Pulse Velocity and Strength Properties of Acrylamide Grouted Sand

H. A. Gonzalez and C. Vipulanandan

Center for Innovative Grouting Materials and Technology (CIGMAT)
Department of Civil and Environmental Engineering
University of Houston, Houston, TX 77204-4003
Tel: 713-743-4291; email: hagonzalez@uh.edu

Abstract

In order to better characterize the behavior of acrylamide grouted sand, triaxial test, and Pulse velocity method were used. The results showed that the strength properties and pulse velocity remained nearly constant after 3 days of curing. The average pulse velocity, friction angle and cohesion were $4.25x10^3$ ft/sec (1300 m/s), 10^o, and 53 psi (366 kPa), respectively for the acrylamide grouted sand.

1. Introduction

Non Destructive Tests (NDT), such as the ultrasonic pulse velocity and impact resonance have been successfully used to quantify the properties of different construction materials. Ata and Vipulanandan (2000) used the impact resonance method to determine the cyclic and dynamic properties of sodium silicate grouted sand. They reported P-wave velocities ranging from $10x10^3$ in/sec (260 m/s) to $16x10^3$ in/sec (420 m/s). Dano, Hicher and Tailliez (2004) studied the engineering properties of three different grouted sands by means of triaxial and grindosonic (impact resonance) tests, and cohesion varied from 30 psi (200 kPa) to 68 psi (450 kPa) and friction angle varied from 39° and 42° . Ribay, Maigre, Cabrillac and Gouvernot (2004) used the resonant column to determine the shear modulus ranged from $30x10^3$ psi (200 MPa) to $75x10^3$ psi (500 MPa) and damping ratios varied from 1% to 5% for sodium silicate, microfine cement and mineral grout grouted sands.

2. Objectives

The overall objective was to determine the changes in the mechanical properties of acrylamide grouted sand with curing time, using the Ultrasonic Pulse Velocity method, and the triaxial tests.

3. Materials and Testing Method

Commercially available “AV-118 Duriflex” N-methylolacrylamide (NMA) grout (Avanti Grout International, Webster Texas) was used for this study. Commercially available sand with the USCS classification of SP and d_{10} = 0.10 mm, and d_{50} = 0.19 mm with specific gravity of 2.62 was also used in
this study

4. Results and Discussion

The average unit weight of the grouted sand specimens was 118.6 pcf with a std. dev. of 5.25% and a COV of 0.02%. Triaxial UU tests were performed at confining pressures of 5, 10 and 20 psi. A stress-strain relationship of grouted sand is shown in Figure 1 and the failure strains were in the range of 2.5% to 3.5%. The angles of internal friction obtained after 3, 14, and 28 days were 11, 7 and 11 degrees respectively, and the

cohesion were 51 psi (325 kPa), 58 psi (400 kPa)and 49 psi (338.1kPa), respectively (Figure 2).

The P-wave pulse velocity tests performed on the samples just before the triaxial tests and the values measured after 3, 14 and 28 days were $51x10^3$ in/sec (1300 m/s), $55x10^3$ in/sec (1400 m/s), and $51x10^3$ in/sec (1300 m/s) (Figure 3).

5. Conclusion

The pulse velocity, and cohesion, and friction angle of grouted sand remained almost unchanged after 3 days of curing.

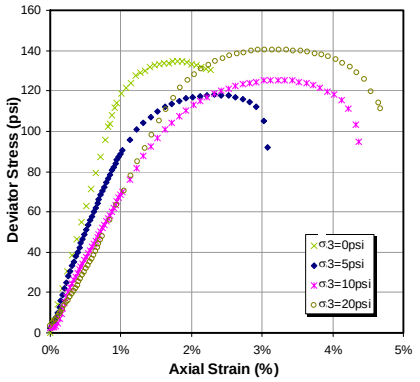

Figure 1 Representative compression stress-strain curves after 14 days of curing

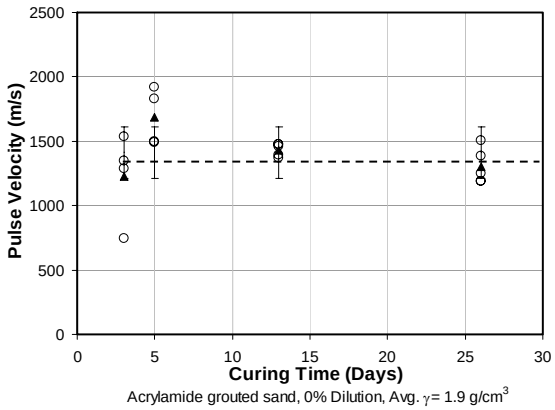

Figure 2 Variation of P-wave velocity with curing time.

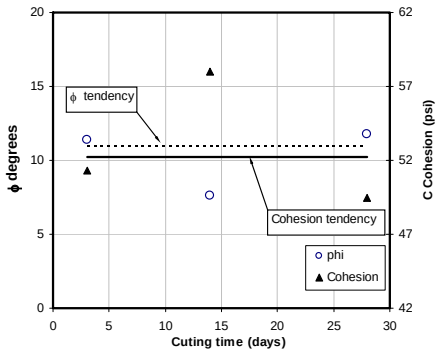

Figure 3 Variation of Cohesion and Internal friction angle with curing time.

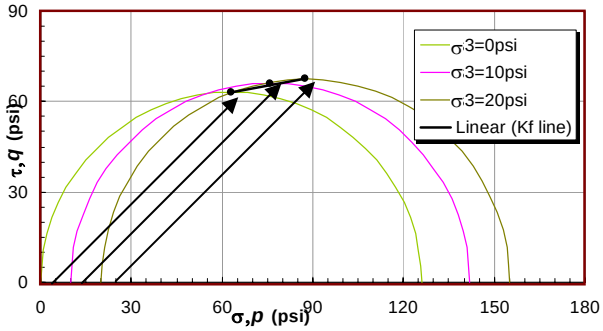

Figure 4 Mohr circles and stress paths of grouted sand after 28 days curing dime

5. Acknowledgements:

This work was supported by the Center for Innovative Grouting Materials and Technology (CIGMAT) with funds from NSF-International and private companies.

6. References:

Ata A. and Vipulanandan C. (2000), "Cyclic and dynamic properties of sodium silicate grouted sand,". J Geotec Geoenv Engng. 126 (7):650-656.

Dano C. and Hicher P.-Y. (2003) "Behaviour of uncemented sand and grouted sands before peak strength,". Soils Foundations J. 43(4):13-19.

Dano C. and Hicher P.-Y. and Tailliez S. (2004),"Engineering properties of grouted sand. J Geotec Geoenv Engng,". 130(3): 328-338.