature field and mechanical performance of the GRR walls significantly depended on the ambient temperature and the number of the freeze-thaw cycles. The effect of ambient temperature on the temperature field in the model GRR walls gradually reduced with the distance from boundary increase, which is more obvious for the model GRR wall with the loading plate. The settlement at the top of the model walls and the lateral displacement increased with the increase of the number of freeze-thaw cycles, especially for the model wall with a surcharge. The additional earth pressures and geogrid strains in the model GRR walls significantly varied with the ambient temperature. The test results also showed that the performance change of GRR walls mainly happened in the initial two to three freeze-thaw cycles.

Keywords: Geosynthetics, GRR walls, freeze-thaw cycle, model test, performance

Laboratory evaluation of dynamic shear response of sand-geomembrane interface

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Abstract: The seismic stability of geosynthetic structures incorporating soil-geomembrane interfaces depends largely on their response to dynamic loads caused by earthquakes or traffic. The present study investigates the dynamic shearing response of sand-smooth geomembrane interface through fixed block-type shake table tests. The influence of dynamic loading parameters, like sliding velocity, loading frequency, normal stress, displacement amplitude and the number of cycles, and relative density of sand on the shearing behavior of the sand-geomembrane interface, are examined. Results show that the peak cyclic shear stress is significantly influenced by normal stress, shear displacement amplitude, loading cycles, and relative density of sand. The dynamic coefficient of friction of the sand-geomembrane interface displays an increasing trend with an increase in loading frequency, shear displacement amplitude, and relative density of sand but decreases for the rest of the considered parameters. The shape of the hysteresis loops is dependent on the normal stress and displacement amplitude. The dynamic coefficients of friction are also compared with the corresponding values under static conditions. The results from the present study emphasize the importance of considering the design basis value of the dynamic coefficient of friction for each parameter during the design stage of geosynthetic structures involving sand and geomembrane.

Keywords: Geosynthetics, sand, geomembrane, interface, dynamic load, coefficient of friction, damping ratio, secant shear modulus