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Observation of the Behavior of Organic Soil by Adding Lime, Fly Ash and Cement

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ABSTRACT

Organic soil is a kind of soil that contains organic matter. Soil organic matter (SOM) is that kind of organic matter of soil, which consists of different ingredients such as plants, animal residues, cells and tissues of soil etc. at various stages of decomposition. Normally organic soils are rich in water content with high porosity and therefore successful stabilization has to depend on the type and amount of binder added. The commonly used binders are lime, fly ash and cement. This study reveals the variation of behavior of organic soil-lime, organic soil- fly ash and organic soil-cement mixtures at an amount of 5%, 10%, 15% and 20 %. The maximum shear stress and maximum angle of friction were found for 10% cement mixed with soil.

Keywords:- *organic soil, shear stress, angle of internal friction*

INTRODUCTION

Organic soil is a soil that is created by the decomposition of plant and animal materials to create a nutrient and mineral rich mini-ecosystem with microorganisms that feed and breathe life back into the soil. Organic soil contains carbon-based material that is living or was once living. The soil particles may contain organic matter and is not suitable as a construction material or as a foundation of structures. According to the American Standard for Testing and Material (ASTM), organic soil is a soil having organic matter content (OMC) of more than 25% [1]. It is generally formed under anaerobic conditions through the action of fungi, bacteria, and chemical compounds on plant compounds on plant remains [2-4]. Presence of organic matter in organic soil may influence many of the physical, chemical and biological properties of soils such as soil structure, soil compressibility and shear strength. Organic soil should be stabilized before use. Soil stabilization means chemical or mechanical treatment designed to increase or maintain the stability of a soil mass or otherwise to improve its engineering properties, as by increasing its shear strength, reducing its compressibility, or decreasing its tendency to absorb water. Usually, lime, fly ash, cement etc. are used to stabilize the soil. These elements have binding property that increases the cohesion between inter molecular particles. This study includes whether adding fly ash, cement or lime has any effect on different engineering properties of organic soil and if it is whether it is positive or negative.

METHODOLOGY

For this research, samples were collected from a plant nursery. Later the soil was prepared for mixing admixture and conducting tests by grinding and sieving. Then lime, fly ash and cement were mixed with the soil in proportions of 5%, 10%, 15% and 20%. After that, different laboratory tests such as direct shear test,

unconfined compressive strength test and specific gravity test were conducted according to American Society for Testing and Materials (ASTM) in the Geotechnical Engineering Lab of AUST.(Figure 1)

Fig.1: *Soil sample preparation*

LABORATORY TEST RESULTS

The different laboratory test results of organic soils with admixtures are given below:

Direct Shear Test

The values of normal stress and shear stress for lime, fly ash and cement mixed organic soil are given in the following Figure 2, 3 and 4 respectively.

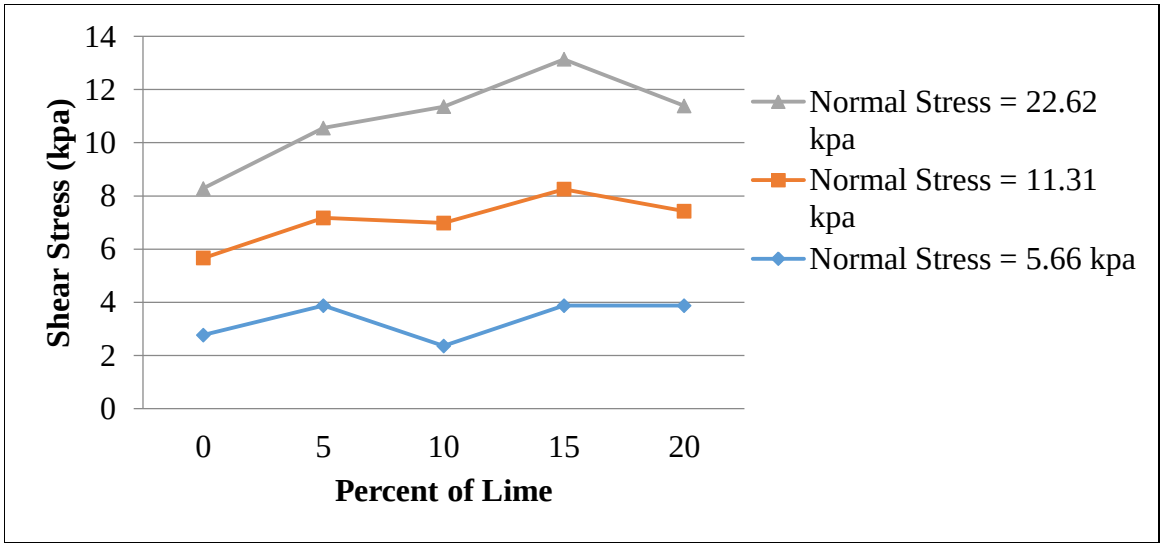

Fig.2: *Variation of shear stresses when organic soil mixed with lime*

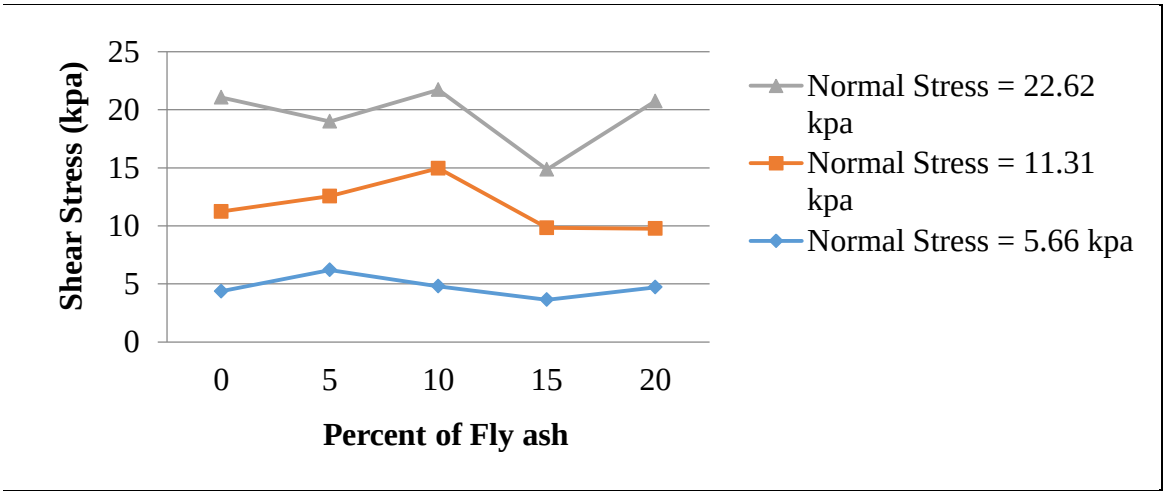

Fig.3: *Variation of shear stresses when organic soil mixed with fly ash*

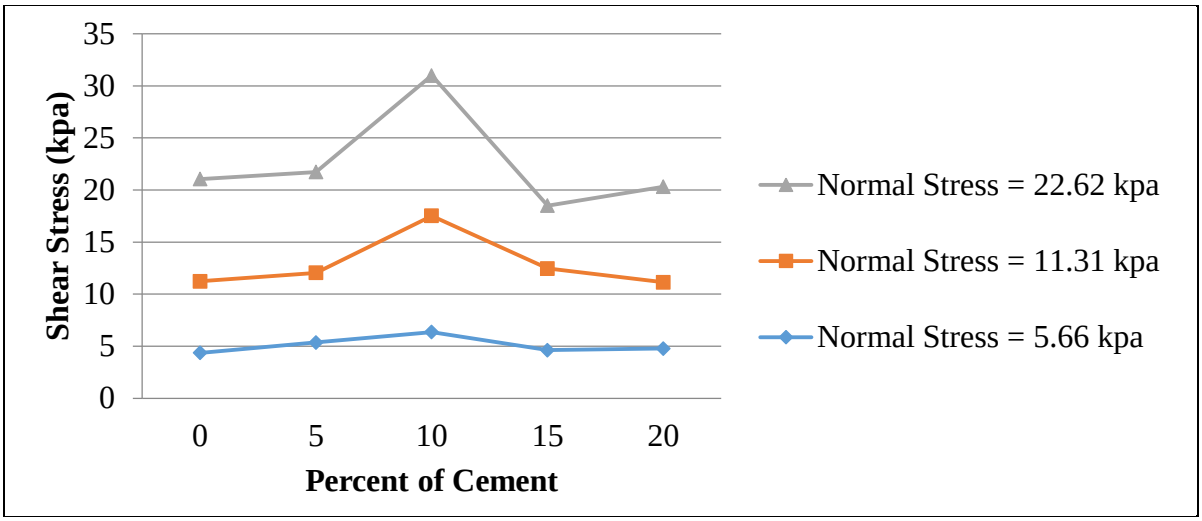

Fig.4: *Variation of shear stresses when organic soil mixed with cement*

It is seen that there was a gradual increment of shear stress in case of lime mixed soil and the maximum value was found for 15% lime. Fly ash showed different scenario. Gradual increment and decrement was found for fly ash. On the other hand cement mixed sample gave the maximum value for 10% cement.

Angle of internal frictions (φ) was determined from shear stress vs. normal stress graph for each sample. Figure 5 shows and summarize the value of angle of internal friction (φ) for the above stated soil samples mixed with lime, fly ash and cement.

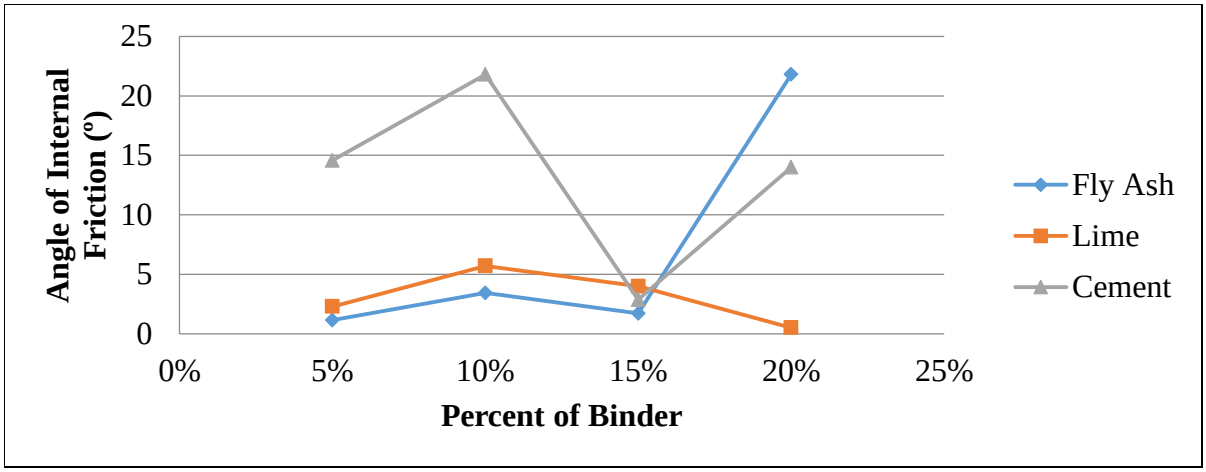

Fig.5: *Variation of angle of internal friction with percentage of binder*

The angle of internal friction increased in 10% and again gradually decreased at 15% and 20% for lime. With the increase of fly ash in organic soil, angle of internal friction suddenly raised at 20%. On the other hand, there was a variation of angle of internal friction with the increase of percentage of cement with organic soil. Angle of internal friction highly decreased at 15% but there was rapid rise of angle of internal friction at 10% and 20% of cement.

Unconfined Compressive Strength Test

The variation of unconfined compressive strength with percentage of binder is shown in the following Figure 6.

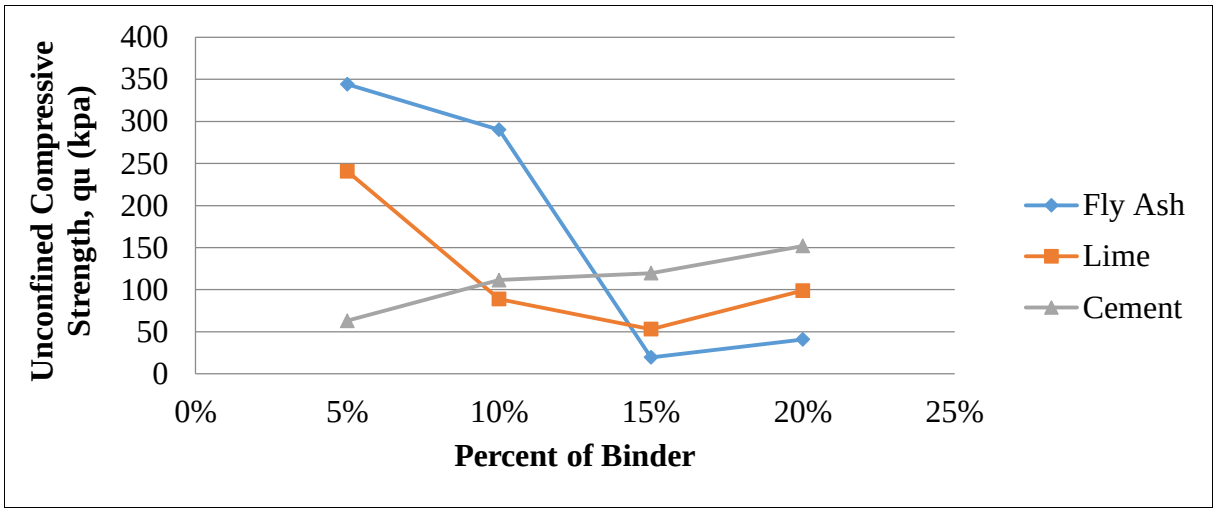

Fig.6: *Variation of unconfined compressive strength with percentage of binder*

Figure 6 shows that the unconfined compressive strength decreased with the increase of fly ash and lime with percentage of 5%, 10%, 15% but increased at 20%. Unconfined compressive strength increased gradually with the increase of cement mixture.

Specific Gravity Test

The variation of specific gravity with percentage of binder is shown in the following Figure 7.

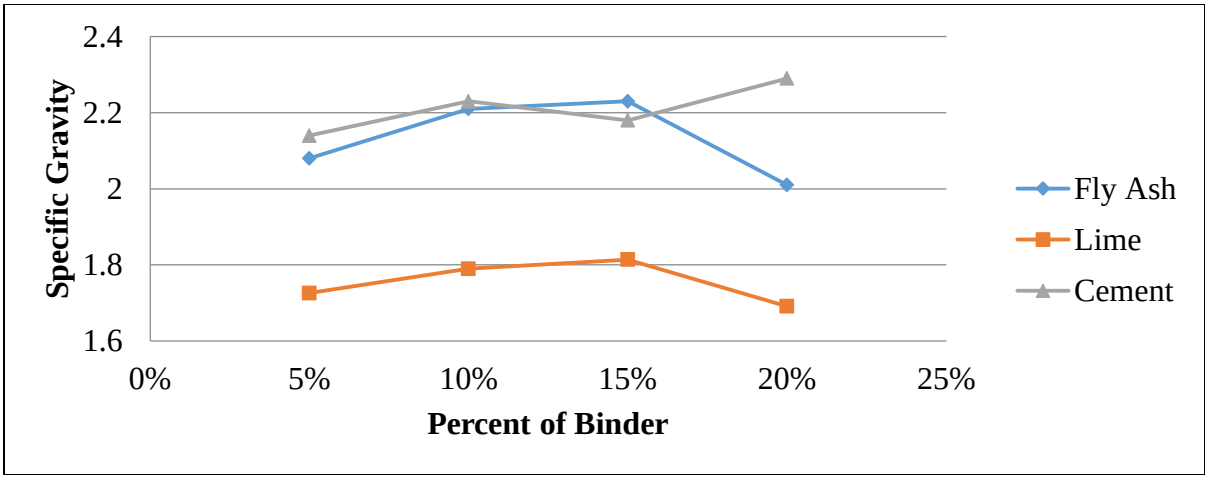

Fig.7: *Variation of specific gravity with percentage of binder*

Figure 7 shows that the specific gravity increased with the increase of fly ash and lime but at 20% both values of specific gravity decreased whereas for cement specific gravity increased slightly at 10% and 20% but decreased at 15%.

CONCLUSIONS AND RECOMMENDATION

Lime stabilization is an economical way of soil stabilization. Normally lime modification increases strength of soil. In this research, the maximum stress was found for 15% lime mixed with organic soil. The effect can be brought by either quicklime, CaO or hydrated lime, Ca (OH)2. Generally, fly ash has little cementitious properties compared to lime and cement. Our research did not show satisfactory results for fly ash. On the contrary, cement reaction is not dependent on soil minerals, and the key role is its

reaction with water that may be available in any soil. On this research, the maximum shear stress and maximum angle of friction were found for 10% cement mixed with soil. The ultimate effect on setting and gain in strength of cement-stabilized soil must consider during mix design in order to achieve the desired strength as these may vary depending on various factors involved.

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