Filling of Polyurethane with Fly Ash for use in Compaction Grouting

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Abstract
The effects of adding Class F fly ash as a filler to a commercially available polyurethane grout for use in compaction grouting was investigated.

1 Introduction

a) Compaction Grouting:

Historically, compaction grout has used non-expansive materials pumped into the ground at pressures which cause the soil to displace and densify. High pressure used in compaction grouting will not allow for application close to the surface. This will be fundamentally changed in this research, where the focus is to use an expansive grout, where the grout expansion perform the soil densification rather than the external pressure applied during compaction grouting.

b) Polyurethane:

Expansion of polyurethane grout is caused by two simultaneous processes; urethane forming and carbon dioxide (CO_2) generation. The three reactants involved in this process are hydroxyl group ended resin, polyisocyanate, and water (Mattey 2001). Addition of Class F fly ash could significantly alter the behavior of the polyurethane grout (Goods 1998).

2 Objectives

The overall objective was to investigate the potential using fly ash as a filler in polyurethane to develop the compaction grout.

3 Materials and Testing Method

a) Sand Chamber Model Test:

The purpose of the physical model study was to determine the range of soil densification that can be obtained by using polyurethane in compaction grouting. Two CPT sites, diagonally opposite were used to determine the soil density (Shethji 2004). To confirm that the grout densified the soil, not filling the voids, a Plexiglas barrier was installed into the sand chamber with vertical chalk lines along the carrier. The grout will be inserted and the effect on the lines measured.

b) Wet-Dry Cycle Test:

The water absorption during wet and dry cycles for foamed grout was determined by measuring changes in both weight and volume. These measurements were taken while immersing the specimen in water on regular cycles of two weeks, one week for wetting and one week for drying.

4. Results and Discussion

a) Sand Chamber Test Results

The grout bulbs generated had similar shapes and were consistent with the bulbs generated by conventional compaction grouts. It can be observed that expansive compaction grouting performs similar to injection compaction grouting. The relative density improvement was from 65% to 79% for 10/50/10 (Figure 1 and 2). The split chamber test resulted in a 5 inch radius.

b) Wet-Dry Cycle Tests

Sample 10/50/10 average swell was 28% with an average shrink of 0%. Sample 10/30/30 shrank back toward (in some cases, even below) its original volume. The average swell was 25% with an average shrink of -2%. The swelling capacity of the grout showed to be proportional to the volume expansion obtained. The influence of the unit weight in swelling capacity of the grout showed an increase in unit weight relates to a decrease in swelling capacity.

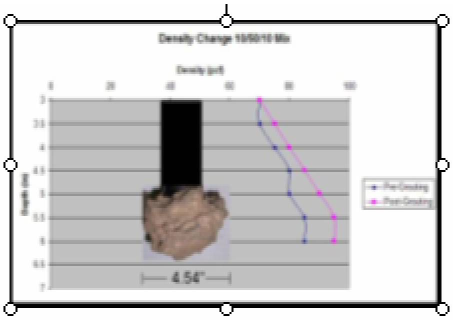

Figure 1. Resulting Soil Densification Measured by CPT for Mix Design 10/50/10

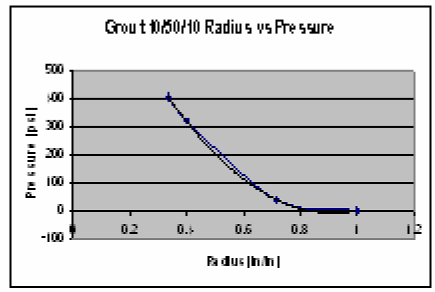

Figure 2. Grout Radius versus Corresponding Expansive Pressure Generated

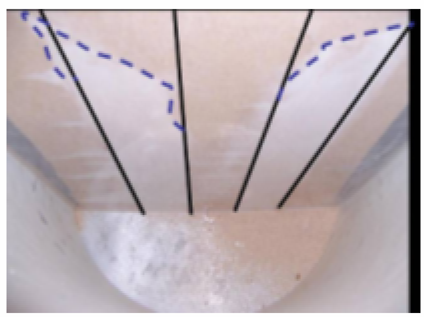

Figure 3. Results from for Split Sand Chamber Test

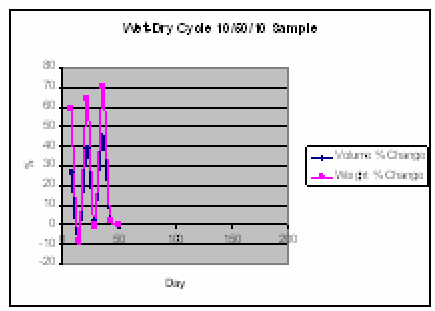

Figure 4. Shrinkage and Swelling of 10/50/10 Specimen

5 Conclusions

Use of expansive grouts for compaction grouting (near surface) was injected using model tests. Preliminary results are showing a promising trend.

6 Acknowledgements

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7 References

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