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Soil Stabilization by Using Fly Ash and Rice Husk Ash

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Abstract: ***A number of studies have been find out to investigate the effect of addition of waste materials on modifying the properties of soil. The present study shows the modification of soil properties by adding locally available materials such as rice husk ash and fly ash. The cost of stabilization may be reduced by replacing by a good proportion of stabilizing agent using rice husk ash. The soil used in the present study is clay with high compressibility, whichneeds to be strengthened to minimizevolume changes in the soil.***

The soil is stabilized by varying different percentages of rice husk ash and also fly ash. Observations are made for changes in compaction characteristics of the soil, unconfined compressive strength and California bearing ratio values of the soil. From the results, it is observed that the maximum dry density is increased with increase in percentages of rice husk ash, and the corresponding optimum moisture content is decreased and vice versa with the addition of fly ash to the soil. The optimum amount of rice husk ash and fly ash for improving the properties of the soil are discussed in detail. It can test by using some laboratory test like liquid limit , plastic limit and standard proctor test (light compaction) , CBR test , Soil sample is mixing of fly ash as percentage of 5% , 10% , 15% , 20%and rice huskash of 10%, 15%, 20%, 25%, and the study of the work was to evaluate the effect of fly ash and rice husk ash to improve the performances of black cotton soil .

Keywords: Soil Stabilization, Fly Ash, Expansive Soil, Soil Modification, Soil Modification.

I. INTRODUCTION

Black Cotton soilsare fertile and very goodfor agriculture, horticulture, sericulture and aquaculture. Black cotton soils are expansive clays with potential for shrinking or swelling under changing moisture condition

Soil stabilization means improving the soil properties for better stability. All types of soil at a particular location are not be same or suitable for construction work because of their poor bearing capacity. In any construction work the soil should be stable enough to bear a load of that structure in such a problematic condition we need to improve capacity of the soil-by-soil stabilization Soil plays an important role in every construction work because all structures are constructed on earth.

Clays exhibit generally undesirable engineering properties. They tend to have low shear strengths and to lose shear strength further upon wetting or other physical disturbances1They can be plastic and compressible and they expand when wetted and shrink when dried. Some types expand and shrink greatly upon wetting and drying – a very undesirable feature. Cohesive soils can creepover time under constant load, especially when the shear stress is approaching its shear strength, making them prone to sliding.Depending upon the soil type, the effective fly ash It improves the engineering properties of the soil, e.g:

Strength - to increase the strength and bearing capacity, Volume stability - to control the swell-shrink characteristics caused by moisture changes, Durability - to increase the resistance to erosion, weathering or traffic loading. To reduce the pavement thickness as well as cost.

II. OBJECTIVES OF THE PROJECT

1) To study the OMC and maximum dry density for different perportion of RHA and FA.
2) To find the ways to use industrial waste by products in soil stabilization thus,reducing the costs of stabilization .
3) To determine the strength charactristics of soil on addition of best percentage of FA and RHA.
4) To reduce the swelling and shrinkage characteristics of black cotton soil, making it more stable for construction purposes

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III. LITERATURE REVIEW

S. Bhuvaneshwari [1], R. G. Robinson [2], S. R. Gandhi[3] (FAUP), TIFAC, DST, New Delhi (2005) has also discussed the stabilization of expansive Soils using fly ash extensive laboratory / field trials have been carried Out by out to check the improvements in the properties of expansive soil with fly ash in varying percentages**.** Prasanna et al. (2022) presented the soil samples that were stabilised by fly ash and rice husk ash wastes, which contribute a major part in increased disposal problems. In the present study fly ash and rice husk ash and the combination of fly ash and rice husk ash was added in varying percentages suchas 5%, 10%, 15%, 20% and 25% to improve the soil properties.

Pravin Patel,Dr. H. K. Mahiyar, et al.,(2014) The objective of this work is to estimate the effect of RHA, Fly ash and Lime on some geotechnical properties of black cotton soil, in order to determine the suitability of RHA, Fly ash and Lime for use as a modifier or stabilizer in the treatment of black cotton soil for roadwork.. The optimum percentage of fly ash at 20% for gave the best result for sub grade soil. CBR value of Black Cotton soil also increase with increasing varying % fly ash. The optimum percentage of fly ash at 20% for gave the best result for sub grade soil. M SANTHOSH,Thovtu Sushma Hindhu, et al.,(2023) The main objective of this study is to evaluate the feasibility of using Rice Husk Ash as soil stabilization material. A series of laboratory experiment has been conducted on soil blended with Rice Husk Ash in 0%, 2.5%, 5%, 7.5%and 10% by weight of dry soil. The results like liquid limit, plastic limit, compaction, compressive strength values are studied by using various percentages of rice husk ash in black cotton soil.

Jai Prakash, Kusum Kumari , Vijay Kumar (2017**)** Silica present in RHA is capable to replace the exchangeable ion present in clay mineral thus can reduce shrinkage and swelling property of clay minerals. The addition of RICE HUSK ASH alone to the test soil resulted in first increase in CBR Value thereafter it decreases towards the end. **Aparna Roy (2014**) For maximum improvement in strength, soil stabilization using 10% RHA content with 6% cement is recommended as optimum amount for practical purposes. This study aimed at examining the effect of industrial wastes rice husk ash and fly ash on soft soil stabilization. This paper attempted to improve the geotechnical properties of a soil replaced by Rice Husk

Ash (RHA) and fly ash with pozzolonic importance (FA). In the present study industrial wastes such as fly ash and rice husk ash and the combination of fly ash and rice husk ash were added in varyingpercentages like 5%, 10%, 15%, 20% and 25% to analyze engineering properties of the soil.

IV. MATERIALS

1) Black Cotton Soil: Describe source, classification and physical properties (grain size distribution, specific gravity, natural moisture content).
2) Fly Ash (FA): Fly ash is collected in constroiogix solution pvt. Ltd company and the fly contains some physical and they are followed by.
3) Rice Husk Ash (RHA): Source, method of production (burning and calcination temperature), amorphous silica content, fineness.

V. MIX PROPORTIONS

Select binder contents based on preliminary trials and literature:

1) FA: 0% , 5%, 10%, 15%, 20% (by dry weight of soil)
2) RHA: 0% , 10%, 15%, 20%, 25% (by dry weight of soil) Fly ash (FA) and rice husk ash (RHA) were used as stabilizing additives in different proportions based on the dry weight of soil.

The prepared mixtures were then tested to determine changes in compaction characteristics, strength behavior, and overall stabilization performance.

VI. METHODOLOGY

The soil was collected, air-dried, and passed through a 4.75 mm sieve. Fly ash and rice husk ash were added to the soil in different proportions by dry weight. The materials were mixed thoroughly to obtain a uniform blend. Water was added gradually, and the mixture was kept for 24 hours for proper moisture distribution. Laboratorytestssuchas Atterberglimits, Standard Proctor test, CBR test, and UCS test were conducted on both untreated and treated samples. The results were compared to determine the optimum percentage of fly ash and rice husk ash for soil stabilization.

A. Test Conduct By Only Soil

1) sieve analysis
2) liquid limit

3) plastic limit
4) Standard proctor test
5) CBR

B. Test Methods

1) Compaction

The tests were performed in accordance with ASTM D 1557. The specimens were of 102mm diameter and 116mm height. The degree of compaction of soil influences several of its engineering properties such as CBR value, compressibility, stiffness, compressive strength, permeability, shrink, and swell potential. It is, therefore, important to achieve the desired degree of relative compaction necessary to meet the required soil characteristics**.**

Table for standardproctortestby mixing of fly ashand rice husk of different ratio

Sr.No	Mixing of soil +fly ash + rice husk ash ratio	MDD	OMC
1	Soil only	1.8 gm/cm3	18.6%
2	Soil + 5% Fly ash + 10% rice husk ash	1.72 gm/cm3	19.3%
3	Soil +10% Fly ash + 15% rice husk ash	1.4 gm/cm	23.2%
4	Soil +15% Fly ash + 20% rice husk ash	1.33 gm/cm	30%
5	Soil +20% Fly ash + 25% rice husk ash	1.18 gm/cm	36.2%

2) CBR

The CBR tests were conducted in accordance with ASTM D 1883. The sample sizes were of 152mm diameter and 126mm length. At the OMC and maximum dry unit weight values of the natural soil, the tests were performed.

Unconfined compressive strength (UCS) test – IS : 2720 (Part 10) - 1991

California bearing ratio (CBR) test – IS : 2720 (Part 16) – 1987 Liquid & Plastic limit test – IS 2720 (Part 5) – 1985 Standard proctor test – IS : 2720 (Part 7) – 1980 various percentage of fly ash and rice husk ash of soaked CBR value of un soaked CBR for different percentage of

Sr .No	Mixing of soil+ Fly ash +rice husk ash	CBR value of 2,5mm	CBR value of 5mm
1	Soil only	2.26%	1.71
2	Soil + 5% Fly ash + 10% rice husk ash	5.14%	6.25%
3	Soil +10% Fly ash + 15% rice husk ash	6.50%	6.85%
4	Soil +15% Fly ash + 20% rice husk ash	6.6%	7.06%
5	Soil +20% Fly ash + 25% rice husk ash	6.95%	7.25%

fly ash and rice husk ash

Sr No	Mixing of soil+ Fly ash +rice husk ash	CBR value of 2,5mm	CBR value of 5mm
1	Soil only	1.8 gm/cm3	18.6%
2	Soil + 5% Fly ash + 10% rice husk ash	1.72 gm/cm3	19.3%
3	Soil +10% Fly ash + 15% rice husk ash	1.4 gm/cm	23.2%
4	Soil +15% Fly ash + 20% rice husk ash	1.33 gm/cm	30%
5	Soil +20% Fly ash + 25% rice husk ash	1.18 gm/cm	36.2%

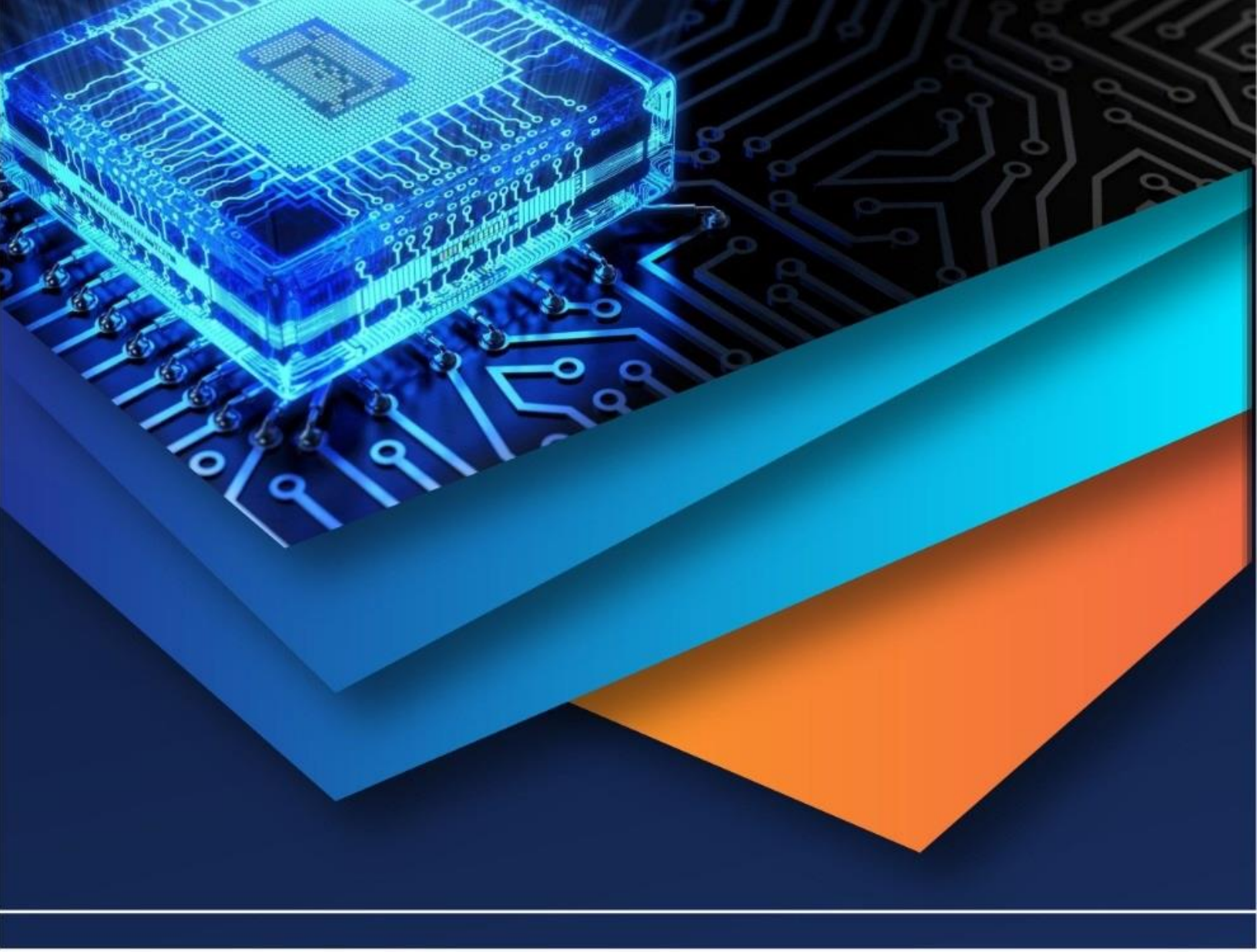
VII. CONCLUSION

The study on soil stabilization using fly ash and rice husk ash demonstrates that these waste materialscan effectively improve the engineering properties of weak soil. The addition of fly ash and rice husk ash reduced the plasticity characteristics of the soil and enhanced its compaction behavior by increasing the maximum dry density and reducing the optimum moisture content. The California Bearing Ratio (CBR) values also increased, indicating a significant improvement in the load-bearing capacity of the stabilized soil. The results show that the combined use of fly ash and rice husk ash provides better performance than untreated soil, making the soil more suitable for pavement subgrade and foundation applications. The optimum mix proportion produced the highest strength and stability, confirming that agricultural and industrial by-products can be used as cost-effective and environmentally friendly stabilizing agents.

REFERENCES

[1] A. Kumar and D. Gupta, “Stabilization of clayey soil using fly ash and rice husk ash,” International Journal of Civil Engineering and Technology, vol. 8, no. 4, pp. 112–118, 2017.
[2] M. Basha, R. Hashim, H. Mahmud, and A. Muntohar, “Stabilization of residual soil with rice husk ash and cement,” Construction and Building Materials, vol. 19, no. 6, pp. 448–453, 2005.
[3] A. Muntohar and G. Hantoro, “Influence of rice husk ash and lime on engineering properties of a clayey subgrade,” Electronic Journal of Geotechnical Engineering, vol. 5, pp. 1–9, 2000.
[4] S. Brooks, “Soil stabilization with fly ash and rice husk ash,” Journal of Materials in Civil Engineering, vol. 21, no. 4, pp. 123–130, 2009.
[5] B. Prasad and K. Sharma, “Improvement in CBR value of expansive soil using industrial waste,” International Journal of Engineering Research and Applications, vol. 4, no. 8, pp. 95–101, 2014.

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