COMPARATIVE STUDY OF IMPROVING THE VARIOUS PROPERTIES OF CLAYEY SOIL BY USING FOUNDRY SAND AND RICE HUSK ASH

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Abstract: Soil is one of the most abundant construction materials. Almost all construction is built with or upon soil. However, unlike many other materials of seemingly equal importance, its properties cannot be predetermined for it is naturally occurring material. The disposal of waste materials is a big problem in the developing country like India. Due to lack of land required for disposal technique. The substitution of these waste materials in the form of stabilizing agent in the soil stabilization is a modern approach by which waste materials can be advantageously used. Various Efforts have been made in developing countries to utilize waste materials in construction. In addition to getting rid of these waste materials, their use in construction has been found to go a long way in protecting the environment from contamination. This study, particularly aims at testing the viability of utilizing waste materials such as Rice Husk Ash and Foundry sand which are eco-friendly as well as economical, for soil stabilization. In this study the percentage of foundary sand is taken bas 5 to 15 % and 10 to 20 % rice husk ash.

Keywords: Foundry sand, Rice husk Ash, Clayey soil, unconfined compressive strength.

1.0 INTRODUCTION

Soil is a standout amongst the most imperative engineering materials. Be that as it may, in contrast to numerous different materials of apparently level with significance, its properties can't be foreordained for it is naturally occurring material. Soil is end product of a rock, after a long duration of time & with respect to weathering action soil formation takes place. Soil characteristics which will be changes depending on the surrounding nature & the parental rock. It is required to bear the load without any failure. But in some places the soil may be weak which cannot resist the oncoming load. The disposal of waste materials is a major issue in the creating nation like India. Because of absence of land required for transfer strategy. The substitution of these waste materials in the type of balancing out operator in the dirt adjustment is a cutting edge approach by which squander materials can be favorably utilized. Clay soil often possess poor strength characteristic and pose serious construction problem causing large differential settlement to the structure constructed over them. Since Clayey soil exhibit high swelling and shrinkage when exposed to change in moisture content and hence found to be most troublesome from engineering considerations. This behaviour is due to presence of a mineral montmorillonite, Kaolinite and Illite but mostly due to montmorillonite. Sometimes, it is not possible to avoid

clayey soil in such sites because of non-availability of alternative locations having good load bearing capacity. The stabilization of clayey soil in such location is required by using various admixtures so that the strength of subgrade characteristic of soil can Rice Husk ash remains independent from anyone else has minimal cementitious esteem however within the sight of dampness it responds synthetically and frames cementitious mixes and ascribes to the improvement of solidarity and compressibility attributes of soils. So as to accomplish both the need of improving the properties of marine muds and furthermore to utilize the mechanical squanders, The focal point of this report is to think about the plausibility of balancing out soil by utilizing rice husk powder and Foundary sand, consequently re-utilizing waste materials and giving a prudent and ecofriendly strategy for soil adjustment.

1.2 LITERATURE REVIEW ON FOUNDRY SAND AND RICE HUSK ASH

Victor Ronoh et al studied on the Characteristics of Earth Blocks Stabilized with Rice Husk Ash and Cement. This study investigated the feasibility of using Rice Husk Ash (RHA) as a partial replacement of cement in the stabilization of black cotton Soil (clay soil) for the production of compressed earth blocks. The soil used in this study was excavated from a construction site in Juja. RHA was collected from rice mills in Mwea, where RHA is produced through open fire burning of rice husks. Particle size distribution, Atterberg's limits, Standard Proctor Compaction and compressive strength tests were carried out according to British standard procedures. The soil used was classified as A-7-5 in the AASHTO classification system. Stabilization was done using different quantities of RHA and cement. This study established that to achieve minimum strength of soil blocks (2.5 MPa), soil should be stabilized with at least 5% cement and 7.5% RHA. When the quantity of RHA exceeded 7.5%, the compressive strength went below the 2.5 MPa required by Kenya Bureau of Standard.

B Kanddulna et al did the experimental study on Clayey Soil with Lime and Rice Husk Ash. In this study, highly plastic clay was stabilized by using lime and rice husk ash (RHA).The present investigation has been carried out with agricultural waste materials like Rice Husk Ash (RHA) and cheaply available lime is mixed with clayey soil improvement of weak sub grade in terms of compaction and strength characteristics. In this investigation lime and rice husk ash (RHA) is added 5%, 10% 15% and 20% by weight of soil. The main objective of this investigation is to access cheaply availability of lime and rice husk ash for improving engineering property of clayey soil for making capable of taking more load form structure to foundation. In this experimental investigation, the stabilizer reduces the MDD 1.382 to 1.325 g/cm3 with lime and rice husk ash reduces MDD 1.382 to 1.330 g/cm3. The investigations show optimum strength at 15 % of lime and 15% of rice husk ash (RHA).

Chayan Gupta et al did the modification of soil by the Application of Waste Materials. In this study, a literature survey has been done on various studies presented by various authors. It is clear from the aforesaid literature review that till now either fly ash alone or fly ash lime combination or fly ash reinforced with any

fiber has been used in soil stabilization process. Therefore, a new combination of river sand, fly ash and marble dust together has been used for the modification of black cotton soil in the present study. A series of standard proctor compaction test were conducted on black cotton soil (BCS) mixed with different percentages of river sand (SD) i.e. 10%, 20%, 30%, 40% & 50%. The purpose of mixing waste river sand in black cotton soil was to make the blending process easy and convenient and to satisfy the criteria of good soil for mix design also mixture behaves as a cohesive non-swelling soil (CNS) layer concept.

Gbenga M. studied on the influence of rice husk ash on soil permeability. The research focused

Garima Kishore et al studied on the Engineering Properties of Soil. Stabilized With Lime and Rice Husk Ash. The objective of this work is to utilize the effectiveness of Rice husk ash as pozzolanic material to enhance the lime treatment of soil. Laboratory test results present the influence of different mix proportions of Lime and rice husk ash on compaction, Permeability and strength properties of soil. The materials used in the experiments are Sandy soil, Rice husk ash and lime. The optimum result of permeability is at 6% Lime with 15% RHA, according to the specification.

Ajeet et al studied on the Stabilization of Soil by Foundry Sand Waste with Fly-Ash. In this study the fly-ash and foundry sand waste is being mixed with soil to investigate the relative strength gain in terms of bearing capacity and compaction and the experiment conducted by using standard proctor compaction apparatus. The tests were performed as per Indian standard specification. The Addition of 1% fly ash and 0.25% of foundry sand waste gave 1.88g/cc of MDD and Addition of 2% fly ash and 0.5% of foundry sand waste gave 1.9g/cc of MDD.

Sudipta Adhikary et al studied on the Potentials of Rice-Husk Ash as a Soil Stabilizer. This paper presents the results of experimental study carried out by the virgin soil sample was taken alongside the pond of "Jadavpur University"(Jadavpur Campus), Classified as CI(clay of medium plastic) as per AASTHO soil classification system and was stabilized with 5%,10%,15% & 20 % of Rice Husk Ash(RHA) by weight of the dry virgin soil. The improvement of the Geo- Technical properties of the fine grain soil with varying percentages of RHA was done with the facilitate of various standardize laboratory tests. The testing program conducted on the virgin soil samples by mixed with specified percentages of rice-husk materials, it is included Atterberg's limits, "California Bearing Ratio(CBR)", "Unconfined Compressive Strength(U.C.S)" , and "Standard Proctor test ".It was found that a general decrease in the maximum dry density(MDD) and increase in optimum moisture content(OMC) is shown with increase of the percentages (%) of RHA content and there was also a significant improvement shown in CBR and UCS values with the increase in percentages(%) of RHA.

Vikas Sharma et al did the study on Soil Stabilization by Using Wheat Husk Ash. The sample for testing was set up as per the requirements of the tests. The soil sample was first sieved through the appropriate strainer for a respective test. The required quantum of soil was weighed out for the test. The wheat husk ash to be added to the soil was similarly sieved through the required strainer, for the particular test and a while later the required quantum was weighed out and added to the earth for test. The soil and the wheat husk ash were then mixed in dry state before testing. The blend sample was then used for performing out the distinctive tests. The test results concluded that Addition of different % of WHA, water content increased up to a certain limit afterwards gradually decreasing. Addition of 7% WHA has been given optimum result.

consumption of materials for stabilization of sub-base layer in construction of forest roads.

1.3 MATERIAL USED

1.3.1 Soil Samples

Soil is end product of a rock, after a long duration of time & with respect to weathering action soil formation takes place. Soil samples for this study were collected from Ambala District.

Figure 1.1: Soil Sample

1.3.2 Rice husk Ash

Rice Husk Ash is used in the present experimental study was obtained from rice mills Karnal, Haryana.

Figure 1.2: Rice Husk Ash

1.3.3 Foundry Sand

Foundry sand which is very high in silica is regularly discarded by the metal industry. Currently, there is no mechanism for its disposal, but international studies say that up to 50 per cent foundry sand can be utilized for economical and sustainable development of concrete.

Figure 1.3: Foundry Sand

1.4 MIX PREPARATION

Soil sample has been stabilized with Foundry sand and Rice husk ash. Following mix will be prepared with different percentage of Foundry Sand and Rice husk ash

1. **M 1**- Soil sample
2. **M 2**- Soil sample + 5% Foundry Sand
3. **M 3**- Soil sample + 10% Foundry Sand
4. **M 4**- Soil sample + 15% Foundry Sand
5. **M 5**- Soil sample + 5% Foundry Sand + 10% Rice husk ash
6. **M 6**- Soil sample + 5% Foundry Sand + 15% Rice husk ash
7. **M 7**- Soil sample + 5% Foundry Sand + 20% Rice husk ash
8. **M 8**- Soil sample + 10% Foundry Sand + 10% Rice husk ash
9. **M 9**- Soil sample + 10% Foundry Sand + 15% Rice husk ash
10. **M 10**- Soil sample +10% Foundry Sand + 20% Rice husk ash
11. **M 11**- Soil sample + 15% Foundry Sand + 10% Rice husk ash
12. **M 12**- Soil sample + 15% Foundry Sand + 15% Rice husk ash
13. **M 13**- Soil sample +15% Foundry Sand + 20% Rice husk ash

1.5 UNCONFINED COMPRESSIVE STRENGTH

The most important property for a weak soil deposit is its compressive strength which gives a measure of the load it can take before it fails. The test was carried out after the specimen was moist cured for 7 and 28 days.

Table 1.1: Unconfined Compressive strength

Sr. No	Mix	UNCONFINED COMPRESSIVE STRENGTH (KN/m^2)	
		7 Days Curing	28 Days Curing
1	M-1 (Soil)	128	132
2.	M-2 (Soil + 5 % F.S)	142	202
3.	M-3 (Soil + 10 % F.S)	152	215
4.	M-4 (Soil + 15 % F.S)	164	219
5.	M-5(Soil + 5 % F.S + 10 % R.H.A)	168	224
6.	M-6(Soil + 5 % F.S + 15 % R.H.A)	175	245
7.	M-7 (Soil + 5 % F.S + 20 % R.H.A)	162	202
8.	M-8 (Soil + 10 % F.S + 10 % R.H.A)	172	245
9.	M-9 (Soil + 10 % F.S + 15 % R.H.A)	184	254
10.	M-10 (Soil + 10 % F.S + 20 % R.H.A)	154	174
11.	M-11 (Soil + 15 % F.S + 10 % R.H.A)	173	251
12.	M-12 (Soil + 15 % F.S + 15 % R.H.A)	184	259
13.	M-13 (Soil + 15 % F.S + 20 % R.H.A)	189	234

1.6 EFFECT ON CBR

California bearing ratio is the ratio of force per unit area required to penetrate a soil mass with standard circular piston at the rate of 1.25 mm/min, to a required extent, for the corresponding penetration of a standard material.

Table 1.2: CBR Variation for both soaked and unsoaked

Sr. No	Mix	Unsoaked	Soaked
1	M-1 (Soil)	2.5	3.8
2.	M-2 (Soil + 5 % F.S)	4.32	5.47
3.	M-3 (Soil + 10 % F.S)	4.58	5.67
4.	M-4 (Soil + 15 % F.S)	5.01	5.87
5.	M-5(Soil + 5 % F.S + 10 % R.H.A)	5.21	6.21
6.	M-6(Soil + 5 % F.S + 15 % R.H.A)	5.47	6.54
7.	M-7 (Soil + 5 % F.S + 20 % R.H.A)	6.54	7.25
8.	M-8 (Soil + 10 % F.S + 10 % R.H.A)	7.21	8.45
9.	M-9 (Soil + 10 % F.S + 15 % R.H.A)	7.85	8.21
10.	M-10 (Soil + 10 % F.S + 20 % R.H.A)	7.54	8.02
11.	M-11 (Soil + 15 % F.S + 10 % R.H.A)	7.24	7.87
12.	M-12 (Soil + 15 % F.S + 15 % R.H.A)	7.87	8.98
13.	M-13 (Soil + 15 % F.S + 20 % R.H.A)	8.23	9.23

CONCLUSION

In the present study performance of two industrial wastes foundry sand and rice husk ash in the stabilization of weak soil are studied through laboratory investigation. The various tests like Liquid limit, standard proctor, unconfined compressive strength and CBR test were conducted. The following conclusions have been made from these test results.

1. Rice Husk Ash is found to influence the index and engineering properties of clayey soil so as to make the soil suitable for construction as a foundation material for structures built over it.
2. The LL and PL of the virgin soil shown a significant improvement with increase of percentages of RHA, whereas the PI values shown a decrement with increase in percentages of RHA content.
3. Stabilization of soil with cement and RHA is a feasible construction technology because the compressive strength of stabilized soil is higher than the strength of unstabilized Soil.
4. Eco-friendly and Economic materials like Rice Husk Ash and Foundry Sand, made a significant impact on the stability properties of soil, when added to the soil sample in required quantities.
5. There is enormous increase in the unconfined compressive Strength (UCS) with increase RHA content.
6. For maximum improvement in strength, soil stabilization using 10% RHA content with 10 % Foundry sand is recommended as optimum amount for practical purposes.
7. Optimum moisture Content of soil increases with increase in the percentages of Foundary sand and rice husk ash.
8. From Unconfined compression test results it can be concluded that Rice Husk ash has effectively stabilized soil and has led to increase in unconfined compressive strength of the soil.

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