ANOVA 프로그램에 의한 지오멤브레인의 성능 평가

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Evaluation of Geomembrane Performance by ANOVA Program

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1. Introduction

One way analysis of variance (ANOVA) was performed to examine whether or not the two important properties, load at yield and the elongation at yield were statistically affected by different pH and temperatures for geomembranes. A p-statistic which is no higher than the significance levels α=0.05 and α =0.01 respectively indicates a statistically significant effect and a highly significant effect (p-statistics higher than α=0.05 suggests there is no significant difference). In this study, to determine whether or not the four pH (temperature) conditions affect the properties of samples, 20 data obtained at the same pH condition at each stage, regardless of the temperatures (pH values), were grouped for ANOVA.

2. Experimental

For analysis by ANOVA, we used un-notched smooth(UN-S), textured(UN-T) and notched smooth(N-S), textured(N-T) HDPE geomembranes. Tensile test was performed with recording the load at yield point and break point for both original and treated samples. HCl, NaOH and distilled water were used to get pH values of 4, 7, 8 and 12.

3. Results and Discussion

No significant differences were found among pH groups in both load at yield (*Table 1*) and elongation at yield (*Table 2*) for four types of samples over the 120-day period. Exceptionally, for the four pH groups, means of load at yield were observed to be significantly different for UN-S and UN-T samples after 60-day treatments, the reason of which is not determined. Nevertheless, longer exposure indicates that it's unlikely the different pH conditions have an effect on load at yield of all types of samples. pH effects on elongation at yield were not detected over 90-day treatments for all samples. However, significant increases of elongation at yield with the increase of pH are found in N-T and UN-S samples after 120-day exposures in solutions higher pH. This indicates that, although pH may not affect the elongation at yield of samples within short periods (e.g. 3 months), and elongation may increase when samples are exposed longer in solutions of higher pH values. On the contrary, significant or highly significant differences in load at yield were commonly found for all samples among the four temperature groups over the 120-day treatments (*Table 3*). The similar results were obtained for elongation at yield as well (*Table 4*). Furthermore, it was clear that the load at yield significantly decrease with the increased temperature,

whereas elongation at yield increases with the increased temperatures. t-test is used to assess whether the means of load at yield and elongation at yield are statistically different from smooth geomembrane (notched and un-notched) and textured (notched and un-notched) geomembrane. At lower temperature (20 and 40°C) there are no significant differences between notched smooth and textured HDPE GM in both load at yield and elongation at yield for each treated stage. The same as notched samples, on significant differences were found between un-notched smooth and textured HDPE GM in both load at yield and elongation at yield for each treated stage. Exceptionally, when the temperature increased, at higher temperature (60 and 80°C) the differences between smooth and textured HDPE GM became significant in both load at yield and elongation at yield.

Table 1. Significant levels of differences of the means of load at yield between four pH groups (+, p<=0.05; ++, p <= 0.01; -, p >0.05)

Test Period	N-S	N-T	UN-S	UN-T
30 Days	-	-	-	-
90 Days	-	-	-	-
120 Days	-	-	-	-

Table 2. Significant levels of differences of the means of elongation at yield between four pH groups (+, p<=0.05; ++, p<=0.01; -, p>0.05)

Test Period	N-S	N-T	UN-S	UN-T
30 Days	-	-	-	-
90 Days	-	-	-	-
120 Days	-	+	+	-

Table 3. Significant levels of differences of the means of load at yield between four temperature groups (+, p<=0.05; ++, p <= 0.01; -, p >0.05)

Test Period	N-S	N-T	UN-S	UN-T
30 Days	++	++	++	++
90 Days	++	++	++	++
120 Days	++	++	++	++

Table 4. Significant levels of differences of the means of elongation at yield between four temperature groups (+, p<=0.05; ++, p<=0.01; -, p>0.05)

Test Period	N-S	N-T	UN-S	UN-T
30 Days	++	++	++	++
90 Days	++	++	++	++
120 Days	++	++	++	++

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Reference

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