Behavior of Polyurethane Grout Under Wet-Dry Cycles

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Abstract

In this study a hydrophilic polyurethane grout was mixed with varying the amount of water up to 6 times the weight of the grout. The behavior of cured polyurethane grout specimens were studied under wet and drying cycles. This was intended to simulate the field conditions. Each cycle had a week of exposure in water and another week in air� A multiple regression analysis was performed in order to predict this characteristic of the grout.� The cured grout unit weight varied from 3.2 kN/m^3 (20 pcf) to 61 pcf. During the test, weight change and volume change were measured. To date up to 40 wet-dry cycles have been completed.

1. INTRODUCTION

Polyurethane grouts are a unique material that offers the elasticity of rubber combined with the toughness and durability of metal. Currently in the civil engineering field, this grout is being used for stabilizing soils, stopping infiltration into water and wastewater systems, treating and containing wastes, slabs jacking, and structural repair of concrete facilities. Due to this wide range of applications, there is an increased interest in better characterizing the behavior of hydrophilic polyurethane grouts. In this study we are characterizing the behavior of polyurethane grouts, especially for wet and drying cycles. Different specimens were prepared under different conditions of water-to-grout ratios, as well as different volume expansion allowed. In addition to varying the water-to-grout ratio, we restrained the volume expansion going from 0% up to 150% of the initial volume. Curing parameters were analyzed and Pressure-Temperature-Time relationship during curing was developed and related to other characteristics of the grout.

2. OBJECTIVES

The objective of this study was to determine the response of Polyurethane grouts to predict it. We did this by:

1. Performing a number of tests in order to have a statistically represented population.
2. Performing Multiple regression analysis in the test results gotten to analyze and predict the behavior within the range of data we have already tested.
3. Determining the mechanical properties of cured specimen and associating them to the one another and to the conditions under which they were made, as well as their macrostructure

3. MATERIALS AND TESTING

A commercially available AV-202 multigrout (Avanti International, Webster Texas) was selected for this investigation. Uncured monomer is dark brown in color, with a viscosity of 2500 cps (at 30^{o}C) with a specific gravity of 1.15. Polyurethane grout selected for this study had a free volume expansion of over 800% for a water-to-grout ratio of 0.5 (by volume).

4. RESULT AND DISCUSSION

Swelling and Shrinking behavior: Here, the water absorption during wet and dry

�cycles for foamed grouts was determined by measuring the change in both weight and volume when immersing the specimen into water on regular cycles. Figure 1 and 2 show two cycles for different specimens. Specimen 11c with a water-to-grout ratio of 0.5 and a

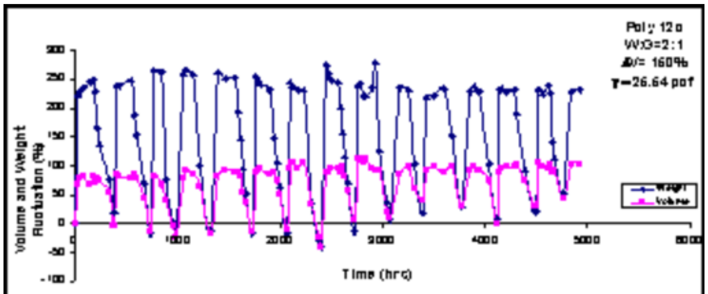

Figure 2. Swelling-Shrinking Cycle Poly 12c W:G = 2:1 ΔV= 150% γ= 25.54 pcf

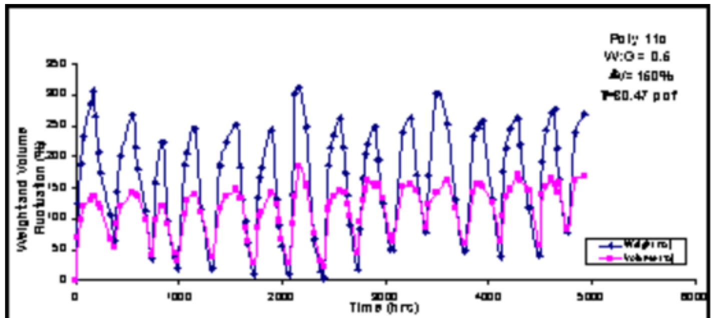

Figure 1. Swelling-Shrinking Cycle Poly 11c W:G = 0.5 ΔV allowed = 150% γ = 30.47

DV=150% shows a maximum of 250% and a minimum shrinkage of 0%. Specimen 12c, which had a water-to-grout ratio of 2 and a DV = 150%, presented a swelling of 180% and a shrinkage going from 0% to �10% After performing a series of test on different specimen prepared under different conditions, a Multiple regression analysis was produced and it is presented. ������������������

5. CONCLUSIONS

At equal volume expansion allowed, the water-to-grout ratio influenced the swelling and shrinking behavior of the grout. Specimen 11c (w-g = 0.5), expanded and then shrank back to its original volume. In contrast, specimen 12c (w-g = 2) had less expansion than specimen 11c and shrank back toward (in some cases, even below) its original volume. Compared to the unit weight of cured polyurethane, the initial water-to-grout ratio was more important in influencing the behavior of the grout regarding to wet and dry cycles.

6. ACKNOWLEDGMENT

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7. REFERENCES

CIGMAT News and Literature Review, Vol. 1, No. 3 (1995), Center for Innovative Grouting Materials and Technology (CIGMAT), University of Houston, November 1995.(htttp://gem1.cive.uh.edu)

If you have any questions, please contact **Dr. C.Vipulanandan**