Soil Stabilization using Rice Husk Ash and Cement

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Abstract

Soil stabilization has turned into a noteworthy issue in development designing and the investigates in regards to the viability of utilizing modern squanders are quickly expanding. The present trial work quickly portrays the appropriateness of the locally accessible Rice Husk Ash (RHA) to be utilized in the nearby development industry in a manner to limit the measure of waste to be arranged to the earth causing natural contamination. The normal soil stabilization methods are winding up expensive step by step because of the ascent of expense of the balancing out specialists like, cement, lime, and so on. The expense of stabilization might be limited by supplanting a decent extent of settling specialist utilizing RHA. It will limit the ecological dangers moreover. Soil test taken for the investigation is mud with high versatility (CH) which genuinely requires to be fortified. The soil is balanced out with various rates of Rice Husk Ash and a little measure of cement. Perceptions are made for the adjustments in the properties of the soil, for example, Maximum dry thickness (MDD), Optimum moisture content (OMC), California bearing ratio (CBR) and Unconfined compressive pressure (UCS). The outcomes got demonstrate that the expansion in RHA content builds the OMC however diminishes the MDD. Likewise, the CBR esteem and UCS of soil are extensively improved with the RHA content. From the perception of most extreme improvement in quality, 10% RHA content with 6% cement is prescribed as optimum sum for reasonable purposes. Watching the huge improvement of CBR-estimation of soil, the present soil stabilization strategy may for the most part be suggested for development of asphalt.

Keywords: Soil Stabilization, Rice Husk Ash (RHA), Cement, Optimum Moisture Content (OMC), California Bearing Ratio (CBR), Unconfined Compressive Stress (UCS).

1. Introduction

Structural building ventures situated in zones with delicate or powerless soils have generally fused improvement of soil properties by utilizing different techniques. Soil Stabilization is being utilized for an assortment of building works, the most widely recognized application being in the development of street and asphalts, where the principle objective is to expand the quality or strength of soil and to diminish the development cost by utilizing the locally accessible materials. Over the occasions, cement and lime are the two primary materials utilized for balancing out soils. These materials have quickly expanded in price because of the sharp increment in the expense of vitality. Along these lines the utilization of agrarian waste, (for example, rice husk ash - RHA) will significantly diminish the expense of development and also decreasing the natural perils they causes. Rice husk is a farming waste gotten from processing of rice. Around 108 tons of rice husk is created every year on the planet. Consequently, utilization of RHA for redesigning of soil ought to be empowered.

The past works with RHA have demonstrated that it has promising possibilities of improving the building properties of soils for sub-grade purposes. Therefore, this work concentrated on exploring the optimum measure of RHA for commonsense purposes through the perception of impact of RHA on some geotechnical properties of delicate clayey soil which are important for assessing the execution of sub-grade soils. Be that as it may, the RHA must be utilized as a halfway replacement for the more costly balancing out operators (cement/lime) since it has deficient cementation property required to tie the material to an attractive toughness. Henceforth, in the present investigation, a little measure of cement was blended with HRA and the impact of soil stabilization on soil properties like, optimum moisture content, most extreme dry thickness, California bearing Ratio and unconfined compressive pressure is watched and the optimum content is discovered from the greatest improvement. By paying a little expense for cement, a huge improvement of CBR-estimation of soil is seen which demonstrates the cost-adequacy of development of asphalt.

2. Materials

The soil test utilized for this examination is gathered from neighborhood Vaagdevi College of engineering at a profundity of 1.5m to 2.5m utilizing the strategy for irritated inspecting. The properties of the soil utilized in the examination are given in Table 1. The general geotechnical properties of the soil named Clay with high pliancy (CH) in the IS Soil Classification System.

Table 1: Properties of the natural soil.

Characteristics	**Description**
Natural Moisture content (%)	21.5
Percent passing IS sieve 75 micron	81
Specific gravity	2.33
Liquid limit(%)	50.4
Plastic limit (%)	27.6
Plasticity index (%)	22.8
Maximum dry density(gm/cc)	1.54
Optimum moisture content (%)	20.0
California bearing ratio, unsoaked (%)	1.46
Unconfined compressive strength (KN/m2)	70

The RHA was collected from mamnoor rice mill. The RHA was ground and sieved through 0.075mm aperture before use. The oxide composition of RHA is shown in Table 2.

Table 2: Oxide composition of RHA.

Constituent	Composition (%)
SiO2	75.2
Al2O3	5.2
Fe2O3	1.02
CaO	1.4
MgO	1.75
Loss on Ignition	15.43

3. Methods of Testing

The laboratory tests completed originally was on the characteristic soil which incorporate Particle estimate appropriation, Atterberg limits, Compaction, CBR and UCS. The geotechnical properties of the soil are resolved as per Indian Standard [8]. Example for Unconfined compressive quality (UCS) and California bearing ratio (CBR) tests are set up at the Optimum moisture contents (OMC) and Maximum dry densities (MDD).

In the second period of the examination, three unique rates of RHA, 10%, 15% and 20% are blended with soil in three distinct tests. For each situation, 6% cement is blended with the soil-RHA blend to get sufficient cementation property to the blend. For the over three distinct extents, tests are done to watch the adjustments in the properties of soil for example Greatest dry thickness, Optimum moisture content, CBR esteem and Unconfined compressive worry of soil.

4. Test Results and Discussion

4.1. Compaction Characteristics

The varieties of MDD and OMC with RHA contents blended with soil and 6% cement are appeared in Figure 1 and Figure 2, individually. The MDD is diminished while the OMC is expanded with increment in the RHA content. The abatement in the MDD can be credited to the replacement of soil and by the RHA in the blend The lessening in the MDD may likewise be clarified by thinking about the RHA as filler (with lower explicit gravity) in the soil voids.

There is increment in OMC with increment RHA contents. The expansion is because of the expansion of RHA, which diminishes the amount of free sediment and earth division and coarser materials with bigger surface regions are framed. These procedures need water to happen. This infers likewise that more water is required so as to reduced the soil-RHA blends.

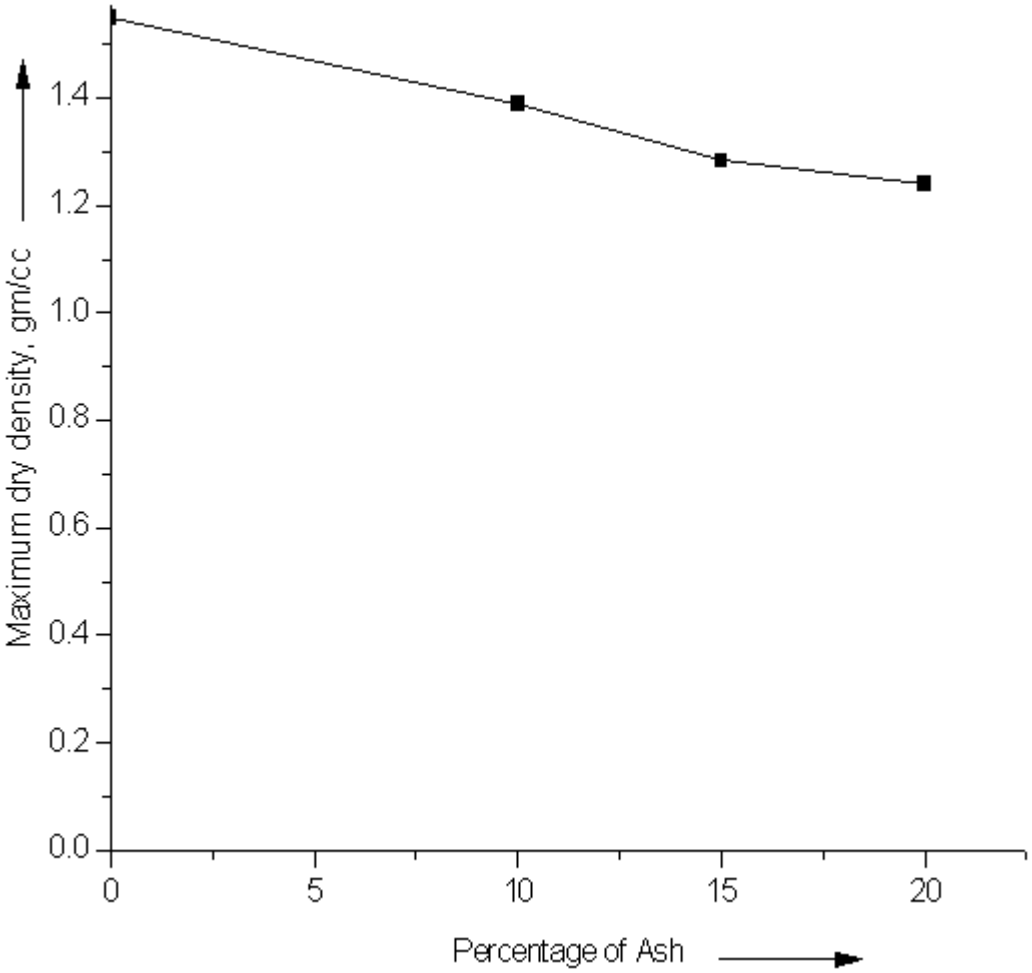

Figure 1: Change in MDD with RHA Content

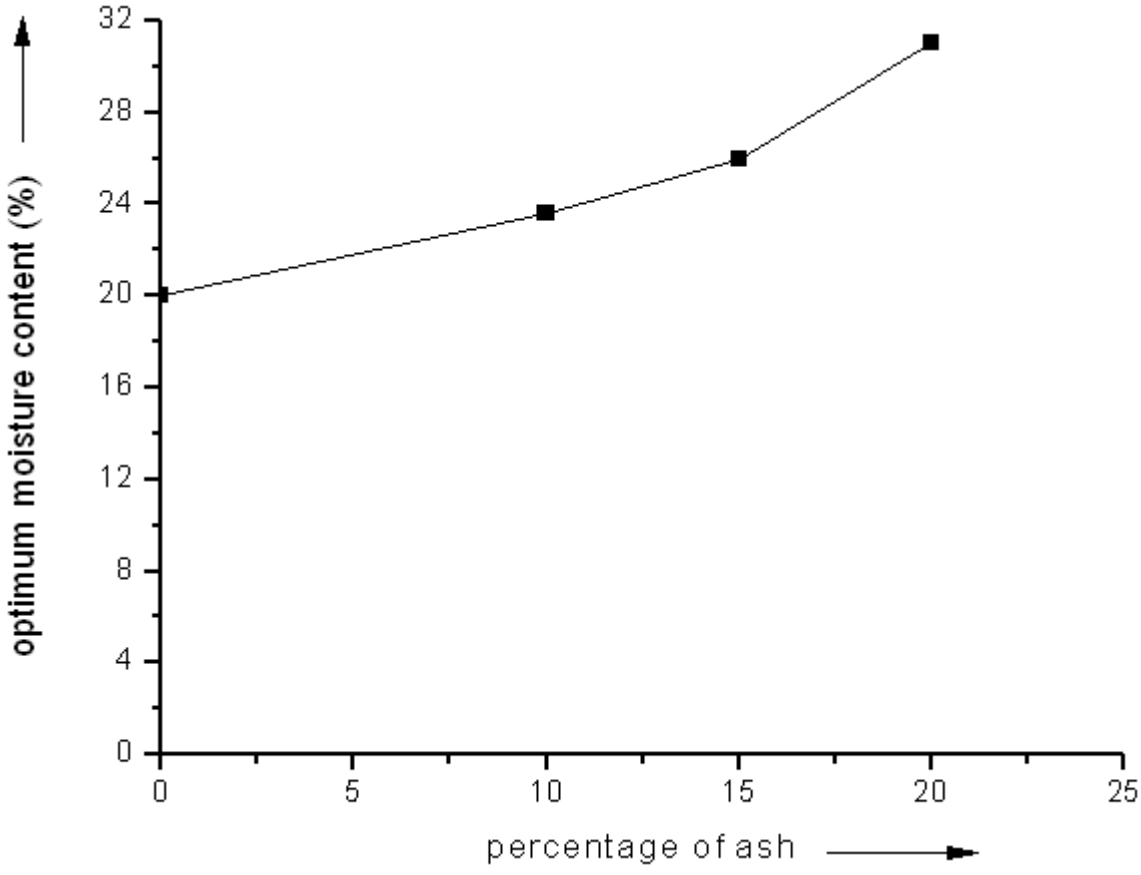

Figure 2: Change in optimum moisture content with RHA Content

4.2. Unconfined Compressive Strength

Unconfined compressive strength (UCS) is the most common and adaptable method of evaluating the strength of stabilized soil. It is the main test recommended for the determination of the required amount of additive to be used in stabilization of soil. Variation of UCS with increase in RHA from 10% to 20% was investigated and the results are shown in Figure 3.

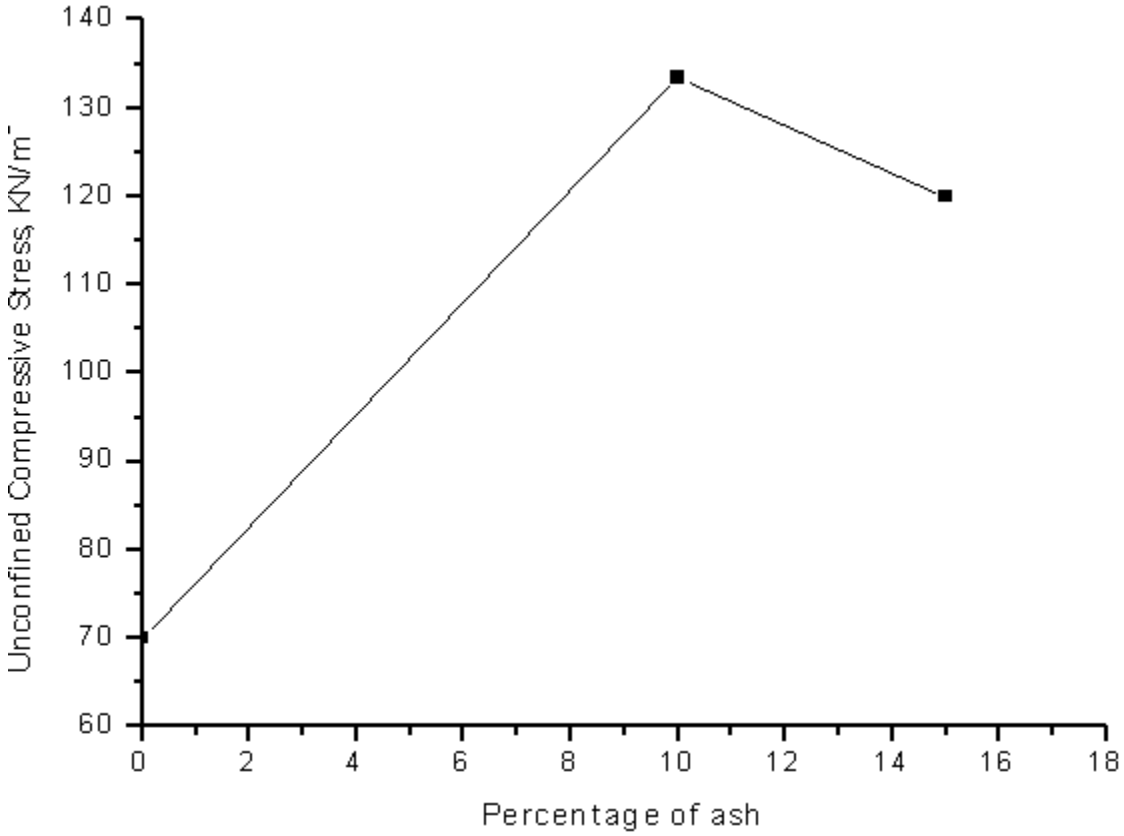

Figure 3. Change in UCS with RHA Content

The UCS is increased by 90.6% for RHA content of 10%. Further the value of UCS is slightly decreased for RHA content of 15%. This decrease may be due to earlier reason given in the case of CBR. The UCS values increase with subsequent addition of RHA to its maximum at 10% RHA after which it dropped. The subsequent increase in the UCS is attributed to the formation of cementitious compounds between the CaOH present in the soil and RHA and the pozzolans present in the RHA. The decrease in the UCS values after the addition of 10% RHA may be due to the excess RHA introduced to the soil and therefore forming weak bonds between the soil and the cementitious compounds formed.

4.3. California Bearing Ratio

As a marker of compacted soil quality and bearing limit, it is generally utilized in the plan of base and sub-base material for asphalt. It is likewise one of the normal tests used to assess the quality of settled soils. The variety of CBR with increment in RHA from 10 to 20% blended with soil and 6% cement is appeared in Figure 4. For unsoaked tests, the CBR esteem is expanded by 106% for RHA content of 10%. Further the CBR esteem is somewhat

diminished for RHA content of 15%. The purpose behind addition in CBR might be a direct result of the progressive arrangement of cementitious mixes in the soil by the response between the RHA and a few measures of CaOH present in the soil and cement present. The lessening in CBR at RHA content of 15% might be because of additional RHA that couldn't be activated for the response which thusly consumes spaces inside the example. This diminished the bond in the soil-RHA blend.

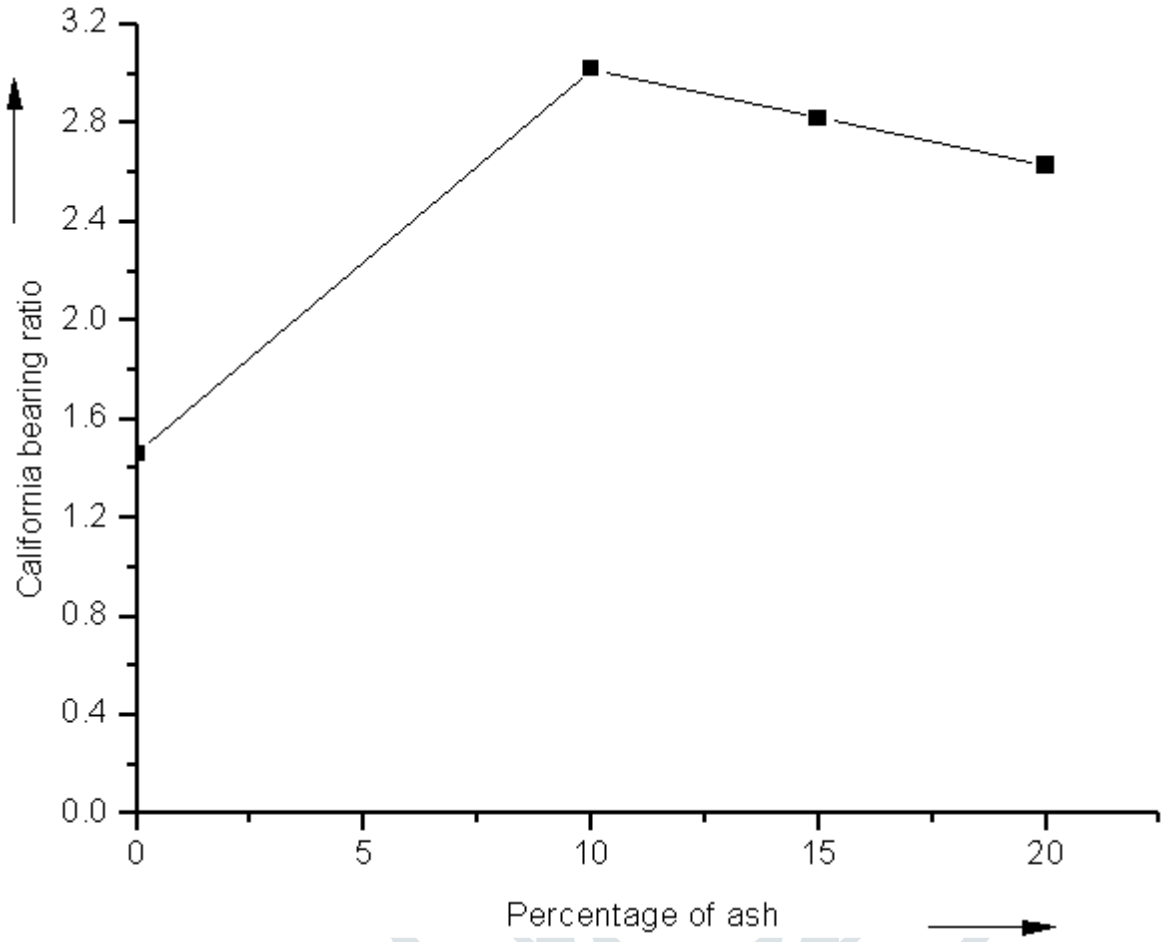

Figure 3. Change in CBR with RHA Content

5. Conclusion

From the consequences of this investigation, the accompanying ends can be brought down:

- The delicate soil is distinguished to be dirt of high pliancy (CH) as indicated by IS Soil Classification System. It has extremely low CBR-esteem (1.46) and Unconfined compressive pressure (70 KN/m2). The soil is required to be settled before doing any development work.
- A comparable pattern is gotten for UCS. The UCS esteem is at its crest at 10% RHA (90.6% improved).
- There is additionally an improvement in the unsoaked CBR (106% at 10% RHA content) contrasted and the CBR of the common soil.
- For greatest improvement in quality, soil stabilization utilizing 10% RHA content with 6% cement is suggested as optimum sum for viable purposes.

- Treatment with RHA and a little level of cement demonstrates a general abatement in the MDD and increment in OMC with increment in the RHA content.

References

1) Ali F Haji, A Adnan and Chew K C (1992), Geotechnical properties of a chemically stabilized soil from Malaysia with rice husk ash as an additive, *Journal of Geotechnical and Geological Engineering*, **10**, No. 2, pp. 117-134.
2) F O Okafor and U N Okonkwo (2009), Effects of rice husk ash on some geotechnical properties of laterite soil, *Leonardo Electronic Journal of Practices and Technologies*, **15**, pp. 67-74.
3) E B Oyetola and M Abdullah (2006), The use of rice husk ash in low-cost sandcrete block production, *Leonardo Electronic Journal of Practices and Technologies*, **8**, pp. 58-70.
4) E A Basha, R Hashim, H B Mahmud and A S Muntohar (2005), Stabilization of residual soil with rice husk ash and cement, *Construction and Building Material*, **19**, Issue 6, P 448-453.
5) Yedlapalli Srivani, Syed viqar malik, "purification of water by rice husk ash filter bed", international journal of creative research thoughts (ijcrt), issn:2320-2882, volume.6, issue 2, page no pp.82-88, april 2018
6) A Hossain and M Khandaker (2011), Stabilized soils in incorporating combinations of rice husk ash and cement kiln dust, *Journal Of Materials In Civil Engineering*, **10.1061**/(ASCE)MT.1943-5533.0000310.
7) IS 2720 (Part1 – 5, 7, 10,16), *Indian Standard Methods of Tests for Soils*.