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Investigation of Sandy Soils Grouting-ability with Sodium Silicate Chemically Grout

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ABSTRACT

Chemically grouts are usually injected in soils for increasing of strength or reducing of permeability in which suspended grout could not pass through the small voids of soil mass and filteration of grout particle. Chemically grouts are injected easily to voids of soils due to liquidity and non-suspending of them. One of important factors of these grouts is their viscosity in which controls the grouting potential of them, so that increasing of grout viscosity reduces its grouting ability. In this paper the grouting ability of sandy soils with a chemically grout is investigated. For evaluation of the soil grouting potential, samples with 4 cm in diameter and 100 cm in height were constructed and then injected. Sand samples with four different particle size (coarse, medium, fine and silty sand) and three relative densities (loose, medium and dens) were injected by sodium silicate grout with three different viscosities (water to sodium silicate ratio). Tests results showed that, particle size has the greatest effect on the grouting and the other mentioned parameters depend on this factor. Reducing of particle size decreases the grouting potential of soil, so that adding 50 % silt to soil (50 % silt and 50 % sand) impossible to fully grouting of the sample without fracturing the sample.

KEYWORDS

Grouting, Sandy Soil, Sodium Silicate Grout

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1- BRIEF INTRODUCTION

Grouting has been known as a soil remediation technique from more than 200 years ago. Portland cement was the first slurry to be grouted. This grout is a suspended grout and cannot penetrate in very fine voids of soil [1]. Therefore, there is a need to use soluble grouts such as sodium silicate and so on.

Herndon and Lenahan (1976) presented the limitations of soil grout-ability considering the particles size of soil [2]. Bell (1993) and Incecik and Ceren (1995) investigated the soils grout-ability regarding only the soil and grout particles size [3 and 4]. However, the large scale tests have shown that the soil grout-ability is a function of different parameters of soil and grout including soil and grout particles size, soil fine content, grout pressure, soil relative density and grout water to cement ratio [5, 6 and7].

Previous studies have evaluated the soil grout-ability by suspended grouts. Dno et al. (2004) studied the engineering properties of grouted sands by very fine Portland cement [8].

Ata and Vipulanandan (1998 and 1999) studied the effective factors on the mechanical and creep properties of grouted sand with sodium silicate chemical grout [9 and 10]. In addition, Hassanlourad et al. (1388) investigated the effective parameters on the shear strength of grouted sand using sodium silicate grout [11]. Later authors performed a series of triaxial tests on the grouted sand samples [12 and 13].

The range of sodium silicate grout-ability in soils has been reported quality in the literature [14]. This is studied in detail in this paper, and the effect of parameters like soil particle size, soil compaction, water to sodium silicate ratio of grout and grout pressure are evaluated experimentally.

2- METHODOLOGY

One silicate sand was used with four different particle size distributions including coarse, medium, fine and silty sand (%50% finer than 0.075 mm).

Sand test samples were prepared with three relative densities of 30, 50 and 90 percent and then injected by sodium silicate grout. Water to sodium silicate (W/S) ratio of the grout was assumed as 0.33, 1 and 2. Grout pressure was adjusted from 120 to 420 cm.

3- MAIN CONTRIBUTIONS

In this paper, some injection tests were performed on the sandy soil. Sodium silicate grout was used for injection. Tests results showed that:

The sodium silicate grout with W/S of 0.33 to 2 is able to be grouted from coarse to very fine sand and even silty sand.

The finer the particles, the smaller the soil internal voids and the lower the grout-ability of soil.

Adding the silt to sand rapidly reduces its grout-ability. Increasing the grout pressure for extra penetration in soil resulted in hydro fracturing and soil disturbance.

Adding the soil compaction adds the necessary grout pressure, however, the effect of compaction is not very effective for the medium and fine-grained sand, and silt size particles rapidly reduce the compaction effect.

Increasing the W/S or concentration of grout decreases the soil grout-ability. The finer the soil, the lower the grout concentration effect.

Overall, the soil particles size is the most effective parameter on its grout-ability and the other mentioned parameters effects are dependent on the soil particle size.

Based on previous reports, the limit of sodium silicate grout was fine-grained sand; however, the results of tests showed that it is possible to inject this grout into silty-sandy soil.

4- SIMULATIOBN RESULTS

The injection radius for three medium, fine and very fine (silt-sand) samples is shown in Fig. 1 as an example. As illustrated in this figure, the finer the soil grain size and the lower the grout W/S ratio, the lower the injection radius. ژ

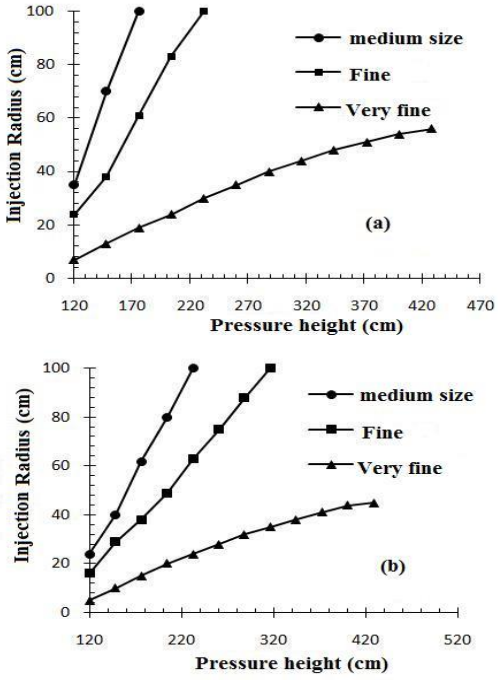

Fig. (1): Injection radius versus grout pressure for three sands with different grain sizes, (a) W/S=1 and Dr=%50, (b) W/S=0.33 and Dr=%50

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