Engineering Behavior of Sand Reinforced with Silt

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Abstract**—** *Many studies have been conducted these last years to investigate the influence of randomly oriented fibers on the mechanical behavior of soils. Yet, few or no studies investigate the influence of Silt on the mechanical behavior of Sand. Therefore, this experimental work has been performed to investigate the influence of Silt on the mechanical behavior of Sand. This experimental work was conducted while using Oedometric apparatus and Proctor mold. The aim is to gradually increase the Silt percentage (0%; 25%; 50%; and 75%) in the Sand and to gradually investigate its mechanical behavior. For all tests, Compaction and Oedometric curves were derived and their results were compared. The results proved that inclusion of Silt affects compaction and Oedometric behaviour of Sand.*

Keywords— Sand, Silt, Proctor test and Oedometric test.

I. INTRODUCTION

In the laboratory, sand is considered like the sliding materials and almost without cohesion with high permeability. However, silt is considered as coherent materials and almost impermeable. For construction, engineer needs intermediate materials (which are not completely permeable and which are not completely impermeable).This intermediate domain is considered as an unsaturated domain and such domain relates to several applications in geotechnics. During these last years, several studies carried out to shear box to the Oedometer and triaxial, were devoted to the study of the behavior of unsaturated soils [1] and [2] conducted a series of tests using direct shear on dry sand reinforced with synthetic, natural and metallic fibers, in order to determine the effect of parameters such as fiber orientation, fiber content, fiber area ratio and fiber stiffness. [3,4,5,6] They also conducted triaxial compression tests on sand reinforced with randomly distributed fibers and observed the influence of various fiber properties, soil properties and other test variables. [7] They conducted an experimental and analytical study based on homogenization technique to evaluate the effect of fiber inclusion on strength of sand. Based on the test results they concluded that increasing the shear strength is directly proportional to the fiber area ratio. For sand reinforced by the fiber, the results showed maximum confining stress. [8] They conducted a laboratory unconfined compression tests on sand specimens reinforced with randomly oriented discrete fibers to isolate the effect of each variable on the performance of the fiber-reinforced material. The results showed that the inclusion of randomly oriented fibers significantly improved the unconfined compressive strength of sands. A maximum performance was achieved at a fiber dosage rate between 0.6 and 1.0% dry weight. When the inclusion of up to 8% of silt does not affect the performance of the fiber reinforcement. [9] This paper aims to study effect of fiber inclusion on compaction characteristic of composite soil (i.e. silty sand composite). A series of laboratory tests are carried out to evaluate fiber effect on optimum water content and maximum dry unit weight of composite soils. The results proved that inclusion of fiber affected compaction behaviour of samples so that increasing in fiber content and length caused increasing in Optimum Moisture Content (OMC) and slightly decreased maximum dry unit weight. This paper aims to investigate the influence of Silt added on the mechanical behavior of sand.

II. MATERIALS AND METHODS

2.1. PLACE OF SAMPLING

The silt used in this work comes from a town of Bangui (Central African Republic). This soil was taken from the depth of 2 - 3,5 m.

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Fig.1: Image of sampling location

2.2. CLASSIFICATION OF MATERIALS

According to Unified Soil Classification System (USCS), the soil used in this study was classified as Low Plasticity Silt (ML). Tables 1, 2 show the properties of the silt and Sand.

TABLE 1. PROPRIETIES OF THE SOIL

Property	Value
Fines Content (%)	92
Liquid Limit (%)	35
Plastic Limit (%)	25,7
Plasticity Index (%)	9,3
USCS and TS Classification	ML

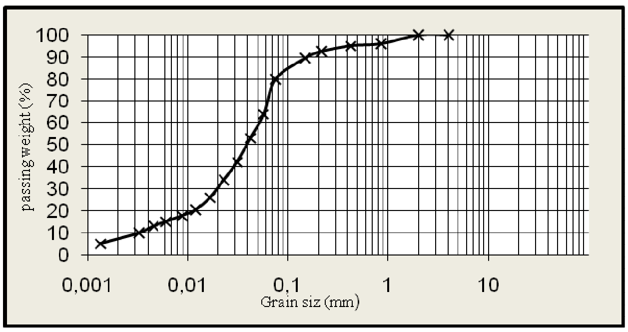

Fig.2: Sedimentometric Curve of Silty soil

TABLE 2. PROPRIETIES OF THE SAND

Propriety	Value
Density of solid grains ρs(g/ cm3)	2,72
Dry density ρs(g/ cm3)	1,74
Void ratio e (%)	56,40
Porosity n (%)	36,03

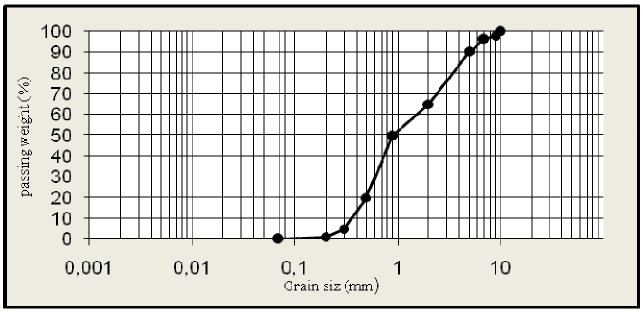

Fig.3: size distribution curve of the sand

For this study, two types of samples (Silt) were collected (intact sampling and revamped). Intact sample refers to the Oedometric tests and revamped sample is related to Proctor tests. For Proctor test, approximately 2.5 kg of materials were taken. The quantities of water proportional to the weight of the materials were added and the standard Proctor mold was filled with three layers of materials. For each layer, the compaction was made by means of a vibro compactor. After compacting the three layers, an amount of about 100 g of materials was taken and filled in the oven for the determination of different moisture contents. The Proctor test was performed according to standard (ASTM D 698).

The Oedometric test was performed according to standard (ASTM D 2435). This test was carried out first on the sand and after the sand mixed with silt. After mixing the sample was placed in the cell between two porous stones. The assembly was placed into a loading frame. The weights are gradually placed on the chassis, and the loads were imposed on the sample. The compression of the sample is measured over time by an indicator. By observing the value of the deviation from the time data, the consolidation of this sample was determined. Once the consolidation is completed, the discharge of the applied weight was made.

III. TEST RESULTS AND DISCUSSIONS

3.1. PROCTOR TESTS

The Proctor tests were carried out firstly on the sand and after the mixtures (25%, 50%, and 75%) of silt. The results of these tests were shown in Fig IV.

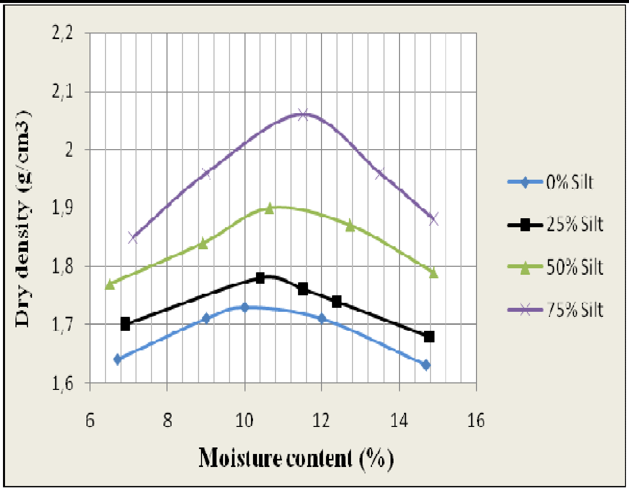

Fig.4: Proctor curves

The result of the Proctor test shows a significant variation when the percentage of silt increases. Proctor curves show a progressive increase of the optimum water content from the sand to the mixing (75% silt - 25% sand). The increase indicates a sensitivity of materials in the presence of water when the percentage of silt increases. There has also been an increase of the maximum dry density when the percentage of silt increases. This explains the increase cohesion in the materials.

3.2. OEDOMETRIC TESTS

The Oedometric tests were carried out firstly on the sand and after the mixtures (25%, 50%, and 75%) of silt. The results of these tests were shown in Fig V.

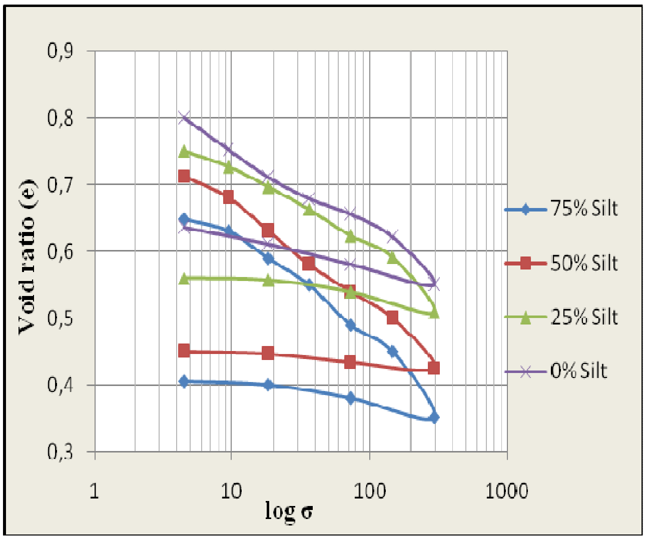

Fig.5: Oedometric curves

We find that the void ratio decreases when the percentage of silt increases in the mixture. These results show that the voids existing in the sand were filled by silt particles. The increase silt also increases the deformation of the mixture and reduces its stiffness.

IV. CONCLUSIONS

Based on the present investigation it is concluded that Engineering Behavior of Sand was affected when we added gradually a quantity of Silt. When the Silt content increases, the optimum water content and the maximum dry density value of mixture also increase. It also concluded that there are significant effects on the void ratio in the sand. When the Silt content increases, the void ratio value of mixture decreases.

V. ACKNOWLEDGMENT

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