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Soil Stabilization By Using Flyash, Rice Husk and Lime

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Abstract **- This study is performed to obtain geotechnical properties of fly ash, rice husk, and lime for its application in the stabilization of soft soil. The geotechnical properties of fly ash will be evaluated by various laboratory tests to investigate the feasibility of using fly ash in soil stabilization. Construction of soft soil is one of the most frequent problems in parts of the world. The study of fly ash, rice husk, and lime is carried out to observe the effectiveness of its addition on stabilization of soft soil. This is also an approach to overcome the increasing amount of solid waste generated by the population.**

Keywords – rice hulk, soil, stabilization, fly ash.

I. INTRODUCTION

Soil stabilization is a technique introduced many years ago with the main purpose of modification of properties of soil[1]. The soil at a given site is not always ideal. They may lack strength and compress too much under load. In such situations rather it would be better for an engineer in charge to relocate the facility or alter the soil structure, stabilize the soil. Now with the scarcity of good building sites, the engineer has to contend with the available site & improve the soil properties and build. This stabilization can be defined as a method to improve the engineering properties of soil. A well-stabilized soil will have higher shearing strength, lower compressibility and lower permeability and a better freeze and though resistance. These are the fundamental requirement for a safe and economical design of foundations, highway, pavements and airport runways[1].

The utilization of rice husk ash (RHA) in the geotechnical application has not been readily accepted due to the low level of confidence in its effectiveness among geotechnical engineers. For this reason, there is a need to fill the gaps currently hindering the full potential of RHA to be harness. The study presented in this paper aimed to provide and guidance on the use of RHA particular for expansive soil.

From the study of topographical & soil map of India, it is found that about 3 lakh sq. meter area of our country is covered by poor quality clayey or black cotton soil. Which extent over an almost central area of the country B.C. soil is residual soil and derives from basalt or traps and contains the clay mineral montmorillonite which is responsible for excessive swelling and shrinkage characteristic of the soil.

In Chhattisgarh state, there is a lot of production of fly ash & rice husk. The advantages of fly ash are that its availability. So by blending fly ash with black cotton soil which is available in maximum areas of our state, the property of natural B.C. soil like C.B.R. can be increased. The use of such plantation in the construction of foundations, road pavements etc. will also prove to be economical and eco-friendly. [1, 2]

Power generation is the most vulnerable criterion of modern civilization where the thermal process takes lead in comparison with hydro-electricity and others, owing to its easiness and availability of the main ingredient that is coal. Nearly 70% of India's total installed power generation capacity is thermal of which coal-based generation is about 90%, But at same time disposal of huge quantity of fly ash generated from the power plants in a burning problem. This is detrimental to animal and plant life. Since it pollutes the environment as well as it requires a large area for its disposal when the availability of land is getting scared day by day.

According to a report of concerned authority, the accumulated fly ash in 2010 over the country was about 110 million tones which are expected to be 140 million tons by the year 2020. This necessitates the effective utilization of this accumulated fly ash is being felt by the engineers and scientists. Utilization in the field of civil engineering extends ample scope for consuming bulk volume efficiently and economically.

Most of the fly ash shows an effective angle of shearing resistance of about 32-35 degrees which is a typical value of coarse sand and it is highly permeable material. [3]

II. MATERIAL & METHOD USED

This paper is carried out at a place where the black cotton soil is present which is not good for construction purposes. In This topic mainly carried out in a different part of Chhattisgarh where the black cotton soil is available.

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For this purpose, we had collected different materials such as fly ash, rice husk and lime from different industries which generate this as a solid waste while running their industries. These were generated in a large amount and their disposal is quite costly also so to minimize a load of landfills we did such experiments.

III. TEST AND TESTING METHODOLOGY

Natural Moisture Content: The water content (w) is defined the ratio of the mass of solids. The water content of the soil is an important property. The characteristics of the soil, especially a fine-grained soil, change to a marked degree with a variation of its water content. This test was carried out as per IS2720 part-2.[4]

Grain Size Analysis: The grain size analysis expresses quantitatively the proportions by mass of various size particles present in the soil. In a soil, the gravel, sand, silt, clay, fractions are recognized as containing particles of decreasing magnitude. The result of grain size analysis can be expressed graphically by grain size distribution curve in which the cumulative % finer than known equivalent grain size are plotted against these sizes. This test was carried out as per IS2720 part-2.

Consistency Limit: Consistency of fine grain soil is the physical state in which it exists. It is used to donate degree of firmness of soil. Consistency soil is indicated by such term as soft, firm or hard. The water content at which the soil changes from one state to another are known as consistency or Atterbergs limits.[5]

Liquid Limit: - Liquid limit is the water content at which the soil changes at which the soil changes from the liquid state to the plastic state. It can be determined in the laboratory either by Casagrande's apparatus or by cone penetration methods. As described in IS2720 part-5.

Plastic Limit: - Plastic limit is the content below which the soil stops behaving as a plastic material. It begins to crumble when rolled into a thread of soil of 3mm Dia. At this water content, the soil loses with plasticity and passes to a semi-solid state. The test procedure adopted is according to IS2720 part-5.[5]

Free Swelling Index: Free swelling is the increases in the volume of soil, without any external constraints, submergence in water. The possibility of damage to the structure due to swelling of expensive clays need to be identified to the out sat, by an investigation of those soils likely to possess undesirable expansion characteristics. This test is carried out as per IS2720 part-40.

Modified Proctor Test: The modified Proctor test is developed to represent heavier compaction than that in the standard Proctor test. The test is used to simulate the field condition where heavy rollers are used. This test is carried out as IS2720 part-16.

California Bearing Ratio (CBR): The CBR test is a type of test develops by the California division of highway in 1929. This test is used for suitability of subgrade and the material used in sub base & base course. The test results have been correlated to the thickness of various materials required for flexible pavement. The test consists of causing the plunger to penetrate the prepared specimen at the rate of 1.25mm/min. the loads required for penetration of 2.5mm &5mm are recorded by proving ring attached with a plunger. The load is expressed as % of the standard load at the respective deformation level and is known as CBR value the test is carried out as per procedure in IS2720 part-16.[6]

Specific Gravity: Specific gravity of solid particles (G) is defined as the ratio of the mass of given volume of solid to the mass of an equal volume of water at 27 degree Celsius the test is carried out as per IS2720 part-3.[6]

IV. GRAPH

a. Soil and Fly ash

Soil + % Fly ash (gm)	Vol. of Water	Sp. wt=W/V (KN/m^3)
100 + 0 = 100	555 - 500 = 55	10 x 1.81 = 18.1
100 + 2 = 102	560 - 500 = 60	10 x 1.7 = 17
100 + 4 = 104	570 - 500 = 70	10 x 1.4 = 14
100 + 6 = 106	590 - 500 = 90	10 x 1.3 = 13
100 + 8 = 108	595 - 500 = 95	10 x 1.13 = 11.3
100 + 10 = 110	610 - 500 = 110	10 x 1.0 = 10
100 + 12 = 112	640 - 500 = 115	x .97 = 9.7

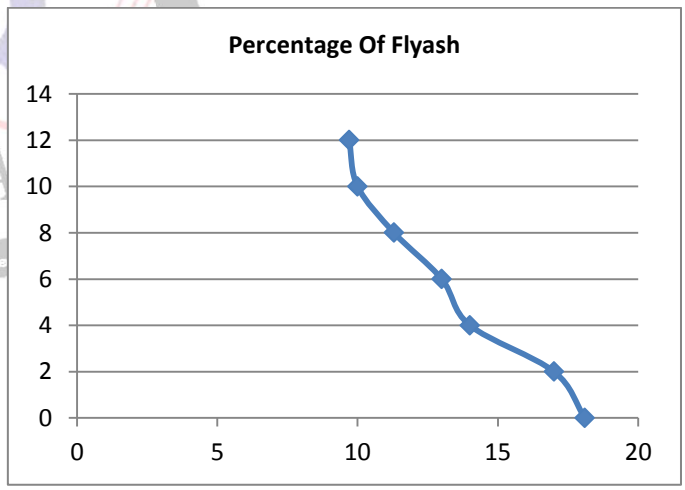

Figure:-1. Graphical representation between percentage of fly ash and sp.weight

b. Soil and Rice Husk

Soil + Rice Husk (gm)	Volume of Water (ml)	Sp. Wt = W/V (KN/m^3)
100 + 0 = 100	555 - 500 = 55	10 x 1.81 = 18.1
100 + 2 = 102	570 - 500 = 70	10 x 1.45 = 14.5
100 + 4 = 104	580 - 500 = 80	10 x 1.3 = 13
100 + 6 = 106	600 - 500 = 100	10 x 1.17 = 11.7
100 + 8 = 108	620 - 500 = 120	10 x 1.08 = 10.8
100 + 10 = 110	630 - 500 = 130	10 x .91 = 9.1
100 + 12 = 112	640 - 500 = 140	10 x .86 = 8.6

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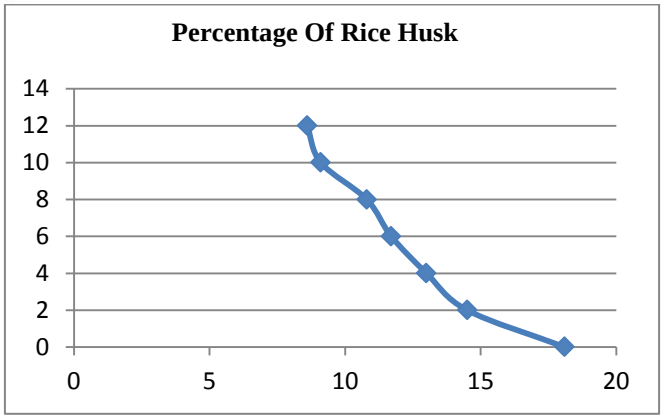

Figure:-2. Graphical representation of percentage of Rice husk and sp.weight

c. Soil, Fly ash, Rice Husk, Lime

Soil +Fly ash + Rice Husk + Lime (gm)	Volume of Water (ml)	Sp. Wt = W/V (KN/m^3)
100 + 2 + 2 + 0 = 104	556 - 500 = 56	10 x 1.85 = 18.5
100 + 2 + 2 + 1 = 105	556.1- 500 = 56.1	10 x 1.87 = 18.7
100 + 2 + 2 + 2 = 106	556.2 - 500 = 56.2	10 x 1.88 = 18.8
100 + 2 + 2 + 3 = 107	556.3 – 500=56.3	10 x 1.9 = 19
100 + 2 + 2 + 4 = 108	558 - 500 = 58.0	10 x 1.86 = 18.6
100 + 2 + 2 + 5 = 109	559 - 500 = 59	10 x 1.84 = 18.4
100 + 2 + 2 + 6 = 110	562 - 500 = 62	10 x 1.77 = 17.7

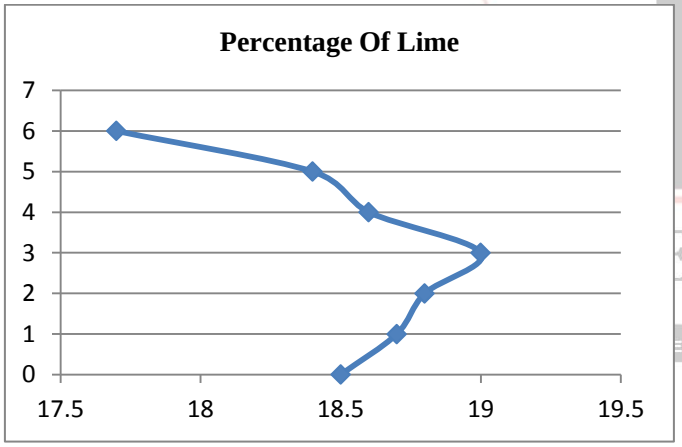

Figure:-3. Graphical representation of percentage of Lime and sp. weight

V. Result and Discussions

In this experimental result we see that the plastic limit value is 37% and liquid limit value 26%, it is good. We see that chemically RHA is lacking in cementations materials, but it contains pozzolanic materials. In general, the plasticity index reduces associated with the addition of RHA. The reduction of plasticity index is an indicator of improvement which can be related to increase in soil strength and decrease in swelling and compressibility.

Consumption of rice husk ash in bulk quantity in the construction of road project can be made with reducing the accumulation hazard and environmental pollution of this waste.

Addition of rice husk ash in increasing proportion with the alluvial soil decreases the maximum dry density of the mixed soil with or without mixing of lime. However, the optimum moisture content of mixed soil increases gradually with the increased percentage of lime and rice husk ash.

VI. Conclusion

1. In general, the addition of RHS solely decreases the plasticity of expansive soil, as a result of reducing liquid limit and increasing the plastic limit. Addition of RHA significantly reduces the plasticity index, whereas as much as 80% of reduction is achieved by the addition of RHA in greater lime content. It is noticed that 6% lime addition is enough to improve the consistency limits of expansive soils.
2. The swelling and swelling pressure of expansive soils decrease in concomitant with the addition of lime and RHA. The swelling of expansive soil is almost zero when it is added 6% lime and 6% RHS. Fly ash has good potential for use in the geotechnical application. When used in structural fills or embankments, fly ash offers several advantages over natural soils or rock. The relatively low unit weight of fly ash makes it well suited for placement over soft or low bearing strength soils.

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