Review of Compaction Grouting Materials for Soil Treatment

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Abstract

Compaction grouting involves injection of very stiff mortar like grout material to densify the surrounding soil, and the objective here is to displace or replace the soil and compact it in place. Although this procedure has been used there is still room for improving the grout mix, developing the field quality control methods and behavior of grouts under various environments. The composition of the grout material has been reviewed and analyzed in this study.

1. Introduction

The purpose of this study is to summarize the composition of grout materials used and how their properties vary with different mix proportions. The rheological properties of the grout material are regulated by the gradations of the aggregates, silt sizes (including cement particles), and the amount of water added to the material which in turn governs the flowability of the mix. Warner and Brown (1974) suggested a gradation curve for the grout mix according to which sand content should be 70-80%, fines like silt should be about 0-20%, cement content about 12% and the slump was 38-50mm and Bandimere (1997) recommended a new curve based on today's delivery system, typically 50mm lines. As shown in figure 1, the curve allows the use of coarser size particles because tests have shown that use of more particles less than 0.074mm would result in loss of control over grout. The composition of different grout mixes used in a number of projects and recommended in different publications are also reviewed and analyzed.

2. Objective:

The objective of this study is to review the approach used inn selecting the grout material for compaction grouting.

3. Analysis of Discussion

From the analysis of over 20 mixes reported in the literature the following can be summarized:

1. Most of the mixes followed the Warner and Brown gradation curve (1974), with a fraction of particles in the silt range.
2. Out of 20 mixes, 14 used only sand which was about 70-80% of the total grout mix and others had used silt up to 25%.
3. A total of 5 mixes used cement of about 10-12%, 6 used fly ash of about 12 –20%
4. Slump reported for most the mixes was about 1-2 inches with water content of about 10-20%. 12 mixes had either bentonite or kaolonite of about 1.5-10%.
5. Only three mixes have a reported use of ¾ inch aggregates, which was about 10% of the mix.

Figure 1 **Suggested Particle Size Distribution For Compaction Grout Mixes**

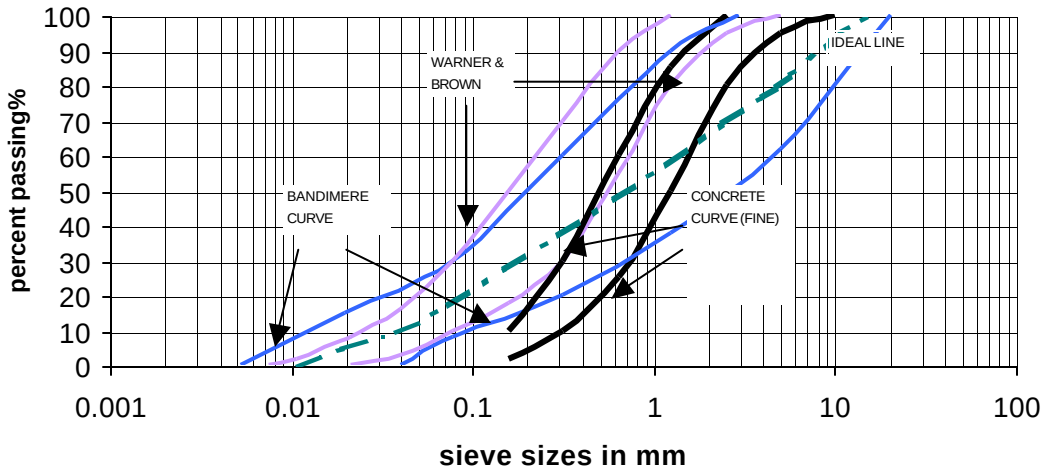

TABLE NO. 1: SOIL PARAMETERS FOR DIFFERENT CURVES

	D10mm	D30mm	D60mm	Cu	Cc
WARNER & BROWN UPPER	0.07	0.30	0.70	9.5	1.73
WARNER & BROWN LOWER	0.02	0.07	0.22	10	1.13
BANDIMERE UPPER	0.08	0.70	4.75	59	1.28
BANDIMERE LOWER	0.02	0.07	0.30	16	0.09
IDEAL CURVE BY BANDIMERE	0.04	0.18	1.40	37	0.62
CONCRETE CURVE (FINE) UPPER	0.30	0.70	1.50	5	1.08
CONCRETE CURVE (FINE) LOWER	0.15	0.30	0.60	4	1.00

4. Conclusion

Compaction grout mixes have been characterized based on particle size.

5. Acknowledgement

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6. References

1) Warner, J., “Compaction Grouting Mechanism –What do we Know” Proceeding: Grouting: Compaction, Remediation and Testing 1997, Geotechnical special publication No66, pp 1-16.
2) Bandimere, S., “Compaction Grouting state of the practice 1997” Proceeding: Grouting: Compaction, Remediation and Testing, Geotechnical special publication No. 66, pp 18-31.

Warner, J.,” Compaction Grouting – The first thirty years”, Proceedings Grouting in Geotechnical Engineering, ASCE 1982, pp 694-707.