Characterizing the Behavior of Polyurethane Grout

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Abstract: The pressure and temperature changes of a curing hydrophilic polyurethane grout with different volume changes were investigated. The temperature peaked before the pressure. The water-to-grout ratio and the volume change affected the changes in pressure and temperature.

1. Introduction

Polyurethane grouts are divided in two major categories, hydrophobic, and hydrophilic grouts. Hydrophilic grouts can incorporate large amounts of water into their chemical structure, thereby creating a gel with a variable water content, which volume increases several times its original volume. Polyurethane grout is being used for controlling leaks in water and wastewater systems during construction and maintenance and treating cracked concrete walls. Leaking is a common problem of dams and sewer systems which are structurally sound and grouting is an effective method of rehabilitation (Karol, 2003). Polyurethane grout shows various characteristics under different allowed volume changes. Maximum temperature and pressure during curing varied notably for the same water-to-grout ratio (Mattey, 2001).

2. Objectives

The objective of this study was to investigate the curing behavior of polyurethane grout under controlled volume change. Specifically, to develop pressure-temperature-time relationship for curing polyurethane under controlled volume change.

3. Materials and specimens

Material. A commercially available AV-202 multigrout (Avanti International, Webster Texas) was selected for this investigation. Uncured grout was dark brown liquid with a viscosity of 2500 cps (at 30°C) and a specific gravity of 1.15.

Specimen preparation. Making of specimens simulated the condition in concrete cracks, where limited space will affect the volume change in the grout and thus generate large pressure. Total volume of the mold was 100 mL. Using this molds allowed us to change the initial mix volumes from 0.5 to 6. Changes in pressure and temperature, generated by the reaction of the grout with water were monitored till readings remained almost unchanged (CIGMAT GR 4, 2004).

4. Test result and discussion

Pressure-Temperature-Time Relationships. The changes in pressure and temperature during curing for two grout mixes with 43% and 150% volume change with 0.5 water-to grout ratio were analyzed. In both cases the temperature rises much faster than the pressure. The peak temperature was reached in 4 and 6 minutes respectively and the maximum temperature increment recorded was of 19°C and 42°C respectively. The gel times were 7.6 min for a ΔV of 43% volume expansion, and 4 min for a volume expansion a ΔV of 150%. For water-to-grout ratio of 0.5, when the volume expansion is 43%, a maximum value in foaming pressure of 175 psi was reached at 14 min after the mixing process began. It can be observed as well that the maximum pressure was reached 7 min after the maximum temperature was recorded. By the time the maximum pressure was reached, the temperature had dropped 8°C from its maximum value of 19°C when the volume change was of 150%, a maximum pressure of 80 psi was recorded at 6 min from starting time of reaction. By this time the maximum temperature had dropped 2°C from its maximum value of 42°C.The unit weights of cured polyurethane grouts varied from 46.2 pcf to 47.7 pcf.

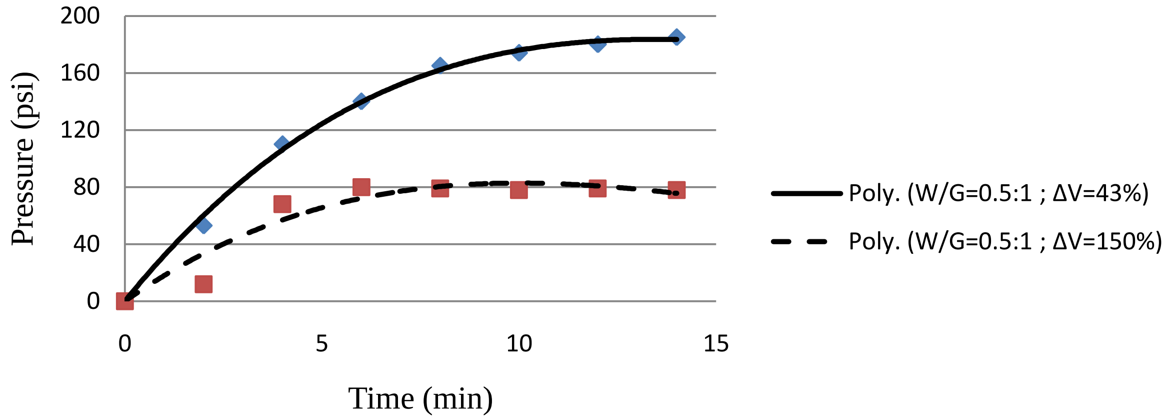

Fig. 1 Change in pressure with curing time

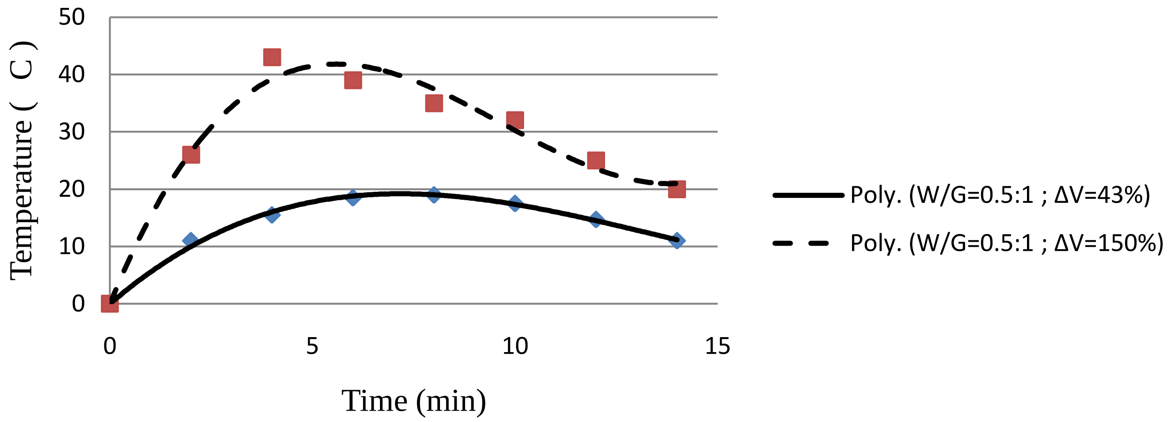

Fig. 2 Change in temperature with curing time

5. Conclusions

Pressure-Temperature-Time Relationships was affected by the water-to-grout ratio and the volume change allowed for the curing grout mix. Maximum temperature peaked first. Increasing the allowed volume change reduced considerably the maximum pressure and increased temperature generated.

6 Acknowledgements

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7 References

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