International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 04 | Apr 2019 www.irjet.net p-ISSN: 2395-0072

Effects of Rice Husk Ash (RHA) and Alccofine-1101 on Stabilization of Clay Soil

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Abstract -*During past a number of stabilization methods are being used to improve geotechnical properties of soil.Now-a-days easily available industrial by-products are used for enhancing the soil properties. In present study, effects of RHA and alccofine 1101 have been studied for improvement in geotechnical properties of clayey soil. The results revealed that OMC increased from 11.50-20.75% with increase in RHA and alccofine content from 1-5%. The highest UCS value was found to be 340 KPa at 87% Soil, 10% RHA and 3% alccofine 1101. Similarly the maximum CBR value was found to be 85.17% at 87% soil, 10% RHA and 3% alccofine 1101. Thus the results revealed that addition of RHA and alccofine 1101 shows effective results for the stabilization of clayey soil.*

***Key Words*: Clayey soil, rice husk ash, alccofine 1101, stabilization, geotechnical properties**

1. INTRODUCTION

Soil is the basic construction material and supports the substructure of any structure. Clayey soils are microscopic and sub-microscopic particles that change significantly in volume with changes in water content. Clayey soil often possesses poor strength characteristics and pose serious construction problem [1]. 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 mineral montmorillonit, kaolinite and illite. Soil improvement could either be by modification or stabilization or both. Stabilization of clayey soil is increased by using various admixtures so that the strength of sub-grade characteristic of soil can be improved. Soil modification is the addition of a modifier (cement, lime, ash, etc.) to a soil to change its index properties, while soil stabilization is the treatment of soils to enable their strength and durability to be improved such that they become totally suitable for construction [2]. Mixing stabilizers in a particular amount in clay soils induce textural change and give better improved strength.
Rice husk is an agricultural waste obtained from milling of rice. Rice milling generates a huge byproduct of rice husk. The RHA was used as an admixture and a stabilizing agent to increase the cementitious property of the stabilized matrix. It has been shown that both cement and RHA reduced the plasticity of soils and MDD but increased OMC [3].
Alccofine is a new generation, micro fine material of particle size much finer than other hydraulic materials like cement, fly ash, silica etc. being manufactured in India. There are two types of alccofine i.e., alccofine 1203 and alccofine 1101 [4]. Alccofine 1101is an alccofine with high calcium silicate. It is a micro finer cementitious grouting material for soil stabilization and rock anchoring. The performance of alccofine is superior to all other admixtures used in India. Therefore, the objective of the study was to optimize the levels of RHA and alccofine-1101 in clayey soil based on UCS test, CBR test and compaction test.

2. Materials and Methods

Materials

Soil: Locally available clay obtained from Kathua, Jammu and Kashmir was used for the study.
Rice husk ash: RHA used for the study was procured from Ludhiana. Rice husk were incinerated at 600 °C resulting in rice husk ash.

Alccofine 1101: Alccofine 1101 was used for the study obtained from commercial supplier.

Methodology

To study the effect of addition of RHA in clayey soil mixed with alccofine-1101, the variables shown in Table 1 are considered in this study:

Table-1: Formulation of mixes containing clay, rice husk ash and alccofine 1101

S. No.	Clay (%)	Rise Husk Ash (%)	Alccofine 1101 (%)
1	100	0	0
2	95	5	0
3	92.5	7.5	0
4	90	10	0
5	99	0	1
6	94	5	1
7	91.5	7.5	1
8	89	10	1
9	97	0	3
10	92	5	3
11	89.5	7.5	3
12	87	10	3
13	95	0	5
14	90	5	5
15	87.5	7.5	5
16	85	10	5

Unconfined Compressive Strength (UCS) Test

UCS test is to determine the compressive strength by keeping the sample at different curing days of 7, 14 and 28 days for the response of pozzolanic action to the material and so that it provides strength to the material. It is generally assumed that the higher the compressive strength tests better the quality of stabilization. It is a special type of unconsolidated un-drained test that is commonly used for clay specimen. In this test the confining stress is zero and the cylindrical soil specimen is loaded axially by compressive force until failure takes place.

California Bearing Ratio (CBR) Test

CBR test is a penetration test for evaluating the stability of sub-grade soil. The CBR testing setup consist of a mould 150 mm diameter with a base plate and a collar, a loading frame with the cylinder plunger of 50 mm diameter and dial gauges to measure the penetration value. The penetration test consists of cylindrical plunger of 50 mm diameter to penetrate a pavement component material at 1.25 mm / min. The load values causes 2.5 and 5.0 mm penetration are recorded. The CBR value is calculated using the relation:

$$\text{CBR (\%)} = \frac{\{\text{Load sustained by the specimen at 2.5 or 5.0 mm penetration}\}}{\{\text{Load sustained by standard aggregate at the corresponding level}\}} \text{ X } 100$$

Compaction test

This test is to determine the O.M.C (Optimum moisture Content). In the compaction test, the weight of rammer was 2.6 Kg and dropped from 310 mm height. The capacity of cylindrical mould was 1000 cc, internal diameter was 100 mm and effective height was 127.3 mm. Compaction test were conducted to get the OMC of the mixes to study the effect of addition of rice husk ash in clayey soil mixed with alccofine-110.

3. RESULTS AND DISCUSSION

Unconfined compressive strength (UCS)

In order to assess the strength development of the each combination of soil–binder samples over time, the tests were carried out for different curing periods, i.e.7, 14 and 28 days. Figure 1 shows the variation of the UCS values of treated expansive soil for different curing periods in relation to the percentage of the binder. The optimum mix is the mix having highest UCS values for the given condition and which is found to be 87% Soil, 10% RHA and 3% alccofine 1101. For clay soil, the UCS value was 86 KPa and this value increased to 220 KPa for 10% increase in RHA and 280 KPa for 10% increase in RHA and 1% alccofine 1101 and 340 KPa for 10% increase in RHA and 3%alccofine 1101. The results showed that the

strength of all mixes increased with the addition of RHA from 0-10%. Further it was observed that the strength of the stabilized soil increases with increase in curing periods from 7 to 28 days. The UCS value of the optimum mix (87 clay, 10 RHA and 3 alccofine 1101) increased from 340 KPa to 570 KPa from 7 to 28 days of curing period. It can be seen that strength increases up to 10% RHA and 3% alccofine contents and after 3% alccofine content the strength decreases thereafter. This trend is similar for all the curing periods. For the same percentage of binder, the strength of the samples was found to be directly proportional to the curing period. The formation of cementitious compounds in the soil– binder matrix is responsible for increase in the UCS of the stabilized soil. However, the addition of binder beyond 20% gave a reduction in strength. The reduction in the compressive strength of soil once the stabilizer/binder content has exceeded a certain level has been reported by various researchers [5].

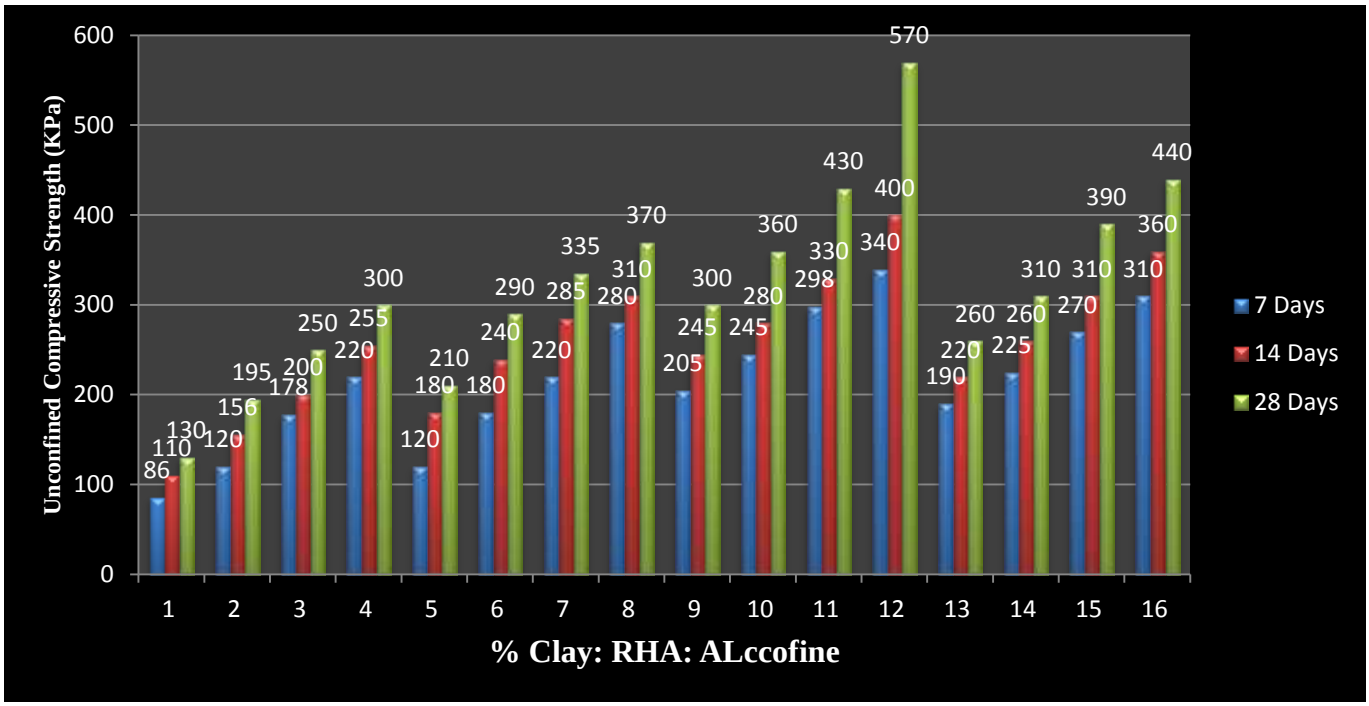

Figure-1: Variation of unconfined compressive strength (KPa) of clayey with Rice Husk Ash and alccofine content: 1). 100:0:0; 2). 95:5:0; 3). 92.5:7.5:0; 4). 90:10:0; 5). 99:0:1; 6). 94:5:1; 7). 91.5:7.5:1; 8). 89:10:1; 9). 97:0:3; 10). 92:5:3; 11). 89.5:7.5:3; 12). 87:10:3; 13). 95:0:5; 14). 95:0:5; 15). 87.5:7.5:5; 16) 85:10:5.

California Bearing Ratio (CBR)

This is a penetration test for evaluating the stability of soil sub grade and other flexible pavement materials. The CBR test was carried out on stabilized soil for different mix proportions of clayey soil, RHA and alccofine (Figure 2). The CBR value increased from 21.09% to 85.17% and maximum value was observed for the optimum mix at 87% Soil, 10% RHA and 3% alccofine 1101. It was observed that addition of industrial waste (RHA) and alccofine 1101 gave an improvement of clayey soil. When the additive alccofine increases beyond 3% the CBR value decreased again. So based on the respective results, quality of soil is increasing from poor condition to excellent condition with the addition of RHA and alccofine 1101 based on CBR test values. Similar results were observed Kumar and Preethi (2014) in clayey soil stabilized with RHA and Lime.

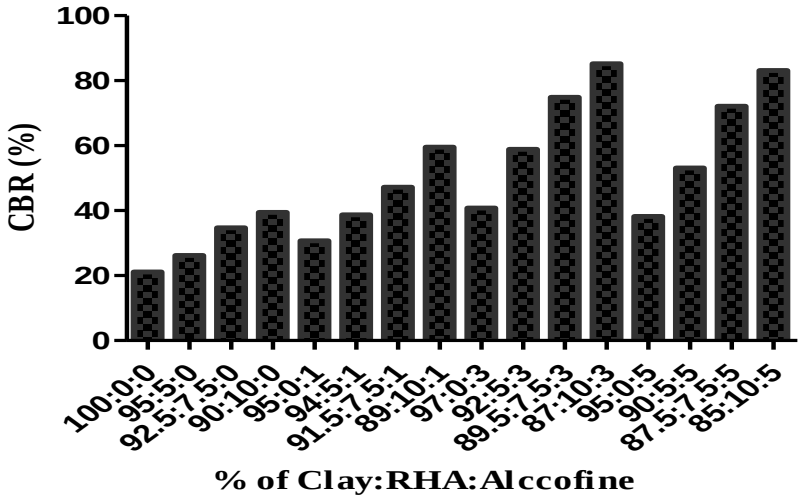

Figure-2: Variation of California Bearing Ratio with Rice Husk Ash and Alccofine content.

Compaction test

The result shows that the OMC increased from 11.50% to 20.75% with increase in RHA content from 5-10% and alccofine 1-5% (Fig. 3). This trend may partly be attributed to the addition of RHA which decreased the quantity of free silt and clay fraction and forming coarser materials with larger surface areas. The increase in OMC is either due to additional amount of held water with flocculent soil structure that is the result of cement interaction or exceeding absorption of water by rice husk ash's porous properties [5]. This implies also that more water was needed in order to compact the soil-RHA mixtures [6].

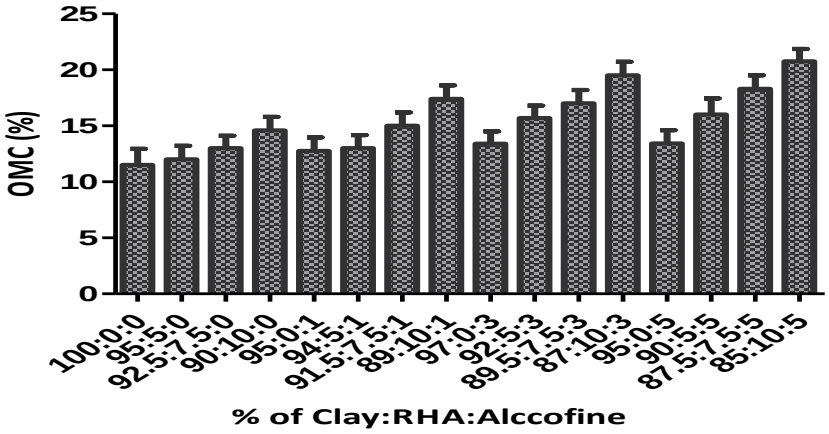

Figure 3: Variation of OMC (%) with different Rice Husk Ash and Alccofine Contents.

3. CONCLUSION

It is noticed that the liquid limit of the clayey soil has been decreased by 53.40 % to 40.20% on addition of rice husk ash from 0% to 10% and alccofine from 0 to 5%. It is observed that the plastic limit of the clayey soil has been improved by 24.31% to 34.90% on addition of rice husk ash from 0% to 10% and alccofine from 0 to 5%. It is observed that the plasticity index of the clayey soil has been decreased by 26.09% to 5.30% on addition of rice husk ash from 0% to 10% and alccofine from 0 to 5%. It is found that the MDD decreased from 1.49 g/cm^3 to 1.29 g/cm^3 of the clayey soil on addition of rice husk ash from 0% to 10% and alccofine from 0 to 5%. However increasing the concentration of alccofine 1101in mixes increased the MDD values than mixes with RHA alone. The OMC increased from 11.50% to 20.75% with increase in RHA content from 5-10% and alccofine 1-5%. The optimum mix is the mix having highest UCS values for the given

condition and which was found to be 340 KPa at 87% Soil, 10% RHA and 3% alccofine 1101. Similarly the maximum CBR value was found to be 85.17% for the optimum mix at 87% Soil, 10% RHA and 3% alccofine 1101.

REFERENCES

[1] Kanddulna B., Kisku N., Murari K., Singh JP. (2016). Experimental Study of Clayey Soil with Lime and Rice Husk Ash. *International Journal of Engineering Trends and Technology.* 38 (7), 365-372.

[2] Kumar BS., Preethi T.V. (2014). Behavior of Clayey Soil Stabilized with Rice Husk Ash & Lime. *International Journal of Engineering Trends and Technology. 11 (1), 44-48.*

[3] Basha EA., Hashim R., Mahmud HB., Muntohar AS. (2005). Stabilization of residual soil with Rice Husk Ash and Cement", Construction and Building Materials.

[4] Shadi VK., Banarase MA. (2015). Experimental Study on Effect of Alccofine on Properties of Concrete-A Review. *International Journal of Research in Engineering Science &Technology*. 297-301.

[5] Sharma M., Soni DK. (2016). Effect of Rise Husk Ash and Cement Mixtures on UCS of Cohesive Soil*. Indian Journal of Science & Technology*. 9(44).

[6] Okafor FO., Okonkwo UN. (2009). Effects of Rice Husk Ash on Some Geotechnical Properties of Lateritic Soil.*Leonardo Electronic Journal of Practices and Technologies*. 15, 67-74.