EVALUATION THE INTERFERENCES OF STABILIZED ORGANIC-CONTAMINATED CLAY SOIL USING HARDENING TEST

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Abstract: Organic soil is a non-homogeneous soil produced as a result of biodegradation of organic matter such as plants, leaves and stems. Increasing the soil's organic content led to changes in the technical nature of the soil. Soil of organic is mostly considered to be the intricate soil at any construction project, due to its very low shear strength and high compressibility. It objects this study was to evaluate interference of organic contaminated clay soil by Stabilization/ Solidification technique (S/S). In this work, sewage sludge was applied as an organic material for different percentages (7%, 14% and 21%) of contaminated soil. The organic soil was treated using cement at (0%, 3%, 6% and 9%) by dry weight. The strength of hardness of the stabilized soils with the effect of organic materials were tested using hardness test at three curing times 7, 14 and 28 day; Based on this results from hardness characteristics strength of the stabilized organic soils, cement was the most effective stabilizer than styrene in terms of improving the strength of organic treated soils.

Keywords: *Organic soil, stabilizer material, strength, hardness test.*

1. Introduction

At specific areas were there various percentages from low to middle organic content in soil. The organic content within the soil perhaps because the humic and non-humic material found at soil;

from a point of view of geotechnics, organic matter presences in soil has ever been a problem of engineers caused unpredictable behavior [1]. In soil, the organic material is found from decomposition of plant and animal waste. When this material is introduced into soil, it is attacked through various insects, worms plus microbes in a soil if the land is wet [2]. This problem is that public trends cannot be stated between the behavior of soil properties and material of organic as it rely on several parameters such as organic matter type, clay content, structure for soil, total impact of organic matter, environmental status and etc. [1]. Most studies have investigated the behavior of organic soil; this behavior is characterized by weak shear strength, high compressibility and high magnitude and creep rate [2].

From studies conducted on different organic matter, Varghese [1] stated, while even the tiny amount from organic content about 3-4% can influence the soil geotechnical characteristic.

Ekwue [3], state that organic matter effects at shear strength for soil rely on whether or not, it get better stability from soil aggregate.

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Adejumo [4], Suggested, when the organic content value within soil is range among (6 and 20) percentage, this effected on soil properties however its behavior remains the same as mineral soil: organic silts / clay and if soils organic content ranges from 21 till 74%, that organic material rule soil properties. Adejumo [4] examined twenty-three Illinois soils; these found the plastic and liquid limits increased linearly to increase content of organic carbon; such result was come by Thiyyakkandi and Annex [5]. Conducted Song et al. [6] research by soils of solid waste into utilize as sub-base matter during road construction and found that together with raise in organic matter content, the curve of compaction tend to be located under and to curves right. Zbar et al., [7] studied the effects from organic matter (drying beds of waste water treatment plant of Rustomyia) on clayey soil; it concluded that; the maximum dry density with best water content decrease with the increase in organic matter because low of specific gravity. Sadiq [8] showed that the organic content functions a signification function on decrease maximum dry density and rising optimum water content. Like result was come via Habbi [9].

improvement of organic soil can represent through exchange the existing soil for excellent materials or variation the soil engineering properties in accordance with standard requirements via adding material other which known as stabilization of soil [10]. Methods of chemical stability have been offered to supply overall settlement and differentiation, increase in strength of soil, reduction in build costs, shortly construction time, in additional another features that might affect their operations at specified projects in organic soil.

2. Materials and Methods

2.1. Materials

Silt Clay: it took from Alkraiati region and utilized as the soil mass.

Organic Materials: raw sewage sludge applied as an origin from organic matters is taken of Rostomya at Baghdad city.

Cement: it took from local markets and utilized as the treatment material.

2.2. Methods

2.2.1 Soil specimen prepared

The specimen of soil was air-dried, grind into smaller sizes using soil mechanical grinder, and sieved through a 2 mm sieve according to ASTM standard. The sieving was performed to ensure that the soil was of uniform grade, then it preserved in clean plastic bags prior to soil analyzing and contamination. The soil samples were mixed by mixing dry silt clay with sewage sludge at different percentages (7, 14 and 21) % by dry weight of soil. The sewage sludge spiked soil was kept in close bucket and allow to physical and chemical behavior of sewage sludge through the soil for duration of seven days. Next the period of soaking, the samples air-dried, grind and sifted. The soil samples were contaminated with sewage sludge as explained previously. Then different percentages of (0%, 3%, 6%, and 9%) of stabilizers (cement(C), and styrene acrylic(St)) were added to the contaminated soil (the percentage added according to the weight of contaminated dry soil). The required optimum water content added to the soil in the case of styrene acrylic was based on fluid content of the mixture (water + styrene). After that, the contaminated soil and stabilizer were mixed for some time until the mixture has a homogenous and uniform appearance. The amount of stabilizer and water was determined from following formulas in eq [11]:

Amount of stabilizer =
 $\text{stabilizer percentage} \times \text{dry soil weight}$
 (1)

Amount of water =
 $\frac{\text{weight of dry soil and stabilizer} \times \text{optimum water content}}{100}$

(2)

2.2.2 Laboratory Test

The classification and physical properties for silt clay are examined at the soil laboratory/college of engineering in Al-Mustansiriayah University as observation in “Table 1”, sewage chemical properties and cement are tested in General Company of Geological Survey and Mining as shown in “Tables 2 and 3” respectively.

Table 1. physical and classification properties of soil		
properties	value	Standard
Specific Gravity (Gs)	2.7	ASTM D 854-00
Liquid Limit (L.L)%	46	B.S.1377:1975
Plastic Limit (P.L)%	24	B.S.1377:1975
Plasticity Index (P.I)%	21	
Maximum dry unit weight yd max. (kN/m ³)	15	
Optimum water content (%) (o.w.c)	19	ASTM D698-78
Unified Soil Classification System (USCS)	Silt Clay	ASTM D2487-06

Table 2. Chemical composition of sludge	
Structure of Chemical	Proportion through weighing
CaO%	16.54
SiO ₂ %	15.85
Al ₂ O ₃ %	3.454
Fe ₂ O ₃ %	3.415
Na ₂ O	1.928
SO ₃ %	4.299
MgO %	2.026
P ₂ O ₅ %	0.889
Other elements %	1.629
Total	50.03

Table 3. Chemical composition of cement	
Structure of Chemical	Proportion through weighing
oxide calcium %	67.87
SiO ₂ %	18.34
Al ₂ O ₃ %	2.646
Fe ₂ O ₃ %	5.534
Na ₂ O %	1.498
SO ₃ %	3.100
MgO %	1.048
P ₂ O ₅ %	0.0643
Other elements %	2.546
Total	100

2.3 Hardness Test

The digital shore-D durometer is general utilized for measurement the rubber hardness according to ASTM. it be performed to measure the hardness organic soil with stabilizer to determine the hardness and strength soil sample (27 sample) examined in this research after 7,14 and 21 day of curing period. Three samples of each percent of addition of the three stabilizers were tested to increase the accuracy of the tests.

3. Results and discussion

Digital Shore-D durometer was applied in this study for hardness test. The samples were prepared for organic –clay soil mixture with addition of different contents of both of cement and styrene acrylic at (0%, 3%, 6%, and 9%) along curing times (7, 14, and 28 days). The results of this test are shown in the figures 1, 2 and 3.

Figure 1 The degree of hardness of 7% Organic Soil with stabilizers percentage.

Figure 2 The degree of hardness of 14% Organic Soil with stabilizers percentage.

Figure 3 The degree of hardness of 21% OS with stabilizers percentage.

We were observation during the previous figures that an increase the content of organic within the soil leads for a decrease at hardness strength; as during 7 days the rate of increase in strength is comparable to the original sample with raise continue until it reaches 14 days where the highest value in this period is then begins to decrease at the 28 days. It can be seen, the cement appears the higher in its hardness for all addition percentages (3%, 6% and 9%) and the styrene acrylic has the lower hardness. Higher hardness reasons were in the specimens with cement, first: is the pozzolanic reactions that produce a cementitious bond between soil mineral substance and second: the cement works increasing the cohesion of soil particles (Kasama et al, [12]). Another reason, (Chen and Lin, [13]) observed that, which caused drop in strength with increasing the sewage sludge; it was because the materials of pozzolanic within sewage sludge, the hydrated cement product and hydroxide of calcium (CH). High values were obtained in the hardness test of samples containing low percentages of organic matter.

4. Conclusions

Cement and styrene acrylic are considered as stabilizers of contaminated land, since they can reduce the mobility of contaminant soils. Twenty-seven tests were performed using

“hardness” device to investigate the influence of these stabilizers on the resistance of organic soil strength. The results indicated that the strength of organic soil reduced together with rising curing period to a same stabilizer percent. Best percentage of increase was in cement by 3% at organic soil 7%, while 9% was cement when at organic soil (14 and 21) %. The best ratio of styrene was 9% for all organic soil ratios.

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Conflict of interest

There are no conflicts to declare

5. References

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