Cellular Grouts for Sliplining

Zhihong Liu, Mohan K. Neelam and C. Vipulanandan
Department of Civil and Environmental Engineering
University of Houston, Houston TX 77204-4791
Phone: 713-743-4291 E-mail: Zliu2@bayou.uh.edu

Abstract
Interest in using sliplining for large diameter (>90 inches) pipe rehabilitation is on the increase. Hence large volumes of grout materials with good working properties and mechanical properties is needed. Since large amount of grout is needed, the material composition must be optimized to reduce cost and heat of hydration. Hence, the use of fly ash was investigated in this study. Up to 50% of fly ash was used as replacement for cement. A series of mechanical and chemical tests are being performed on grouts with unit weights varying from 43 to 55 pcf.

1. Introduction

Sliplining is one of the promising trenchless rehabilitation method used for pipelines. Many sewer pipes with various diameters are being rehabilitated using this method. To meet the requirements of placement and in situ performance, cellular grout should be lightweight with good flow properties and controllable setting time. For large diameter pipes (>90 in), this is more critical since large amount of grouts is needed. This study will focus on developing and characterization cellular grouts for sliplining large diameter pipeline.

2. Testing program

Grout mix prepared in the field (Houston area) with unit weights varying from 43 pcf to 55 pcf, with or without fly ash, were collected and used in this test program. Several 3x6 in. cylindrical specimens, 2x2 in. cubic specimens and 2x2x12 in. beam specimens were prepared for mechanical and chemical tests. The flow cone test and penetration test were performed. Mechanical tests include the compression tests using cylinder and cubic specimens. Bending test were done on beam specimens. The chemical immersion test is focused on the acid resistance of the grout. Cylindrical specimens are immersed in two different concentrations of sulfuric acid, sodium sulfate solutions and D.I. water. The pH of the solution, the calcium ion, the weight of the specimens and the ultrasonic pulse velocity are monitored during the chemical tests.

3. Results

Compression test on 70 cylindrical specimens have been completed. The variation strength and elastic modulus of different types of grouts with curing time are shown in Figure 1 through Figure 4. The compressive strength of 43 pcf grout with or without fly ash didn't differ much in the first 15 days, but the 28-day strength of grout without fly ash was 20% higher than that with fly ash. The 28-day strength of 55 pcf without fly ash was 50% higher than that with fly ash. The elastic modulus had similar trend like the strength. The 28-day modulus of grout without fly ash was 40% and 120% higher than that with fly ash for 43 and 55 pcf grouts respectively. The on-going chemical test has shown that visible discoloration happened to the specimens in the sulfuric acid with a pH of 1 in just one week after the immersion.

4. Conclusion

Based on the experimental results the following conclusion are advanced:
1. Fly ash reduce the 28-day compression strength of grout.
2. Fly ash affected the strength of 54 pcf more than that of 43 pcf.
3. Fly ash affected the elastic modulus more than the compressive strength.
4. Fly ash affected the setting time of 54 pcf more than the 43 pcf grout.

5. Reference

1. C. Vipulanandan, "Testing and Developing Guidelines for Sliplining Grouts".
2. City of Houston specification (Section 02331), "Sliplining Grout".
[3] ASTM C403, "Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance"
[4] ASTM C495, "Test Method for Compressive Strength of Lightweight Insulating Concrete"

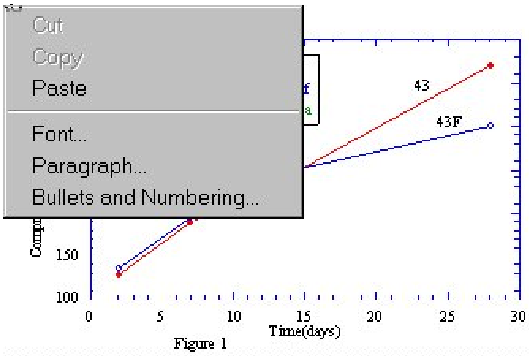

Figure 1

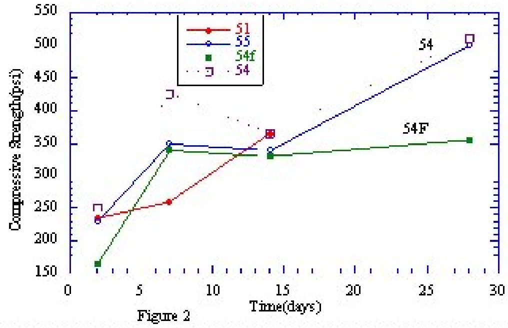

Figure 2

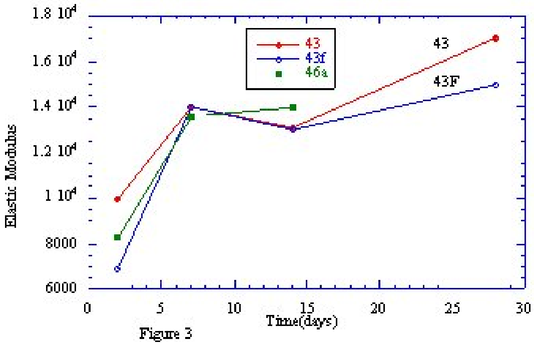

Figure 3

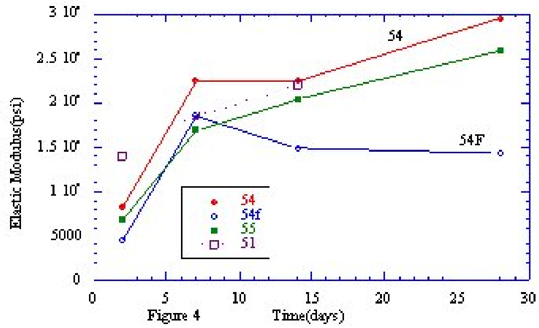

Figure 4

University of Houston, Department of Civil and Environmental Engineering4800 Calhoun, Houston, TX 77024
Phone 713-743-4278 Fax 743-4260