

# Testing of Polyurethane Grouts for Leak Control in Concrete Facilities

**Yenny Matthey and C. Vipulanandan**

Center for Innovative Grouting Materials and Technology (CIGMAT)

Department of Civil and Environmental Engineering

University of Houston, Houston, TX 77204-4791

Phone: 713-743-4291; E-mail: mattheia@hotmail.com

## Abstract

There are no standard testing methods to prepare and test polyurethane grouts for various leakage control applications. Methods of preparing polyurethane grout specimens for physical and mechanical testing are being investigated. Parameters such as pressure, temperature and volume change are being monitored during the sample preparation. Effect of these parameters on the microstructure of the polyurethane are being investigated. CIGMAT Standard Methods (Series G) for preparing specimens are being developed.

## Introduction

Polyurethane is used in civil engineering applications such as coatings, adhesives, concrete repair materials and joint sealants. Polyurethane is also increasingly used in hazardous and non-hazardous waste treatment and containment technology. When done correctly, polyurethane grouting can ensure a permanent repair/rehabilitation, but incorrect grouting can cause many problems. Also grout has to set within the cracked space under confined condition and various pH environments. Hence grout tests should consider some of these factors. The construction/repair market for polyurethane is expected to grow even further in the coming years. Lack of standard testing procedures for foam, gel and rigid polyurethanes in civil engineering applications makes it difficult for the design engineer to select this material. This shortcoming must be overcome with further research, development of testing standards and education.

Polyurethane grouts (concrete repair and joint sealant) are being characterized in the CIGMAT Research Laboratory. Studies will focus on evaluating current test methods and developing new test methods, if necessary, to better characterize these grouts for concrete repair and joint sealants. Organizations such as American Concrete Institute (ACI), International Concrete Repair Institute (ICRI) and ASCE have publications/committees on polyurethane grouts. It should be noted that ASTM has no standard for testing polyurethane grouts and most of the data reported in the literature/supplier brochure are standards developed for various other materials and applications. Some of the tests that have been adopted for polyurethane grouts for concrete repair are summarized in CIGMAT News and Literature Review (Vol. 4, No. 1, 1998).

## 2. Objective

The objectives of this study are as follows: (1) Develop methods to prepare grout specimens under various pressure (P) temperature (T) and volume change ( $\Delta V$ ); (2) Characterize the mechanical properties, bonding strength, microstructure and corrosion resistance (biological and chemical) of the grouts prepared under various conditions; (3) Develop standard methods for testing grouts, and (4) Identify the important grout properties for various rehabilitation applications.

### 3. Testing Program

Major variables for preparing specimens are pressure, volume-change and temperature. Grout mixtures are being prepared according to manufacturers specifications.

#### (a) Methods

Making of specimen:

Making of specimens must simulate the conditions in concrete cracks, where limited space will affect the volume change in the grout and thus generate large pressure. Teflon molds with supporting frames are being used to prepare cylindrical specimens. These molds can also be used to make specimens with no volume change ( $\Delta V=0$ ). Because the reaction proceed so fast, it is a challenge to make specimens without volume change ( $\Delta V = 0$ ), especially for those with high grout proportion (water-to-grout ratio of 0.5). Preliminary results are good and repeatable.

Initial tests are being done on hydrophilic grouts with various grout-to-water ratios. Based on the quality of specimens other grouts (different manufacturers) mixes will be selected for detailed mechanical, bonding and corrosion tests.

Use of admixtures to improve the mechanical/bonding properties and reduce shrinkage will be investigated. Chemical resistance (sulfate resistance) of the grouts will be studied by immersing the specimens into sulfate, and sulfuric acid solutions (pH of 1 and 4). Also biological resistance will be studied with various biologically active solutions.

### 4. CIGMAT Standards

CIGMAT Standard for preparing specimens and measuring the physical and mechanical properties of polyurethane grouts are being developed.

### 5. Conclusions

Based on the experimental results following observations are advanced.

a. Procedure for preparing specimens under controlled conditions have been developed.

b. Change in pressure and temperature over 250 psi and 30<sup>o</sup> C have been observed during the setting of a hydrophilic polyurethane with limited volume change.

### 6. Acknowledgment

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## 7. References

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If you have any questions, please contact [Dr. C.Vipulanandan](#)  
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