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Soil Stabilization With Rice Husk Ash And Lime Sludge

Srinivas Ganta
Assoc. Prof. HOD Civil Dept. Abhinav Hi-Tech College of Engineering Imayath Nagar, RR Dist
Srinivasganta412@gmail.com

ABSTRACT:

Chemical stabilization of soil using cement, lime, etc. is costly. In order to introduce new material which can reduce the cost of chemical stabilization a review is made on rice husk ash. Rice husk is a waste material from paddy crop. After burning it gives the rich amount of silica which may be used as chemical stabilizer for soil stabilization.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. Various tests were also conducted on these mixes in order to find optimum proportion. 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

Keywords:clayey soil, lime, rice husk ash (RHA)Rice husk ash,Soil stabilization,Chemical stabilizer.

1.0 INTRODUCTION:

Stabilization of soil is a method to improve the index and engineering properties of soil. there are certain method of soil stabilization such as mechanical stabilization, chemical stabilization and bio- enzymatic soil stabilization.(RHA)may be used as chemical stabilizer as it contains high silica content. if soil contain medium or coarse sandy particles then mixing of (RHA) will occupy the void created by coarser particles, further leads to increase in shearing and bearing capacity due to increase in chemical bonding other than gravitation force. if major particle of soil contain clay minerals like montmorinolite then (RHA) which is having high silica content, replace exchangeable ion further leads to decrease in action exchange capacity(cec). cec decrease due to decrease in–ve ion as si replace other metallic ion such as na, mg etc. exchangeable ion present in the soil water leads to swelling of soil if it contain clay minerals like montmorinolite as they form week bond between clay particles. as clay surface is negatively charged si make stronger bond then other metallic ion present in clay minerals.clay soil often possess poor strength characteristic and pose serious construction problem causing large differential settlement to the structure constructed over them. Sinceclayey soil exhibit high swelling and shrinkage when exposed to change in moisture content and hence found to be most troublesome from engineering considerations. this behavior is due to presence of a mineral montmorillonit, kaolinite and iolite but mostly due to montmorillonit. Some- times, 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 be improved. Stabilization can be achieved by using either by pozzolanic material or chemicals. the fly ash, rice husk ash (RHA)construction demodulation waste (c&d), bagasse ash, saw dust ash and ground granulated blast furnace slagare some pozzolanic materials which can be used in stabilization of clayey soil. lime, cement, calcium chloride, sodium chloride, sodium silicate, calcium carbide and lime sludge are some chemicals used in stabilization of soil. How-ever, the previous works with (RHA) and lime has shown that it is promising potential of improving engineering properties of soil for subgrade purpose. thus this work focused on investigating the effect of (RHA) and lime on some geotechnical properties of clayey soil which are relevant for evaluating the performance of subgrade soil.

Black Cotton Soil:

Expansive soil which is also called as black cotton soil is very difficult to be used in construction. This is due to hot climate and poor drainage conditions associated with these soil formations. These soils inhibit the moisture from the surface in monsoon and summer season by means of evaporation. Owing to these reasons, the soil possess cyclic swell-shrink behavior, low strength, high moisture content, volume change in soil, differential settlement etc. These failures may result in longitudinal and transverse cracking of pavements, surface distress, rutting of surface and deep cutting in foundations. To overcome these circumstances in the soil, it should be treated and stabilized in best way.

Stabilization:

Stabilization is mostly used in variety of engineering works, where it is main objective is to increase the strength and improve the durability and stability of the soil in a cost effective way. Soil stabilization is the application or treatment of soil by mechanical methods or addition of modifier (cement, lime, bitumen etc.,) or combination of both to improve the strength of the soil. Expansive soil can also be stabilized by using waste materials. The usage of waste material in stabilization has been introduced due to sharp increase in price of stabilizing materials like cement, lime etc and increase in construction cost. To avoid these problems, wastes generated from the industries, agricultural areas can be used to stabilize the soil.

RICE HUSK ASH:

Rice Husk Ash (RHA) is one of the agricultural wastes produced in our country when the rice is milled from paddy. About 108 tones -of rice husk is produced in our world annually. Rice husk consists of about 67-90% of silica. The silica is present in this rice husk in amorphous form and it is considered to be a pozzolanic material. It has been estimated that 1000 kg of rice produce 200 kg of rice husk from which 40 kg of rice husk ash would be generated. The rice husk ash is obtained by burning the rice husk in akiln at a temperature of about 6000ºC for 24 hours. Since the silica is present in amorphous form, it reacts with CaOH and liberates the heat and forms the cementations compounds. Rice Husk is shown in Figure.

Figure 1- Rice Husk

Figure 2- Rice Husk Ash.

Lime:

In this study, lime is used as binding material in small amount to increase the strength of the soil satisfactorily. Lime is nothing but Calcium oxide or Calcium hydroxide. When the lime reacts with the soil, there is exchange of cations in adsorbed water layer which results in decrease in plasticity of soil. The lime is more friable and it is more suitable to use in subgrade. In my project work, the lime is added at a constant rate with the soil mixed with RHA and the improvement in strength is evaluated.

USES OF RICE HUSK ASH:

As a stabilizer : The Rice Husk Ash would appear to be an inert material with the silica in the crystalline form suggested by the structure of the particles, it is very unlikely that it would react with lime to form calcium silicates. It is also unlikely that it would be as reactive as fly ash, which is more finely divided. So Rice Husk Ash would give great results when it is used as a stabilizing material.

In lightweight fill: The ash would appear to be a very suitable light weight fill and should not present great difficulties in compaction, provided its initial moisture content is kept within reasonable limits (say less than 50%). The very high angle of internal friction of the material will mean that its stability will be high. However, the lack of cohesion may lead to problems in construction due to erosion and shearing under heavy rollers. To overcome these problems, it is desirable to place a 3 to 6 inch thick blanket layer of cohesive material for every 2 to 3 ft.

Other uses: The low density of the compacted rice husk ash over a wide range of moisture contents, coupled with small pore size and high permeability should make the material very suitable as a final filter for water supply. Un-burnt rice husk might be used as a first stage filter. Because it is cheaper, it could be replaced frequently, if necessary. The low compacted RHA would suggest its use in light weight concrete.

2.0 LITERATURE:

Parimal jam , Nisheet Tiwari (2016) This behavior is attributed to the presence of a mineral montmorillonit. The wide spread of the black cotton soil has posed challenges and problems to the construction activities. To encounter with it,

innovative and non- traditional research on waste utilization is gaining importance now a days.From the results of the investigation carried out within the scope of the study the following conclusion can be drawn Based on Specific gravity of a soil- With mixing of RHA, specific gravity of the soil increases by 0.3%. Strength of the soil is directly proportional to specific gravity, more is the specific gravity more will be the strength of soil.

B Kaduna 1 , N Kisku2 , K Murari 3J P Singh (2016) It is essential to improve load bearing capacity of clayey soil, for taking more load. 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.OMC of soil increases with increase in the percentages of lime and rice husk ash. MDD of clayey soil decreases with increase in the percentages of lime and rice husk ash content in clayey soilLiquid limit of clayey soil decreases with increase in percentage of lime and rice husk ash. Lime and RHA reduces the plasticity of clayey soilSpecific gravity increases with increase in percentage of lime and rice husk ash in clayey soil.

R. Oviya ,R.Manikandan (2016) These soils are found to be highly problematic in constructional activities. It causes severe damages to the structure because of its alternate swelling and shrinkage nature. This happens due to alternate drying and wetting of soil. To avoid these circumstances, soil must be stabilized and strength is to be increased. Soil can be modified or improved by many methods which include mechanical methods, use of chemicals or wastes as stabilizing agent etcThe specific gravity of the soil decreases with the addition of RHA to the soil. The liquid limit and plastic limit of the soil increases with the percentage increase of RHA. It was also observed that the maximum dry density (MDD) of the soil decreases with the addition of RHA due to lower specific gravity of RHA.

3.0 Methodology:

The soil sample and the perspective stabilizing sample is collected and sieved through 0.075mm aperture before use. Then its oxide composition is found out. And then, preliminary test are done on the soil sample and the stabilizing material to analyze the similarities in the geotechnical properties. The laboratory tests done to determine the properties include Particle size distribute on, Consistency Limits (Atterberg Limits), Insitu soil tests etc. The Standard Compaction test was done to find the optimum moisture content needed for the CBR test specimens. In the second phase of work, the Rice Husk ash is added to the soil from2.5% to 10% at an interval rate of 2.5% and lime is added at constant percentage rate of 2%. By this partial replacement being done in the soil, California Bearing Ratio (CBR) and Unconfined Compressive Strength (UCS) of the natural soil and soil mixed with RHA and soil mixed with RHA + lime is comparatively studied by this experimental work and result is analyzed for effective strength increment and reduction in construction cost and to provide green environment.

MATERIAL USED:

Expansive soil: The soil used in this study is expansive soil, obtained from NIT Campus, collected at a depth of 1.5m from ground level. The Index & Engineering properties of expansive soil are determined as per IS code of practice and determined & presented in table 3.

Rice Husk Ash: Locally available RHA was used in the present work. The physical and chemical properties are determined and presented in table 1and table 2.

Lime: The commercial grade lime was used in this present study. Gypsum: The gypsum was collected from Coriander Fertilizers

Table: 1 Chemical composition of rice husk ash

SiO2	86 %
Al2O3	2.6%
Fe2O3	1.8%
CaO	3.6%
MgO	0.27%
Loss in ignition	4.2%

Similar properties as like the soil sample. Therefore RHA sample is observed in the soil mechanics laboratory and its geotechnical properties is tabulated in Table

Figure Geotechnical Properties of RHA

Properties Test Results	Properties Test Results
Specific gravity	2.4
Liquid Limit (%)	49.4
Plastic Limit (%)	24.97
Plasticity Index (%)	24.43
Water Content (%)	30.16
Optimum Moisture Content (%)	14
Maximum Dry Density (g/cc)	1.51

Unconfined Compressive Strength:

This method is also used to evaluate the strength of stabilized soils. This test is mostly recommended to find out the amount of stabilizing material required in soil stabilization. The variation of UCS of the soil stabilized with RHA-lime admixture is shown in figThe UCs value increased with increase in RHA content at percentage intervals from 2.5% to 10%. The UCS value of the natural black cotton soil was found to be 250 KN/m2 . With the addition of 2.5% of RHA, the UCS value increased to 269 KN/m2 . On Further addition of 5% of RHA to the soil, the UCS value increased to 286 KN/m2 . After that, the UCS value decreases with addition of RHA content in the soil. This is because of the similar reasons said above in the CBR test itself. On excess addition of RHA, the reaction between the CaOH in the soil and rice husk ash becomes slow which results in weak bonding between soil-RHA mixtures.

Chemical Composition of Lime:

Chemical Parameters	Composition Value (%)
Calcium Oxide	90.80
Silica	3.50
Alumina	1.32
Iron Oxide	1.57

Lime is used as a binding material in small amount in this research. It provides an economical way of stabilization being less susceptible to water content. For the work, lime is used in sludge form taken from a industry in Puliyur village in Karur District, Tamilnadu. The Chemcial composition of the lime is tabulated in Table.

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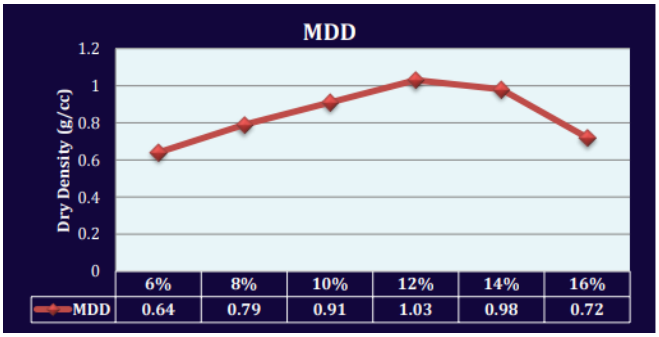
4.0 Results:

The standard compaction test is done according to the procedures given in the relevant Indian Standard Codes. The test is done to determine the variation in optimum moisture content and maximum dry density in natural soil and RHA mixed soil with 2% of lime. The Dry density of soil sample increases with the increase in moisture content in natural soil to a certain limit and get decreased after reaching the maximum dry density value. When the RHA mixed soil is compacted, the maximum dry density decreases with increase in moisture content with increase in RHA content. The decrease in MDD explains that the RHA is a light weight material with low specific gravity and more voids. So it absorbs water more in the void space provided. Hence more water is added to compact RHA mixed soil. Therefore lime is added to decrease the water content and increase the MDD of the soil in a good way



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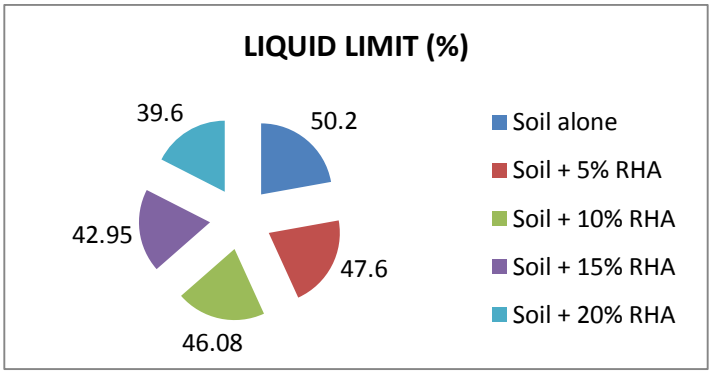
Graph Variation of MDD in Black Cotton Soil sample

Liquid Limit:

This test is done by liquid limit apparatus designed by A. Casagrande. A soil sample which passing through 425 micron and air dried mixed with water to form paste. 1cm thick layer is leveled in cup. Then groove is cut in the soil in the cup and the handle is rotated at the rate of 2 blows per sec. Water content just sufficient to close the groove for 13mm length at 25blows gives liquid limit. The method described herein is based upon.

Table Effect of RHA on Liquid Limit behavior

DESCRIPTION	LIQUID LIMIT (%)
Soil alone	50.20
Soil + 5% RHA	47.60
Soil + 10% RHA	46.08
Soil + 15% RHA	42.95
Soil + 20% RHA	39.60



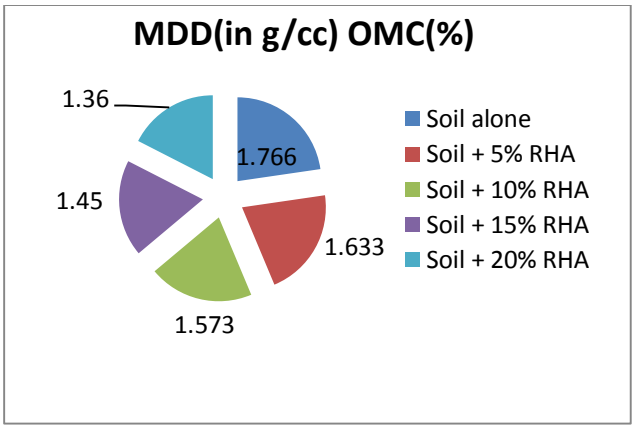
Graph Effect of RHA on Liquid Limit behavior and different variations

Table shows that the effect of Liquid Limit behavior on different percentage of RHA.It can be seen that with addition of RHA, the liquid limit continuously decreases from a water content of 50.20% to 39.60%.the variation of liquid limit of a soil with increasing percentage of RHA. Increase or decrease in liquid limit highly effect the compressibility and swelling characteristics of soil. Generally reduction in the liquid limit means reduction in the compressibility and swelling characteristics which is beneficiary for sub grade soil. Increase or decrease in liquid limit mainly depends on clay minerals present in soil.

Table Effect of RHA for Natural soil on OMC and MDD

DESCRIPTION	OMC(%)	MDD(in g/cc)
Soil alone	16.61	1.766
Soil + 5% RHA	18.12	1.633
Soil + 10% RHA	20.18	1.573
Soil + 15% RHA	22.05	1.45
Soil + 20% RHA	24.02	1.36

Above table shows that Effect of RHA for Natural soil on OMC and MDD. Standard proctor compaction test has been conducted in order to study the effect of solid waste on the compaction characteristics of soil with increasing percentage of RHA by weight basis. The results were obtained for soil with 0, 10, 15and 20% of RHA along with soil and listed



The variation in OMC on adding RHA in different proportion. OMC is increased with increase in the RHA content.The increase is due to the addition of RHA, which decreases the quantity of free silt and clay fraction and coarser materials with larger surface areas are formed. These processes need water to take place. This implies also that more water is needed in order to compact the soil-RHA mixtures

Conclusions:

- The addition of RICE HUSK ASH alone to the test soil resulted in decrease in the value of liquid limit.
- The addition of RICE HUSK ASH alone to the test soil resulted in decrease in the value of MDD.
- OMC of soil increases with increase in the percentages of lime and rice husk ash.
- MDD of clayey soil decreases with increase in the percentages of lime and rice husk ash content in clayey soil.
- Liquid limit of clayey soil decreases with increase in percentage of lime and rice husk ash.
- Lime and RHA reduces the plasticity of clayey soil.
- Specific gravity increases with increase in percentage of lime and rice husk ash in clayey soil.
- Lime is better stabilizing material than rice husk ash.
- Permeability of clayey soil decreases with increases in the percentages of lime and rice husk ash.

References:

[1] Parimal jam , Nisheet Tiwari (2016) Effect of Lime and Rice Husk Ash on Engineering Properties of Black Cotton Soil international journal of innovative technology and research Volume No.4, Issue No.3, April – May 2016, 2924 – 2926.

[2] R. Oviya ,R.Manikandan (2016) An Experimental Investigation On Stabilizing The

Soil Using Rice Husk Ash With Lime As Admixture "International Journal of Informative & Futuristic Research" Volume 3 , Issue 9,

[3] B Kaduna 1 , N Kisku2 , K Murari 3J P Singh (2016) **"**Experimental Study of Clayey Soil with Lime and Rice Husk Ash" International Journal of Engineering Trends and Technology. ISSN: 2231-5381, Volume 38 Number 7.

[4] Akshaya Kumar Sabat,(2014) "Engineering Properties of an Expansive soil Stabilized with Rice husk ash and Lime sludge" International Journal of Engineering and Technology (IJET), Vol 5, No.6

[5] S.M.Prasanna Kumar (2012), Silica and Calcium effects on Geo-tech Properties of Expansive soil extracted from Rice Husk Ash and Lime, "International Conference on Environment Science and Engineering, Vol 32 pp 119-123.