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Investigation of Charcoal Mix on Unconfined Compressive Strength of Soil

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ABSTRACT
Availability of good soil is very much essential for building modern infrastructure. All structures built on soil due to its infinite extent. Thus, it need due consideration in the selection of sites with good soil. The health of soil can be best represented by evaluating its strength parameters. Hence, in this study, the unconfined compressive strength is considered as a medium to represent the soil strength. Soil charcoal mix in various proportions were tested and analyzed for the comparative study. The amount of soil that can be replaced by the charcoal with maximum compressive strength is observed as the optimum.
KEYWORDS – Unconfined Compressive Strength, Charcoal, Laterite soil, Optimum.

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I. INTRODUCTION

For the development of the infrastructure of a community, many important engineering decisions have to go hand in hand. The soil characteristics are thus need due consideration as it is considered as the supporting medium for every Civil Engineering structures. All the structures are founded on or below the surface of earth. In order to be aware about the suitability of soil as a construction material or as a foundation, various properties need to be studied. The stability of civil engineering structures depends on the geotechnical properties of soil, which in turn related to the physical characteristics of the soil.

The strength of soil in terms of Unconfined Compressive Strength is studied with the use of laterite soil as the sample. On the addition of coconut shell charcoal in various percentages by weight of soil, changes in strength characteristics were obtained. Soil health is best represented by soil carbon and its deficiency leads to soil degradation. Charcoal is added to soil in order to improve productivity. Charcoal has good adsorption capacity due to its highly porous structure.UCC test on soil charcoal mix showcases various mix characteristics and ultimately to the best result through optimum percentage of charcoal.

II. MATERIALS

2.1 Laterite soil

Laterite is a soil found in hot and wet tropical areas. This soil is rich in iron and aluminium. Laterite soil has deposits of Iron Oxide, so they appear in rusty – red colour. Laterite soil is developed by the process of weathering of the underlying parent rock. The land area between Tropics of Cancer and Capricorn contain huge deposits of Laterite soil.

2.2 Coconut shell charcoal

Charcoal can be produced by various means. Coconut shell can be used to make charcoal. The charcoal thus produced is known as activated charcoal. Charcoal is extensively used in many industries due to its high adsorbing nature of different chemicals and ions. Charcoal is brittle and porous in nature. It is a bad conductor of electricity thus acts as an insulator.

Table1. Composition of charcoal

COMPOSITION	VALUES
Fixed carbon	78%(minimum)
Volatile matter	15%(maximum)
Ash	2%(maximum)
Moisture	10%(maximum)

III. EXPERIMENTAL INVESTIGATION

The basic physical properties of laterite soil were determined by conducting various laboratory tests. The moisture content of the collected sample was found by conducting oven dry method and pycnometer using air dried sample. Specific gravity

of the sample was identified by oven dried sample tested with pycnometer.The grain size distribution pattern of the sample collected for the project was analyzed by plotting particle size distribution curve. The distribution curve shows that the soil sample belongs to well graded category.

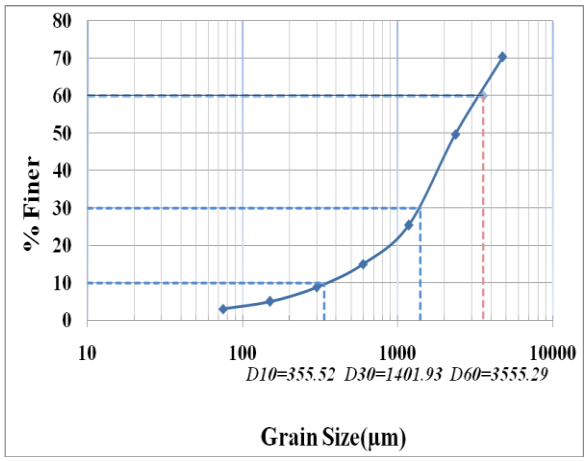

Figure 1- Grain size distribution curve

The permeable property of soil can be determined by constant head permeability test for coarse grained soil and falling head permeability test for fine grained soil .The values obtained by conducting constant and falling head permeability test shows that the laterite sample falls within the permeable category. The maximum dry density and optimum moisture content was found out by standard proctor test. The OMC value from this test was used to conduct UCC test.

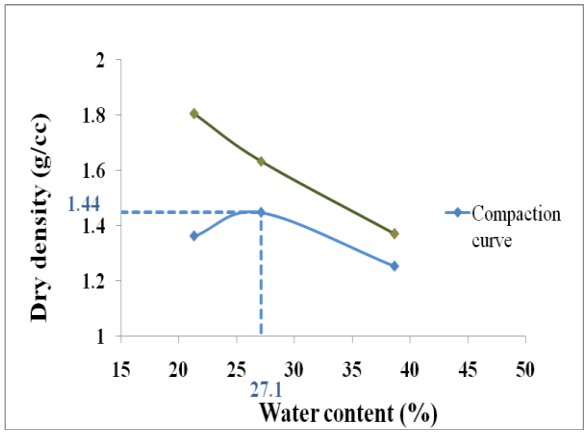

Figure 2- Compaction curve

Table2. Properties of laterite soil

PROPERTIES	VALUES
Water Content	13.69%
Optimum Moisture Content	27.1%
Specific Gravity	2.98
Maximum Dry Density	1.447g/cc
Coefficient of Uniformity	10
Coefficient of Curvature	1.55
Unconfined Compressive Strength	225.691kN/m^2
Permeability – Constant head	$18.1*10^{-3}$ cm/s
Permeability – Falling head	$1.905*10^{-3}$ cm/s

UCC test is a simple laboratory test to find the mechanical properties of soil. The maximum compressive strength of the sample can be identified by plotting stress-strain values obtained by testing the sample. To compare the variation of strength of normal soil and charcoal mixed soil, charcoal and soil are mixed at various proportions.

Figure 3- Sample testing

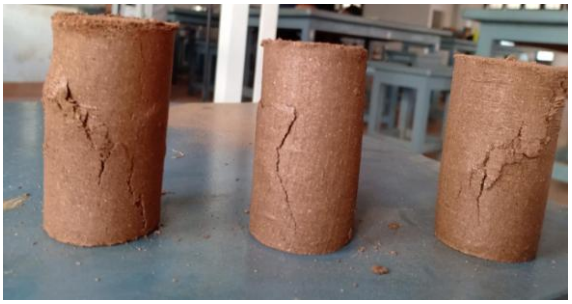

Figure 4- Tested samples

The charcoal is added in four different percentages. The soil is replaced with the selected percentage of charcoal by weight of soil and prepared for UCC test with cylindrical samples having size of 37 mm diameter and 76mm height. The test results for 1%, 2%, 3%, & 4% of charcoal is tabulated and stress- strain graph is plotted to get the maximum compressive strength of each sample.

Table3. Strength comparison

% of charcoal by weight of laterite soil	Maximum Compressive Strength Obtained (kN/m^2)
0%	225.691
1%	228.180
2%	250.560
3%	277.206
4%	238.920

The variation of strength with different percentage of charcoal is plotted. The graph shows increment in % in x axis and compressive strength in kN/m^2.

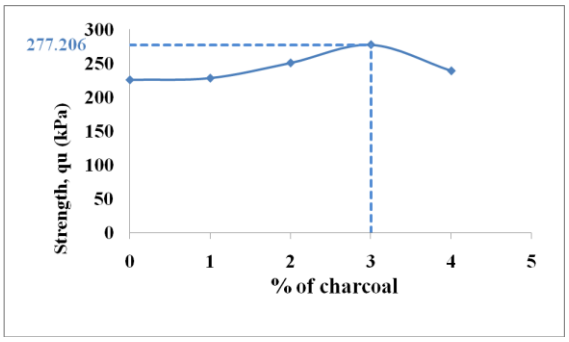

Figure 3- Strength vs. % charcoal graph

IV. RESULTS AND DISCUSSIONS

The most important physical characteristic of activated charcoal is its particle size, which has a great influence on its adsorption capacity. Activated charcoal is an excellent adsorbent because of its large surface area and having high porosity. It is used for wide range of applications for the removal of organic or inorganic compounds. Charcoal is easily available and obtained from pyrolysis of coconut shell.

From the graph, it is clear that the strength of soil increases upto 277.206 kN/m^2. With increase in % of charcoal till 3% and decreased by the further addition of charcoal. Hence the optimum percentage of charcoal was found to be 3%.and the soil can be replaced with 3% of charcoal without compromising the strength of laterite soil.

V. CONCLUSION

From this experimental data, physical properties and strength properties of collected soil sample were obtained by conducting laboratory test. The compressive strength of the soil sample with different percentage of charcoal was conducted. The strength of collected soil sample is increased by the addition of activated charcoal and attains optimum compressive strength at 3% addition of charcoal. After attaining optimum strength, the strength of the soil is decreased by further addition of charcoal.Through this comparitive study, it is found that about 22.83% of strength of soil get enhanced by the addition of 3% of charcoal as compared to normal soil.Charcoal also influenced the physical properties of collected sample and hence the properties of sample were improved.

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