IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684,p-ISSN: 2320-334X,
PP 08-11
www.iosrjournals.org

Comparison Between Paper Sludge And Rice Husk Ash As A Stabilizing Agent For Soft Soil

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Abstract: *Soil stabilization is the alteration of property of locally available soil to improve its engineering performance. Stabilization can increase the shear strength of soil and control shrink – swell properties of soil, thus improving the load bearing capacity of a sub grade to support the pavements and foundation. The objective of this paper is to expose the possibilities of paper sludge and rice husk ash in soil improvement and comparison of the results. Both paper sludge and rice husk ash are waste materials which cannot be disposed easily. The main objective of this paper is to check which stabilizing agent will give more strength. This paper involves the detailed study with various tests such as initial soil properties and to check the strength achievement through unconfined compression test.*

Keywords - *Paper Sludge, Rice Husk Ash (RHA), Unconfined Compressive Strength (UCC)*

I. Introduction

In situ improvement of soil properties using additives is commonly referred to as soil stabilization, which is often used with fine soils. Indeed, soil stabilization is a process whereby natural or synthetic materials are added to soil improving soil properties. It is typically used to modify and improve low-quality materials, which brings about changes in soil properties including decreased rate of subsidence, decreased adhesion coefficient in soils with high cohesion (clay), increased adhesion coefficient in soils with low cohesion (sand), reduced percentage of water absorption and prevention of soil expansion, reduced cost of earth structures (transport), speeded road construction operations, resistance to frost and defrost, improved ductility, reduced rigidity of earth structures, lack of weed growth in the surface of earth structures such as roads and reduced thickness of bearing layer.

Over the last years, environmental issues have prompted human to use industrial wastes as alternatives to some construction materials. Both earthwork researchers and engineers have paid considerable attention to using wastes in soil stabilization and improving physical and mechanical properties of soils. This may help both remove environmental problems and contribute to the economy. Industrial wastes such as fly ash, iron slag, wood ash, plastic wastes and iron filings show considerable potential to stabilize soils, which are occasionally used to improve geotechnical properties of poor soils. Expansive soils shrink when they lose their moisture but swell when they absorb water. Moisture absorption may occur as a result of raining, torrents, leaking pipes of water or sewage, and impeded surface water evaporation due to the built structures adjacent to water reservoirs. Clay soils are highly vulnerable to swelling. This paper deals with an experimental study in soft soil stabilized with paper sludge and rice husk ash and compare their strength.

II. Objectives

This paper aims at improving soil strength and increasing resistance to softening through bonding the soil particles together by adding either RHA or paper sludge and to find which one give more strength to the soil.

III. Scope Of The Study

Paper sludge and RHA are waste materials obtained from industry which cannot be easily disposed. Stabilization can increase the shear strength of soil and control the shrink-swell properties of soil, thus improving the load bearing capacity of a sub grade to support the pavements and foundation. In this study an attempt has been made to study the influence of waste materials in improving the strength properties of soil and thereby easily disposing the waste materials.

IV. Experimental Study

Soft soil was collected from the paddy field. Paper sludge and rice husk ash were collected from the industry. Experiments have done to determine geotechnical characteristics of soil and change in the behavior of soil while using RHA and paper sludge as a stabilizing agent. Physical parameters and the engineering

properties of natural soil and strength characteristics of stabilized soil were determined. A parametric study of the properties was conducted by varying the stabilizing agent and its percentage. Strength behavior of the soil is characterized in terms of unconfined compressive strength at varying percentage of stabilizing agents.

Figure1. Paper sludge

Figure 2. Rice husk ash

V. Results And Discussions

The general properties of the collected clay were obtained by conducting experiment as per IS: 2720. The test results were given in the TABLE I.

TABLE I. General Properties of clay

PROPERTIES	RESULT
Water Content (site) (%)	61.9
Specific Gravity of Soil	2.70
Permeability (cm/s)	9.355×10^{-5}
Liquid Limit (%)	104
Plastic Limit (%)	58
Optimum Moisture Content (%)	26
Maximum Dry Density(g/cc)	1.4
UCC Strength (kN/m^2)	95.34

From the above test results, it is found that the UCC strength of the soil is $95.34 kN/m^2$ which lies in the category of medium stiff soil. When comparing the result with plasticity chart, it is clear that the soil belongs to high plasticity silt. So the soil requires stabilization before using as a natural foundation. The unconfined compression test was conducted on soil with the addition of RHA and paper sludge at varying proportion.

5.1 Effect of RHA on UCC strength

The test results of unconfined compression tests with the addition of RHA varying from 0% to 10% with an increment of 2% are presented in fig 3. Fig 3 shows the variation of UCC strength with varying percentage of RHA. The maximum increase in UCC strength of the stabilized soil is to be 48% compared to natural soil occurring at a RHA content of 6%. Therefore 6% is the optimum RHA content and the maximum strength obtained with the addition of optimum RHA is $141 kN/m^2$.

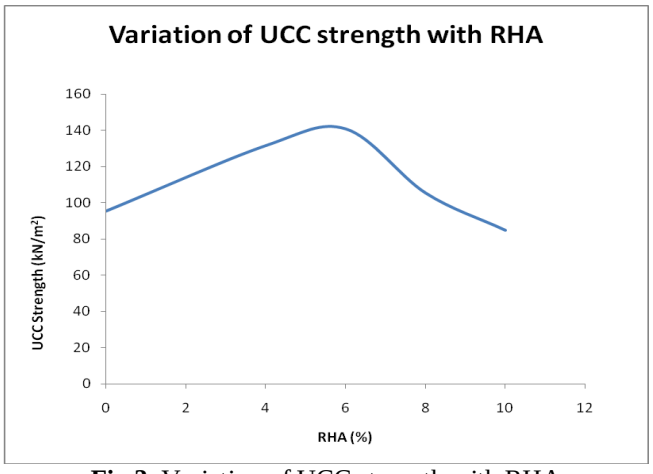

Fig 3. Variation of UCC strength with RHA

5.2 *Effect of paper sludge on UCC strength*

The test results of unconfined compression tests with the addition of paper sludge varying from 2% to 4% with an increment of 0.5% are presented in fig 4. Fig 4 shows the variation of UCC strength with varying percentage of paper sludge. The maximum UCC strength of the stabilized soil is obtained when the paper sludge content was 3%. Therefore 3% is the optimum RHA content and the maximum strength obtained was 277kN/m^2 which is almost three times the initial value.

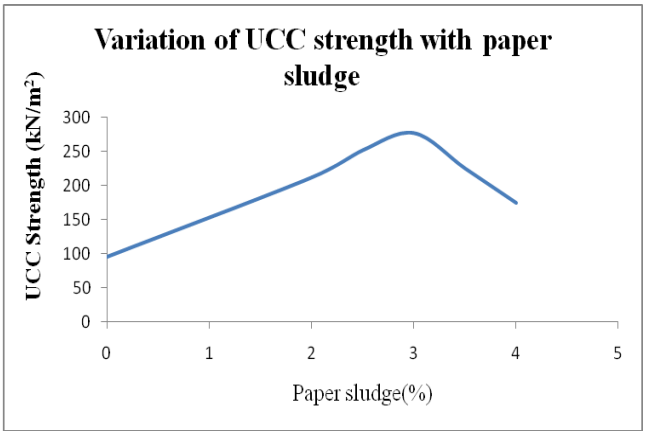

Fig 4. Variation of UCC strength with paper sludge

From the fig 3 and fig 4 it is clear that the UCC strength of the soil increases with the addition of stabilizing agents up to a certain percentage and decreases thereafter. The variation is almost in a similar pattern. While comparing the results, it is clear that the stabilization of soil with paper sludge is more effective since the strength achievement of soil stabilized with optimum percentage of paper sludge is more compared to that of RHA.

VI. Conclusion

The UCC test is the most common test to determine the strength of stabilized soil. The results indicate that the strength characteristics of the soil are improved with the addition optimum percentage of paper sludge when compared to RHA and the improvement was found to be 96%. The strength achievement of soil is due to the pozzolanic reaction and the cementation process of paper sludge. From the studies, it can be observed that the soil stabilized with paper sludge can be effectively used as a ground improvement technique for constructions.

Acknowledgement

We would like to express gratitude to final year B.Tech students of Civil Engineering Department, Sree Narayana Gurukulam College of Engineering, Kadayiruppu for their sincere efforts in performing the experimental works to bring up the study

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