IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684,p-ISSN: 2320-334X,
PP 14-18
www.iosrjournals.org

Behavior of Clayey Soil Stabilized With Rice Husk Ash & Lime

Sudipta Adhikary[1], Sayak Nandy [2] , Romila Roy[3], Shyamsundar Bosu[4], Sayed Sujaudd Daulla[5]
[1,2,3,4,5]*(Department of Civil Engineering, Camellia School of Engineering & Technology, Barasat, India.)*

ABSTRACT: *Specifically in India, Soil generally present is Clay. Where in Various construction works are sincerely proves intricate because of swelling and shrinkage traits of Clayey soil. In this situation, frequently we do not have some other options other than Stabilizing the Soil. In modern-day technology, lot's of Chemical stabilizers are frequently practiced, however these are often high-priced and unhygienic in terms of environmental sustainability. The prevailing investigation has therefore been completed by using Rice Husk Ash(RHA) and Lime. RHA is an agricultural waste fabric of Rice production which commonly increases environmental pollutants. When we combined RHA and Lime collectively with virgin soil it makes some improvement on geotechnical properties of the virgin soil. The content of Silica in RHA and Calcium in Lime produces a pozzolanic and cementitious compound through the various sorts of chemical reactions. In this study RHA and Lime are mixed with distinctive proportions like, RHA as 5%,10%, 15% & 20%, in which Lime as 3% and some common laboratory experiments are done like, Atterberg limit Test, Proactor Compaction test, CBR(both Soaked & Unsoaked), UCS.*

KEYWORDS*: CBR (California Bearing Ratio), MDD (Maximum Dry Density), OMC (Optimum Moisture content), PI (Plasticity Index), UCS (Unconfined Compressive Strength).*

I. INTRODUCTION

Development of soil may be completed both via modification or stabilization or both. change of soil is associated with including some of the modifier (Cement, Lime and many others.) with the virgin soil to change its personal index properties. on the contrary, Soil stabilization is described , as the method by which strength and durability of the virgin soil is better such a manner that the soil end up quite beneficial for construction or other preference uses. over time, Cement and lime are the two foremost materials that are used for stabilization purpose. but, the marketplace charge of these substances are getting pretty high and aside from the monetary issues those stabilizing sellers are not proved as an environmental pleasant materials . As we recognize, that cement itself a prime source of carbon-di oxide production(Co_2) and lime additionally has an submit reactive phase which may additionally often produce a few quantity of carbon-di oxide (Co_2) as well.

In this paper an strive is made to reduce the quantity of use of the above stabilizer as fundamental stabilizing materials with the aid of substituting with Rice Husk Ash (RHA) with aggregate of lime. In our country, we are mostly involved with agricultural activities. consequently using agricultural waste will appreciably lessen the price of stabilization and also could be used as an effective sustainable substance. Rice Husk Ash is an agricultural waste received from milling of Rice. About 108 tones of Rice-Husk is generated yearly within the international belt . In the meantime the ash has been categorized beneath pozzolana , with 60-70% silica and about 49% Alumina and 0.95% Iron Oxides respectively .Therefore replacing houses of the cement in soil stabilization with a secondary cementitous cloth like RHA will considerably reduce the overall environmental impact of the stabilization process. Silica created from RHA have investigated efficiently as a pozzolanic fabric in soil stabilization. In this Paper we are simply trying to emphasize on some common Geo-technical properties of the soil after stabilizing it with diverse percentages(%) of RHA and lime and try to made an conclusion by way of seeing the experimental results.

.

II. MATERIALS USED

A. Soil Used:

Soil sample is collected from our college field at 2.5 m depth. As visual inspection On visible inspection it became determined to be light gray clayey silt. Evaluated properties of the soil are shown in Table-1.0 below. Based on L.L. and P.I. the soil may be classified as CI.

Table:1.0 Physical Properties of soil

SL.No.	Test Conducted	Results
1.	Specific Gravity	2.63
2.	Particle Size Distribution(%)	
	(a) Sand	9
	(b) Silt	81
	(c) Clay	10
3.	Liquid Limit(%)	48
4.	Plastic Limit(%)	26
5.	Plasticity Index(%)	22
6.	Classification of Soil	CI
7.	Maximum Dry Density(MDD) (gm/cc)	1.61
8.	Optimum Moisture Content(OMC) (%)	20
7.	Unconfined Compressive Strength(KN/M^2)	130
8.	California Bearing Ratio(CBR) (%)	
	Unsoaked	4.3
	Soaked	2.6

B. Rice Husk Ash

Rice Husk Ash, essentially a waste fabric ,is produced by way of Rice mill industry even as processing rice from paddy . Rice husk ash is a pozzolanic material that would be doubtlessly utilized in soil . It is most available material ,especially in India and inexpensive too. The Chemical properties of RHA are shown in Table:1.1

Table:1.1 Chemical Properties of RHA

Chemical Composition	Percentage(%)
Silica(SiO_2)	83.60
Aluminium(Al_2o_3)	3.5
Iron(Fe_2O_3)	1.10
Calcium(CaO)	1.80
Magnesium(MgO)	1.28
Sodium(Na_2O)	0.17
Potassium(K_2O)	0.29

C. LIME:

Lime is a caustic material appears usually in white colour, it is normally obtained from Lime stone. When Lime combines through water it generates some heat and gain some reasonable strength characteristics as well.

III. METHODOLOGY

In This paper we have mixed RHA of 5%. 10%. 15% and 20% with virgin soil and conducting the following tests like (a) Atterberg Limit Test, (b) Standard Proactor Test, (c) UCS (d) CBR. And followed by we have mixed 3%. lime subsequently with RHA and Soil mixture and try to evaluate the combined effects of Lime and RHA on the Geo- technical properties of the original soil and comparing the results we are trying to draw a conclusion. Table: 1.2 and Table: 1.3 shows the detail mixed proportion.

Table: 1.2 Mix proportions of Soil and RHA

SL.No.	% Soil	% RHA
1.	100	0
2.	95	5
3.	90	10
4.	85	15
5.	80	20

Table: 1.3 Mix proportions of Soil, Lime and RHA

SL No.	% Soil	% Lime	% RHA
1.	100	0	0
2.	92	3	5
3	87	3	10
4.	82	3	15
5	77	3	20

IV. RESULTS AND DISCUSSION

When RHA is added with the virgin soil, it shows some significant changes on to its Geo-technical properties. It represent in the Table:1.4 and the subsequent graph from Fig:1.0 to Fig 1.4

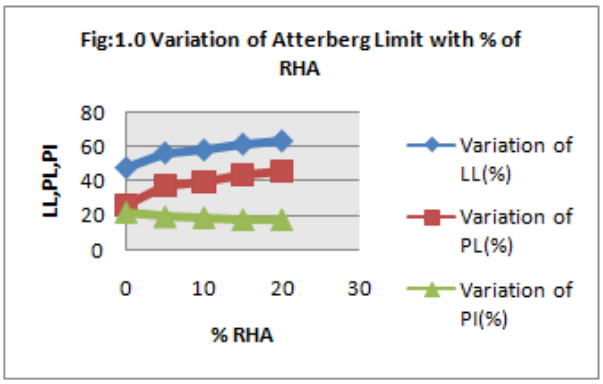
Table-1.4 Shown the Details Test results of Soil and RHA:

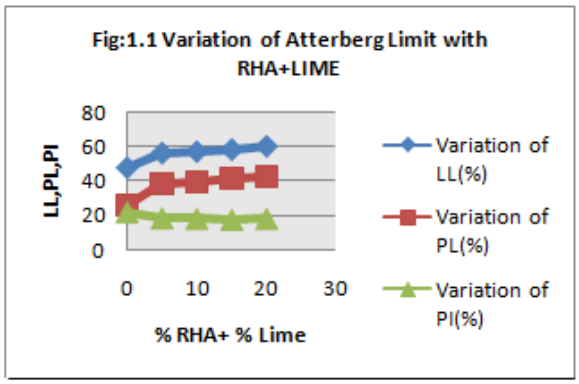
Sl No.	**% Soil**	**% RHA**	**LL(%)**	**PL(%)**	**PI(%)**	**OMC(%)**	**MDD(gm/cc)**	**CBR(%)**		**UCS(KN/M^2)**
								Unsoaked	**Soaked**	
1.	100	0	48	26	22	20	1.61	4.3	2.6	130
2.	95	5	56.6	37.2	19.4	23.5	1.43	7.35	4.8	93
3.	90	10	58.3	39.4	18.9	25.4	1.39	7.9	6.2	99
4.	85	15	61.7	43.95	17.75	28.3	1.35	8.2	7.9	125
5.	80	20	63.5	45.69	17.81	30.8	1.29	8.8	10.6	143

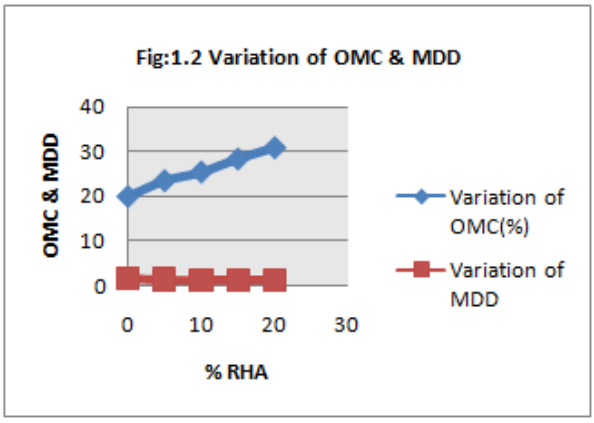
When RHA and Lime both added together with the original soil then it shows the following changes which is presented to the Table1.5

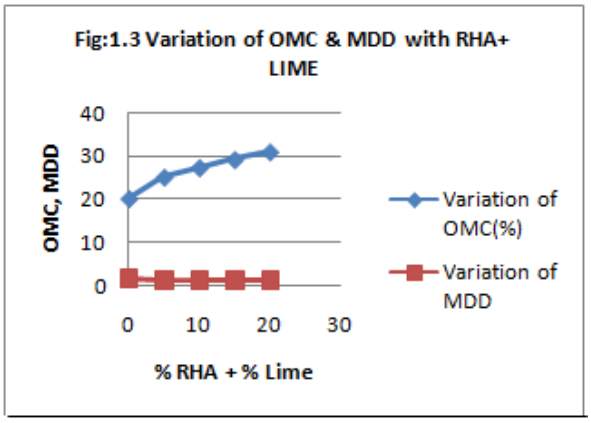
Table: 1.5 shown the Details Test results as follows

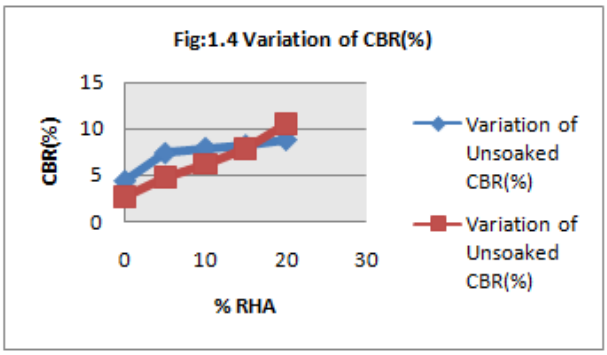
Sl No.	**% Soil**	**% Lime**	**% RHA**	**LL(%)**	**PL(%)**	**PI(%)**	**OMC(%)**	**MDD(%)**	**CBR(%)**		**UCS(KN/M^2)**
									Unsoaked	**Soaked**	
1.	100	0	0	48	26	22	20	1.61	4.3	2.6	130
2.	92	3	5	56.5	38.2	18.3	25	1.41	8	12.5	155
3.	87	3	10	57.3	39.3	18	27.2	1.38	12.85	17	205
4.	82	3	15	58.5	41.1	17.4	29.1	1.33	12	12	106
5.	77	3	20	60.4	42.4	18	30.9	1.29	12.4	11.45	90

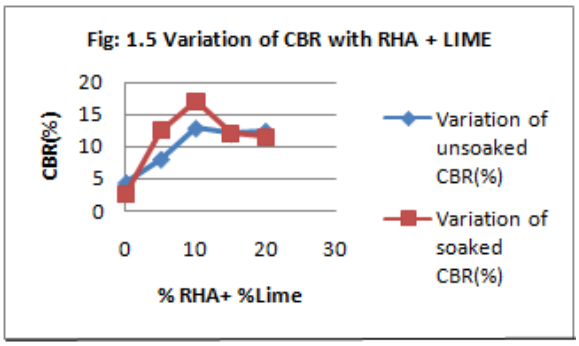


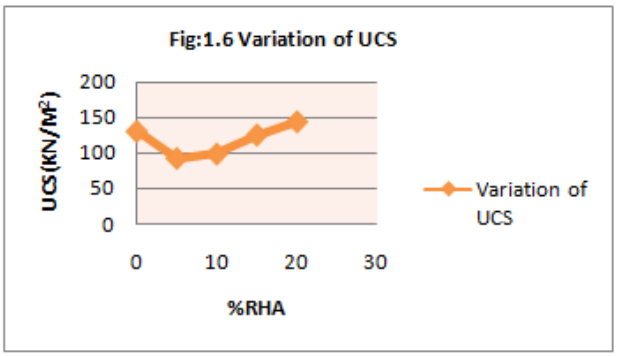


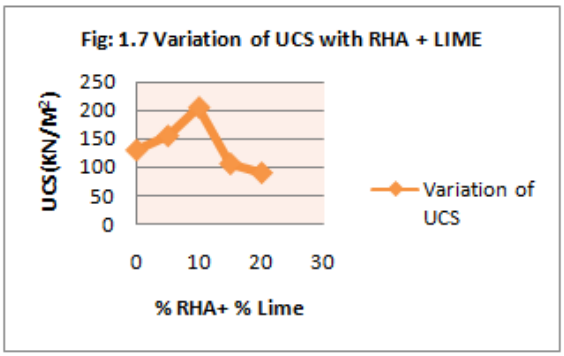












- **Effects of admixture on consistency limits of soil:**

When Lime or RHA or other admixture added separately with soil or in combination with lime & RHA, the value of L.L and P.L. of mixed soil increases sharply but at the same time the value of P.I. of mixed soil decreases. The nature of this change is shown by the Fig: 1.0 & 1.1. Careful observation of the tables 1.4 & 1.5 will show that addition of admixtures make soil MH in all the cases from CI i.e. The term "MH" explain that the stabilized soil is turning to high compressible inorganic silty soil from the medium compressible inorganic clayey silt.

- **Effects of admixture on compaction characteristics of soil:**

The moisture content and dry density relationship of admixture contained soil is presented in figures from 1.2.& 1.3. From the curves it may be observed that with the percentage increase in admixture content optimum moisture content (OMC) of admixed soil increases gradually and maximum dry density(MDD) decreases.

The cause of decrease may be attributed to the replacement of soil in the RHA soil mixture by RHA, which have relatively low specific gravity (1.95) compared to that of the virgin soil which has a specific gravity of 2.63. The cause of decrease in MDD may also be attributed to coating of the soil particles by RHA which results in larger particles with larger voids and hence lesser density, and for Lime and RHA admixed soil, it can be seen that MDD continues to decrease with increase in lime content for a given percentage (%) of RHA content .

- **Effects of admixture on Strength characteristics of soil:**

The CBR curves of individual admixture have been presented from figures 1.4 & 1.5 and the UCS curves to the figure 1.6 & 1.7.From the general nature of the CBR curves it is seen that the CBR values of lime admixed soil in increasing with increasing percentage (%) of lime content and in all the cases of lime soil combination soaked CBR is more than the unsosaked CBR. The UCS value with lime addition also goes on increasing with lime content. But when lime and RHA both are mixed with the virgin soil the strength characteristics have further increased .The increase in CBR value after addition of lime is due to the formation of various cementing agents due to pozzolanic reaction between the amorphous silica or Alumina, present in the natural soil and lime. This reaction produces stable calcium silicate hydrates and calcium aluminate hydrates as the calcium from the lime reacts with the aluminates and silicates solubilized from the clay

V. CONCLUSION

Based on the test results, Addition of RHA enhance the Geo-technical properties of the original soil and it also has nice results at the energy traits of the soil. RHA is an agricultural waste that is cheaper and environmental friendly, so as an powerful stabilizer RHA could have been a very good opportunity. at the opposite while we blended Lime with RHA it is proved that the blended results of the each admixture is pretty handful compare to use any single admixture like RHA.

REFERENCES

[1]. Akhtar, J.N. , Alam,J , Ahmad,S(2008). "The influence of randomly oriented hair fibre and lime on the CBR value of Dadri flyash."Article Department of Civil Engineering Aligarh University.

[2]. AllenLunzhuli.R.KerryRowe(2008)."Effects of viscous behavior of geosynthetic reinforcement And foundation soils on the performance of reinforced embankments". Geotextile and geomembranes Vol 126, pp: 317- 334.

[3]. Athanasopoulou, A. (2014)."Addition of lime and fly ash to improve highway sub-grade soils". Journal of Materials in Civil Engineering, 26(4), 773-775.

[4]. Arvind Kumar., Deepak Gupta., (2015) "Behavior of Cement –stabilized fiber-reinforced Pond Ash, Rice Husk Ash-soil mixtures". ELESVIER. Geotextiles and Geomembranes, pp-1-9.

[5]. Aparna Roy(2014),."Soil Stabilization using Rice husk-Ash and Cement", International Journal of Civil Engineering Research,Vol-5,Number 1,pp-49-54.

[6]. Alhassan, M.,(2008). "Potentials of Rice husk –Ash for soil stabilization" , AU J.T. 11 (4) pp 246-250/ Apr.

[7]. Ambarish Ghosh,.(2003)."Compaction characteristics and Bearing Ratio of Pond Ash stabilized with Lime and Phospho-gypsum", Materials in Civil engineering ASCE/APRIL, pp 343.

[8]. Benson, C.H, Hatipoglu, B., Edil,T.B., (2008). "Evaluation of base prepared from road surface gravel stabilized with fly ash".ASCE geotechnical special publication.

[9]. Brooks, R., Udoeyo, F.F., &Takkalapelli, K.V. (2011)."Geotechnical properties of problem soils stabilized with fly ash and limestone dust in philadelphia". Journal of Materials in Civil Engineering, 23(5), pp711-716.

[10]. Benson, Tuncer B., Edil,Hector, A.,costa.,(2006). "Stabilizing soft fine –grained soils with fly ash". Materials in Civil Engineering ASCE/MARCH/APRIL,. pp 283.

[11]. Erdal Cokca (2001). "Use of Class-C Fly Ashes for the stabilization-of an expensive soil" Journal of Geotechnical and Geo-environmental engineering Vol.127,July,pp-568-573.