《Geosynthetics International》

（国际土工合成材料）

<双月刊>

2018年第25卷第5期

摘要集

中国土工合成材料工程协会秘书处

国际土工合成材料学会中国委员会秘书处

2019年2月

目　录

Comparison of three inclusions in reducing lateral swelling pressure of expansive soils

L.-L. Wan[1], W.-L. Zou[2, 3], X.-Q. Wang[4] and Z. Han[5]
1 PhD Candidate, School of Civil Engineering, Wuhan University, Wuhan, China,
E-mail: wanlianglong@126.com
2 Professor, School of Civil Engineering, Wuhan University, Wuhan, China,
E-mail: zwilliam@126.com
3 Professor, School of Civil Engineering, Xijing University, Xi'an, China,
E-mail: zwilliam@126.com (corresponding author)
4 Professor, School of Civil Engineering and Architecture, Wuhan University of Technology, Wuhan, China, E-mail: xqscwang@126.com
5 Associate Professor, School of Civil Engineering, Wuhan University, Wuhan, China,
E-mail: nicholas.han@hotmail.com

Abstract: Lateral swelling pressures of expansive soils impose significant threats to the stability and safety of retaining structures. Placing a layer of compressible material, such as cohesive non-swelling soil (CNS), expanded polystyrene (EPS) geofoam or cohesionless soil (such as sand), between the retaining structure and the expansive soil can effectively reduce the lateral swelling pressure acting on the retaining structure. The work presented in this paper compares the efficiency of CNS, EPS and sand inclusions in reducing the lateral swelling pressure of a natural expansive clay. A special consolidometer was used to measure the lateral swelling pressure of expansive soil samples with and without inclusions under constant-volume condition, upon saturation. An analytical approach was used to interpret the efficiency of CNS, EPS and sand inclusions in reducing the lateral swelling pressure. It is found that (i) the efficiency of EPS inclusions is much higher than that of CNS and sand inclusions and (ii) sand is more effective than CNS in reducing the lateral swelling pressure at the same degree of compaction. It is suggested that EPS is preferred, the efficiency of sand is limited, and highly compacted CNS is unfavorable in reducing lateral swelling pressures.
Keywords: Geosynthetics, Expanded polystyrene (EPS) geofoam, Expansive soil, Lateral swelling pressure, Inclusion

Numerical study of earth pressures on rigid pipes with tire-derived aggregate inclusions

P. Ni[1], X. Qin[2] and Y. Yi[3]

1 Research Fellow, School of Civil and Environmental Engineering, Nanyang Technological University, Singapore 639798, Singapore, E-mail: pengpeng.ni@ntu.edu.sg

2 PhD Candidate, Institute of Geotechnical Engineering, Southeast University; Jiangsu Key Laboratory of Urban Underground Engineering & Environmental Safety (Southeast University), Nanjing, Jiangsu 210096, China, E-mail: xiaogang.qin2008@gmail.com

3 Assistant Professor, School of Civil and Environmental Engineering, Nanyang Technological University, Singapore 639798, Singapore, E-mail: yiyaolin@ntu.edu.sg (corresponding author)

Abstract: Rigid pipes under high embankments are often installed using the induced trench technique by introducing a compressible zone above the pipe. Made from discarded tires, tire-derived aggregate (TDA) has a high compressibility and is resistant to degradation. A new application, using TDA for induced trench rigid pipes is evaluated. A plane-strain finite element simulation is conducted, in which the constitutive curve of TDA measured from a large-scale compression test is implemented. Comparisons with other compressible materials show that TDA can provide similar benefits of load reduction for rigid pipes. A parametric study is carried out to optimise the design, including the geometry of the TDA zone, the spacing between the pipe and the TDA zone, and the relative stiffness between soil and TDA. Results show that earth pressures around the pipe decrease with the increase of the width of TDA zone but are not influenced significantly by its thickness. In the end, numerical data of the load coefficient for rigid pipes with TDA inclusions are compared with field measurements for other compressible inclusions and two analytical solutions. It is found that existing analytical approaches are applicable to the design of induced trench rigid pipes with TDA inclusions.

Keywords: Geosynthetics, Tire-derived aggregate (TDA), Induced trench, Rigid pipe, Soil arching, Numerical modelling, High embankment

Design and consolidation analysis of geotextile tubes for the Saemangeum project in Korea

H. J. Kim[1], T. W. Park[2], P. R. Dinoy[3], H. S. Kim[4] and H. J. Kim[5]

1 Professor, Department of Civil Engineering, Kunsan National University, Gunsan 573-701, South Korea, E-mail: kimhj@kunsan.ac.kr

2 Graduate Student, Department of Civil and Environmental Engineering, Kunsan National University, Gunsan 573-701, South Korea, E-mail: r2r3r4r5@kunsan.ac.kr (corresponding author)

3 Graduate Student, Department of Civil and Environmental Engineering, Kunsan National University, Gunsan 573-701, South Korea, E-mail: peter_rey@kunsan.ac.kr

4 Graduate Student, Department of Civil and Environmental Engineering, Kunsan National University, Gunsan 573-701, South Korea, E-mail: gudtn3004@kunsan.ac.kr

5 Graduate Student, Department of Civil Engineering, University of Colorado Boulder, Boulder, CO 80309, USA, E-mail: Hyeon.Kim@colorado.edu

Abstract: In planning and designing geotextile tubes, predicting the consolidation characteristics is very important to ensure that the capacity and deformation of the tubes are well regulated during construction. Design and construction parameters, such as dewatering time and permeability, must be evaluated considering the interaction of the soil and geotextile during filling and consolidation. In this study, field scale tests, such as the hanging bag test and geotextile tube demonstration tests, were performed as a geotechnical design approach in determining the equivalent soil-geotextile consolidation parameters. In the hanging bag test, seepage pressure was applied to simulate the effect of filling pressure in the actual construction site. Procedures to determine the required slurry volume, soil-geotextile consolidation parameters, tube geometry, and consolidation characteristics were introduced in this study. The procedures were proposed on the basis of the areal method, which considers the vertical and lateral movement of the tube, and the large strain consolidation theory, which considers finite strain and the change of the coefficient of consolidation. Finally, using the proposed procedures and obtained consolidation parameters, a parametric study was performed to show the applicability of the areal method and large strain consolidation theory.

Keywords: Geosynthetics, Geotextile tubes, Hanging bag test, Consolidation, Equivalent soil-geotextile consolidation parameters

17-year elevated temperature study of HDPE geomembrane longevity in air, water and leachate

A. M. R. Ewais[1], R. K. Rowe[2], S. Rimal[3] and H. P. Sangam[4]

1 Assistant professor, Civil Engineering Department, Ain-Shams University, Cairo, Egypt, E-mail: amr.ragab@eng.asu.edu.eg

2 Professor, Canada Research Chair in Geotechnical and Geoenvironmental Engineering, and Killam Fellow, GeoEngineering Centre at Queen's-RMC, Queen's University, Ellis Hall, Kingston, ON, Canada, K7L 3N6, E-mail: kerry@civil.queensu.ca (corresponding author)

3 Geotechnical Engineer, Golder Associates Ltd., 6925 Century Avenue, Suite #100, Mississauga, ON, Canada L5N 7K2, E-mail: Santosh_Rimal@golder.com

4 Director, Mine Environment, Mining & Metallurgy, SNC-Lavalin 195 The West Mall, Toronto, ON, Canada M9C 5K1, E-mail: Henri.Sangam@snclavalin.com

Abstract: 17-year investigation of a geomembrane (GMB) aged at 55, 70 and 85 ℃ in air, water and leachate is reported. At test termination, the mechanical properties had only reached nominal failure in leachate and water at 70 and 85 ℃. Consistent with a previous study, there is a significant reduction in stress crack resistance (SCR) before there is clear evidence of oxidative degradation; this is attributed to the morphological changes due to disentanglement of entangled polymer chains. The effect of this apparent morphological change on SCR appeared to be greatest for the GMB when immersed in water and leachate at 70 ℃, although it is evident for all fluids at all three test temperatures. Using the most conservative estimates, the time to nominal failure (tNF, time to 50% of the initial or specified property value) in leachate, water and air (no UV exposure) ranged from >13, 18 and 170 years at 60 ℃ to 660, 1500, and 1700 years, respectively, at 20 ℃. Assuming minimal tensile strains in the GMB, the time to nominal failure of this GMB in a composite liner is likely estimated to vary from >50 years at 60 ℃ to >550 years at 35 ℃ and > 1100 years at 20 ℃.

Keywords: Geosynthetics, Geomembrane, HDPE, Degradation, Service-life, Landfill liner, Chain disentanglement

Field monitoring and numerical modeling of 4.4 m-high mechanically stabilized earth wall

M. A. Salem[1], M. A. Hammad[2] and M. I. Amer[3]
1 Associate Professor, Faculty of Engineering, Cairo University, Giza 12613, Egypt,
E-mail: manalasalem@eng.cu.edu.eg (corresponding author)
2 Graduate Student, Faculty of Engineering, Cairo University, Giza 12613, Egypt,
E-mail: mmareygeo@gmail.com
3 Professor, Faculty of Engineering, Cairo University, Giza 12613, Egypt,
E-mail: m.amer@cu.edu.eg

Abstract: A full-scale mechanically stabilized earth (MSE) wall was constructed and monitored in a residential compound in New Cairo, Egypt. The height of the wall was 4.4 m and the facing consisted of modular concrete blocks. The wall was reinforced with high-density polyethylene geogrid. This paper presents the instrumentation program and interpretation of measurements recorded at end of construction and after applying loads on top of the wall. Strains in the geogrid layers were measured using strain gauges. Deformations of the wall face were surveyed using a total station device. Backfill soil properties and geogrid stiffness properties were characterized through laboratory testing. A two-dimensional finite element model was developed to simulate the performance of the instrumented wall at end of construction. Reinforcement loads deduced from measured strains were compared to different load prediction methods: AASHTO Simplified, K-stiffness, Simplified stiffness, and finite element modeling. The paper highlights important aspects to be considered in numerical modeling of MSE walls. Predicted horizontal wall displacements and reinforcement loads from finite element modeling compared well to field measurements. The Simplified stiffness method better predicted the reinforcement loads compared to the AASHTO Simplified and K-stiffness methods.

Keywords: Geosynthetics, MSE wall, Monitoring, Strain gauges, Reinforcement load, Finite element