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Geotextile's Permeability Performance Measurements in Drainage Systems Under Pressure

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ABSTRACT: One of the most important applications of geotextiles is as drainage and filtration adjacent soil in civil engineering projects. The using of this material has several benefits such as such as permeability and filtration that effect of these benefits, theoretical or experimental, have been evaluated by researchers. One of the important issues is the effect of contact pressure on permeability of geotextile-soil systems which has been less investigated. In this paper, the impact of overhead pressure on permeability of the soil in the vicinity of nonwoven geotextiles in a drainage system has been investigated by experimental tests. For this purpose, a special measuring cell was designed and built in soil and geotextile system which the hydraulic properties were evaluated in variation of pressure. The results showed that the variation of system permeability is non-linear in variation of overhead pressure. Also the thickness of geotextile has important effect on the permeability in a soil-geotextile system.

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1- Introduction

Geotextiles are one of the important materials which used to drainage and filtrations in construction projects. These materials have many benefits such as cost-effective, high tensile strength, easy handling and long-term resistance against physical and chemical erosion. However, the occlusion and clogging are the main problems of geotextiles. This issue was studied by researchers (e.g. [1-4]).

In this paper, a special measuring cell was designed and built in soil and geotextile system which the hydraulic properties were evaluated in variation pressures and the effect of head pressure has been investigated on geotextile clogging.

2- Equipment and materials

To evaluate clogging, a device was designed and built based on ASDM-D5101 with the difference that a piston was designed to apply pressure to soil sample. The designed device has been shown in Figure 1. The main body of device is Plexiglas and perforated top and bottom plates were made from polyamide.

Figure 1. The designed device

The properties of used geotextile and soil were shown in Table 1 and Table 2.

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Table 1. Geotextile properties

Geotextile	Polymer type	Mass per unit area (gr/m^2)	Thickness (mm)	Fiber diameter (mm)	AOS (mm)
G1	Polypropylene	250	1.2	0.0268	0.18
G2	Polypropylene	500	3.8	0.043	0.09

Table 2. The used soil properties

Soil type	Cu	Cc	γ_{max} (kN/m^3)	γ_{min} (kN/m^3)	Gs
G1	11.42	1.3	18.75	15.45	2.67

3- Results and Discussions

Based on principles of loading and permeability, many tests have been done that results of them were shown in Figure 2. Figure 2 shows that the reduce in flow rate is high in initial times and then it decreases during loading time. Also, the permeability increases with pressure increasing (after 100 kPa).

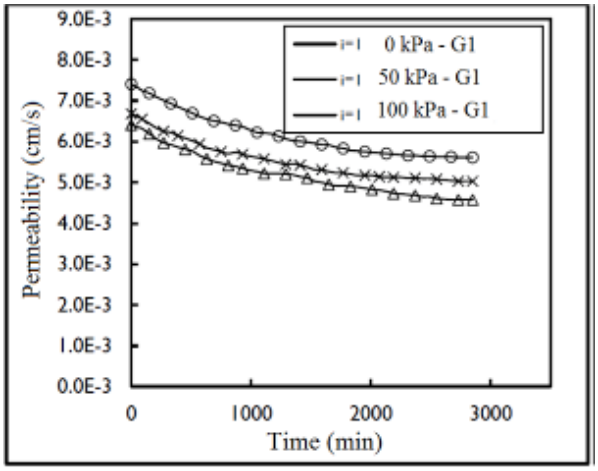

Figure 2. Permeability of soil-geotextile (G1) with hydraulic gradient =1 in different pressures

The ratio of porosity and pressure was plotted for different hydronic gradient in Figure 3. This Figure indicates that hydraulic gradient has low effect on porosity while pressure has significantly effect on porosity.

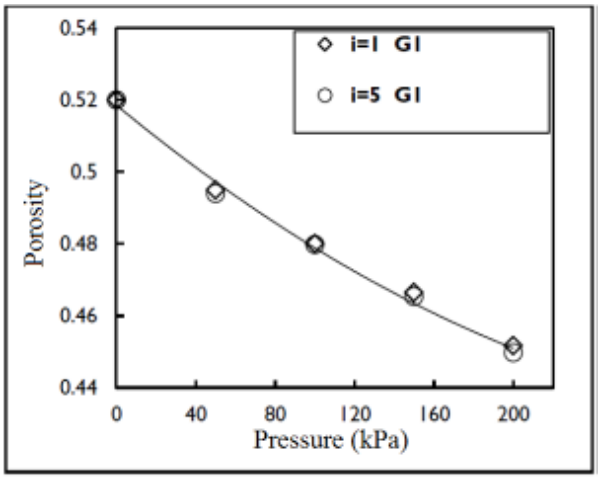

Figure 3. The variation of porosity in different pressures for soil-geotextile (G1) system

Figure 4 was plotted based on the results of this paper and kozeny-carman equation that is suitable for sandy soils. The different behavior of geotextiles could be seen in Figure 4.

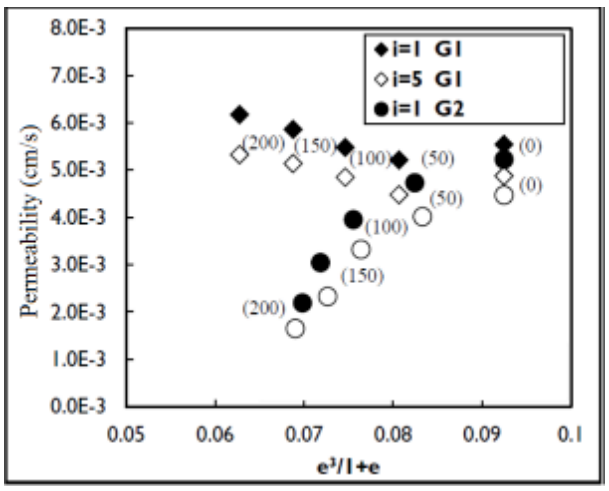

Figure 4. The average of permeability versus kozeny-carman equation

The index of flow variation versus pressure was plotted in Figure 5. As can be seen, the hydraulic gradient decreases initially and then it increases with pressure increasing in G1, while the index of flow variation decreases in G2.

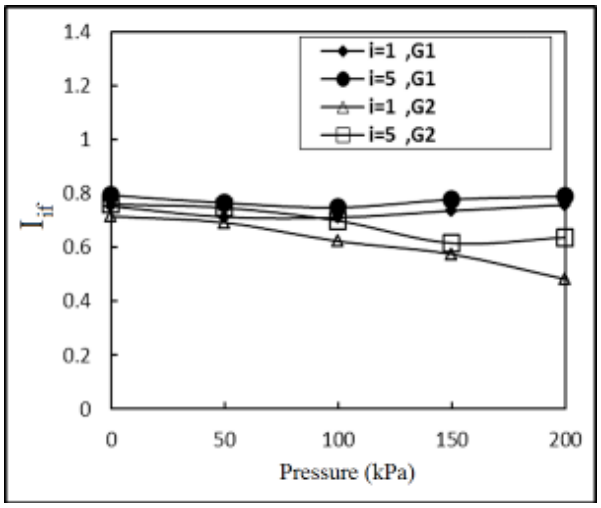

Figure 5. The variation of flow index versus pressure

4- Conclusion

The results of experimental tests showed that pressure and hydraulic gradient can effect on the permeability of soil-geotextile system. Also, the permeability of soil-geotextile system increases with increasing pressure. The 5 times variation of hydraulic gradient can effect on clogging times so that clogging is during loading in low hydraulic gradient.

References

[1] Bell, J. R. and Hicks, R.G. 1980. "Evaluation of Test Methods and Use Criteria for Geotechnical Fabrics in Highway Applications-Interim Report,". U.S. Department of Transportation, Federal Highway dministration, Report No. FHWA / RD-80/021, Washington, DC, USA, in June, 190 p.

[2] Metcalfe, R. C. 1993. "Performance of Geotextile Separators in Western Washington,". MSCE Thesis, University of Washington, Seattle, 262 pp.

[3] Kohler, H. J. 1993. "The influence of hydraulic head and hydraulic gradient on the filtration process,". Proc. Filters in Geotechnical and hydraulic engineering Balkema, Rotterdam.

[4] Mouw, K. A. G. et al. 1986. "Geotextiles in shore and botton protection works," Pro. Third Int, Conf, on Geotextiles Vienna, Austria.

[5] Palmeira, E.M., and Gardoni, M.G. 2002." Drainage and filtration properties of nonwoven geotextiles under confinement using different experimental techniques", International Journal of Geotextiles and Geomembranes, 20 (2), 97-115.

[6] Wu Cho-Sen., Yung-Shan Hong., Yun-Wei Ya. and Bow-Shung Chang. 2006. "Soil-nonwoven geotextile filtration behavior under contact with drainage materials. Elsevier Ltd. Journal of Elsevier ,Geotextiles, and Geomembranes, 1(1),1-10

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