International Journal of Enhanced Research in Educational Development
ISSN: 2320-8708, Vol. 3 Issue 5, September-October, 2015

Stability of Clay Soil Using Rice Husk Ash and Stone Dust

Shyam bhushan[1], Rajesh Kumar[2], Assistant Professor Ved Parkash[3]

Abstract: Soil stabilization has become a major issue in construction engineering and the researches regarding the effectiveness of using industrial wastes are rapidly increasing. The present experimental work briefly describes the suitability of the locally available Rice Husk Ash (RHA) to be used in the local construction industry in a way to minimize the amount of waste to be disposed to the environment causing environmental pollution. The common soil stabilization techniques are becoming costly day by day due to the rise of cost of the stabilizing agents like, cement, lime, etc. The cost of stabilization may be minimized by replacing a good proportion of stabilizing agent using RHA. It will minimize the environmental hazards also. Soil sample taken for the study is clay with medium plasticity (CI) which truly requires to be strengthened. The soil is stabilized with different percentages of Rice Husk Ash and a small amount of Stone Dust. Observations are made for the changes in the properties of the soil such as Maximum dry density (MDD), Optimum moisture content (OMC) and Unconfined compressive stress (UCS). UCS of soil are considerably improved with the RHA content and Stone Dust.

Keywords: Soil Stabilization, Clay Soil (CI), Rice Husk Ash (RHA), Stone Dust, Optimum Moisture Content (OMC) Unconfined Compressive Stress (UCS).

I. Introduction

Soil is a good and comfortable material for the construction purpose so it also very important to know about the properties and feasibilities of used soil before use in any kind of construction process. One parameter of the main parameters is that the variation in the properties and characteristics of the soil is changes according to the change in the area and environment of the soil for any land-based structure, the foundation is very important and has to be strong to support the entire structure. In order for the foundation to be strong, the soil around it plays a very critical role. So, to work with soils, we need to have proper knowledge about their properties and factors which affect their behavior. The process of soil stabilization helps to achieve the required properties in a soil needed for the construction work. From the beginning of construction work, the necessity of enhancing soil properties has come to the light. Some types of soil have low bearing capacity and do not fulfill the engineering works. So to improve the engineering properties of soil and make it suitable for engineering works soil stabilization is needed. Soil stabilization is the process which improves the engineering properties of soil and makes it stable. The main objective of soil stabilization is to improve the strength and stability of soil and mainly to lower the construction cost. The stability and bearing capacity of soil depends on the shear strength, which is directly proportional to the type and condition of the soil. In some of the situations where two materials do not have the desired engineering properties, but when they mix together, they produce satisfactory material. The new stabilized material will be more stable and fulfil the desired conditions.

II. Objectives of The Study

1) Improvement in stability of soil for the good building construction in civil engineering.
2) Making the foundation process cheap and comfortable in economically.
3) Observe a right concentration mixture of the additional components like rice hush ash and stone dust.
4) Use of wastage material which is producing in high potential and having disposal problems.

III. Literature Review

Rice Husk Ash

Rice husk ash (RHA) is the ash produced by burning of rice husk.

Bhasin et al. (1988) made a laboratory study on the stabilization of black cotton soil as a pavement material using RHA, along with other industrial wastes like fly ash, bagasse ash, lime sludge, black sulphite liquor independently with and without lime. The RHA causes greater improvement than that caused by other wastes due to presence of higher percentage of reactive silica in it. In combination with lime, RHA improved the properties of black cotton soil significantly.

Sabat (2013) had studied the effect of lime sludge (from paper manufacturing industry) on compaction, CBR, shear strength parameters, coefficient of compression, Ps and durability of an expansive soil stabilized with optimum percentage of RHA after 7days of curing. The optimum proportion soil: RHA: lime sludge was found to be 75:10:15.

Ashango and Patra (2014) had studied the static and cyclic properties of clay subgrade stabilized with RHA and Portland slag cement. The optimum percentage of RHA was found to be 10% and Portland slag cement as 7.5% for stabilization of expansive soil. They concluded that the stabilized expansive soil was found suitable for subgrade of flexible pavement as, there was significant increase in strength and the stabilized soil was durable

Marble Dust

Marble dusts are the wastes/dusts produced during cutting and polishing of marble.

Swami (2002) and, Palaniappan and Stalin (2009) had stabilized expansive soil using marble dust and were successful in improving different properties of expansive soil.

Sabat and Nanda (2011) had studied the effects of marble dust on strength and durability of rice husk ash stabilized expansive soil and found that addition of marble dust increased the strength, decreased the swelling pressure and made the soil-rice husk ash mixes durable. The optimum proportion of soil: rice husk ash: marble dust was found to be 70:10:20.

Zhang et al.(2013) had found the positive effects of marble dust on strength, swelling and durability of biomass ash stabilized expansive soil. The optimum proportion of soil: biomass ash: marble dust was found to be 75:10:15.

Gupta and Sharma (2014) had studied the effect of fly ash, sand and marble dust on compaction and CBR values of expansive soil ,there was approximately 200% increase in soaked CBR in the sample having soil -52.36%,sand-22.44%,fly ash -13.2% and marble dust- 12%.

IV. Materials Used

Soil used

Soil used in the experiments has been collected from village ATWAN, KURUKSHETRA (HARYANA). Soil sample is collected from 0.3-0.5 m below the ground surface

Table. 1

S.NO.	Properties	Typical Value
1.	I.S. Classification	CI
2.	Plastic Limit	42.35
3.	Liquid Limit	21.23
4.	Plastic Index	21.12
5.	Specific Gravity	2.61

.

Rice Husk Ash: Locally available RHA was used in the test.

Stone Dust: The Stone Dust was collected from Locally STONE CRUSHER.

V. Experimental Process

1) Analysis of standard protcor test(SPT)
2) Unconfined Compressive Strength (UCS)

A. Standard Protcor Test(SPT)

To perform the SPT for Clay soil, rice husk ash and stone dust with variation in composition in quantity sample are prepared that are shown below in table no. 1. Individually test for all samples so to perform the test we have made 15 sample of different – 2 compositions.

Table no. 2 Composition of 15 samples

Sample 1	CI - 100% + SD - 0% + RHA- 0%
Sample 2	CI - 95% + SD - 0% + RHA- 5%
Sample 3	CI - 90% + SD - 0% + RHA- 10%
Sample 4	CI - 85% + SD - 0% + RHA- 15%
Sample 5	CI - 80% + SD- 0% + RHA - 20%
Sample 6	CI - 90% + SD - 10% + RHA - 0%
Sample 7	CI - 85% + SD - 10% + RHA - 5%
Sample 8	CI - 80% + SD - 10% + RHA - 10%
Sample 9	CI - 75% + SD - 10% + RHA - 15%
Sample 10	CI - 70% + SD - 10% + RHA - 20%
Sample 11	CI - 80% + SD - 20% + RHA - 0%
Sample 12	CI- 75% + SD - 20%+ RHA - 5%
Sample 13	CI - 70% + SD - 20%+ RHA - 10%
Sample 14	CI - 65% + SD - 20% + RHA - 15%
Sample 15	CI - 60% + SD - 20% + RHA - 20%

B. Unconfined Compressive Test

The unconfined compressive tests were conducted on the rice husk ash and stone dust clay soil samples. it is noted that unconfined compressive value of the rice husk ash and stone dust in various proportions has increased gradually from 0kg/mm2 to maximum compressive strength and materials combinations is optimum percentages of unconfined compressive value is find out.

Table 3 List of sample composition formation for the UCS test performance

Sample test -1	Parent Soil (CI - 100% + SD - 0% + RHA- 0%)
Sample test -2	CI - 95% + SD - 0% + RHA- 5%
Sample test -3	CI - 90% + SD - 0% + RHA- 10%
Sample test -4	CI - 85% + SD - 0% + RHA- 15%
Sample test -5	CI - 80% + SD- 0% + RHA - 20%
Sample test -6	CI - 90% + SD - 10% + RHA - 0%
Sample test -7	CI - 85% + SD - 10% + RHA - 5%
Sample test -8	CI - 80% + SD - 10% + RHA - 10%
Sample test -9	CI - 75% + SD - 10% + RHA - 15%
Sample test -10	CI - 70% + SD - 10% + RHA - 20%
Sample test -11	CI - 80% + SD - 20% + RHA - 0%
Sample test -12	CI- 75% + SD - 20%+ RHA - 5%
Sample test -13	CI - 70% + SD - 20%+ RHA - 10%
Sample test -14	CI - 65% + SD - 20% + RHA - 15%
Sample test -15	CI - 60% + SD - 20% + RHA - 20%

VI. Results and Discussion

A. Standard Proctor Test Comparison

The Standard Proctor Test were conducted on the rice husk ash and stone dust with clay soil samples. it is noted that dry density value increase with the decreasing of water content . The various results for Standard Proctor Test are compared in graphical presentation in below graph.

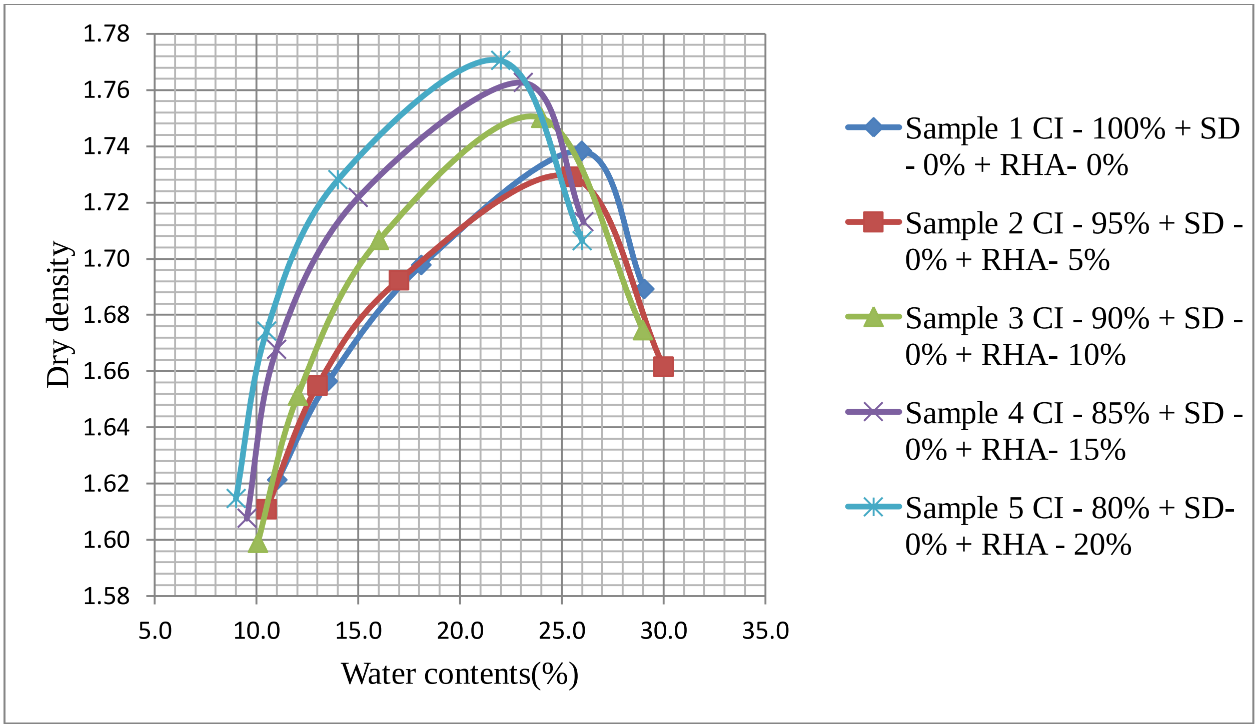
Table no.4 Comparisons between Maximum Dry density and Maximum water content

Result for All Maximum		
Dry density and Maximum water content		
Sample	Maximum Dry density, Ɣd	Maximum Water contents, w (%)
Sample 1	1.74	26.00
Sample 2	1.73	25.50
Sample 3	1.75	24.00
Sample 4	1.76	23.10
Sample 5	1.77	22.00
Sample 6	1.73	26.00
Sample 7	1.74	25.40
Sample 8	1.76	24.60
Sample 9	1.77	23.00
Sample 10	1.78	22.10
Sample 11	1.74	26.10
Sample 12	1.75	25.10
Sample 13	1.76	24.30
Sample 14	1.77	24.50
Sample 15	1.79	23.00

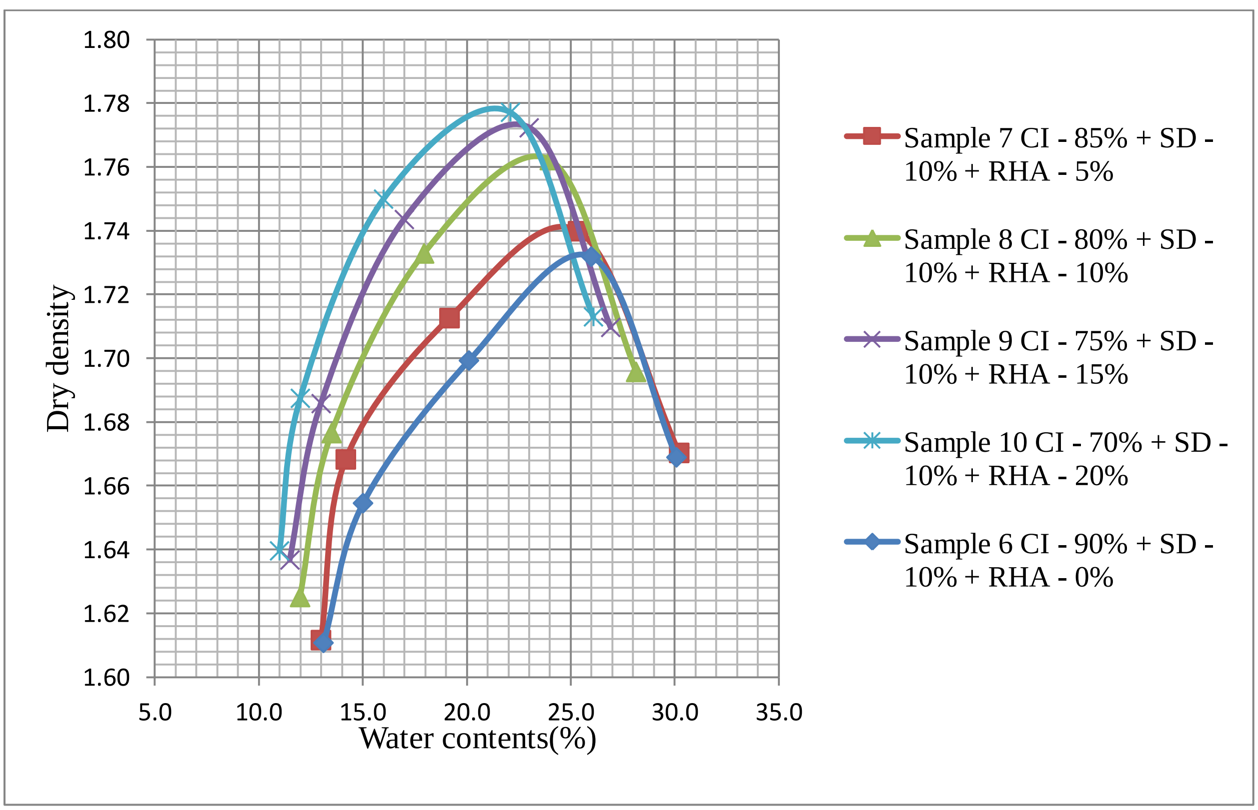
The table shows the maximum dry density at maximum water content for Standard Proctor test. The maximum water content values for Standard Proctor test is select from the curve height.

While performing the SPT test we plot various curve with combination of Clay soil, Stone Dust and Rice husk Ash.

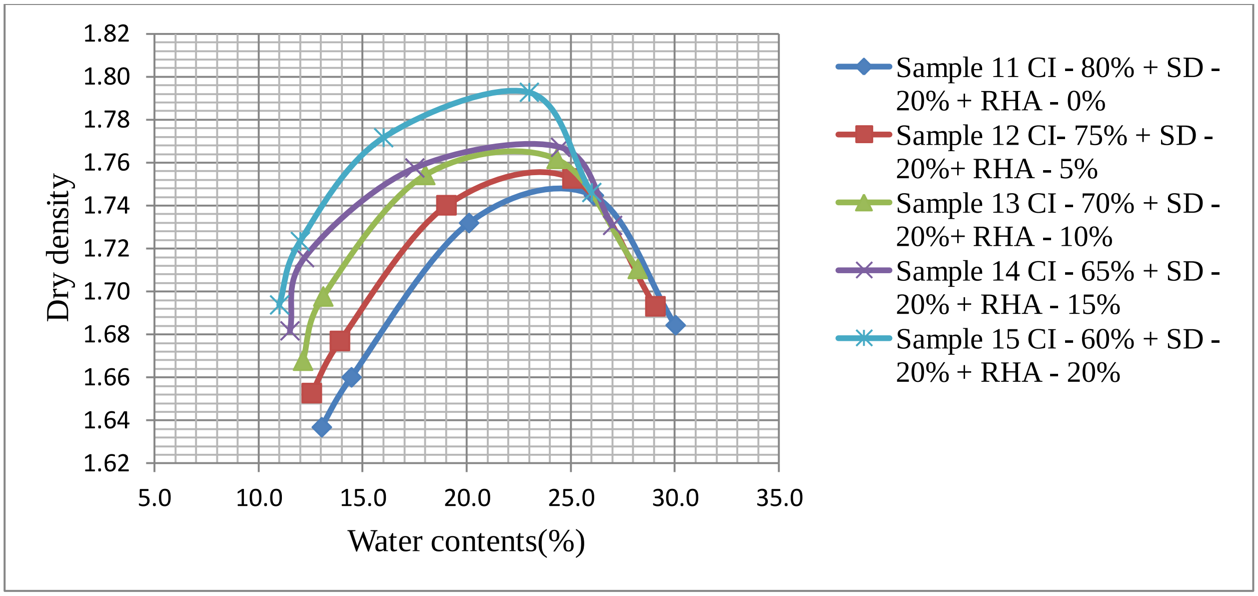
Graph 1 Graphical presentations of comparison between Maximum dry density and maximum water content for SD - 0 %, RHA-(0.0, 5.0, 10.0, 15.0, and 20.0) %



Graph 2 Graphical presentations of comparison between Maximum dry density and maximum water content for SD-10 %, RHA-(0.0, 5.0, 10.0, 15.0, and 20.0) %



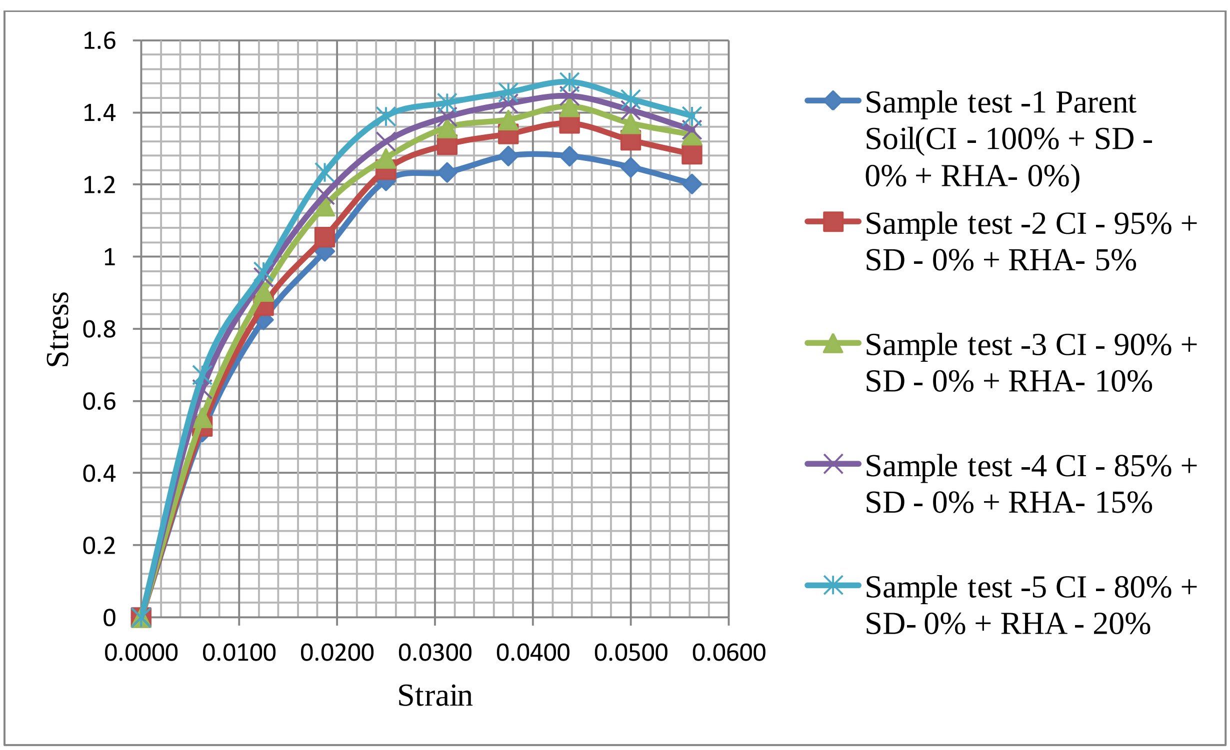
Graph 3 Graphical presentations of comparison between Maximum dry density and maximum water content for SD-20 %, RHA-(0.0, 5.0, 10.0, 15.0, and 20.0) %



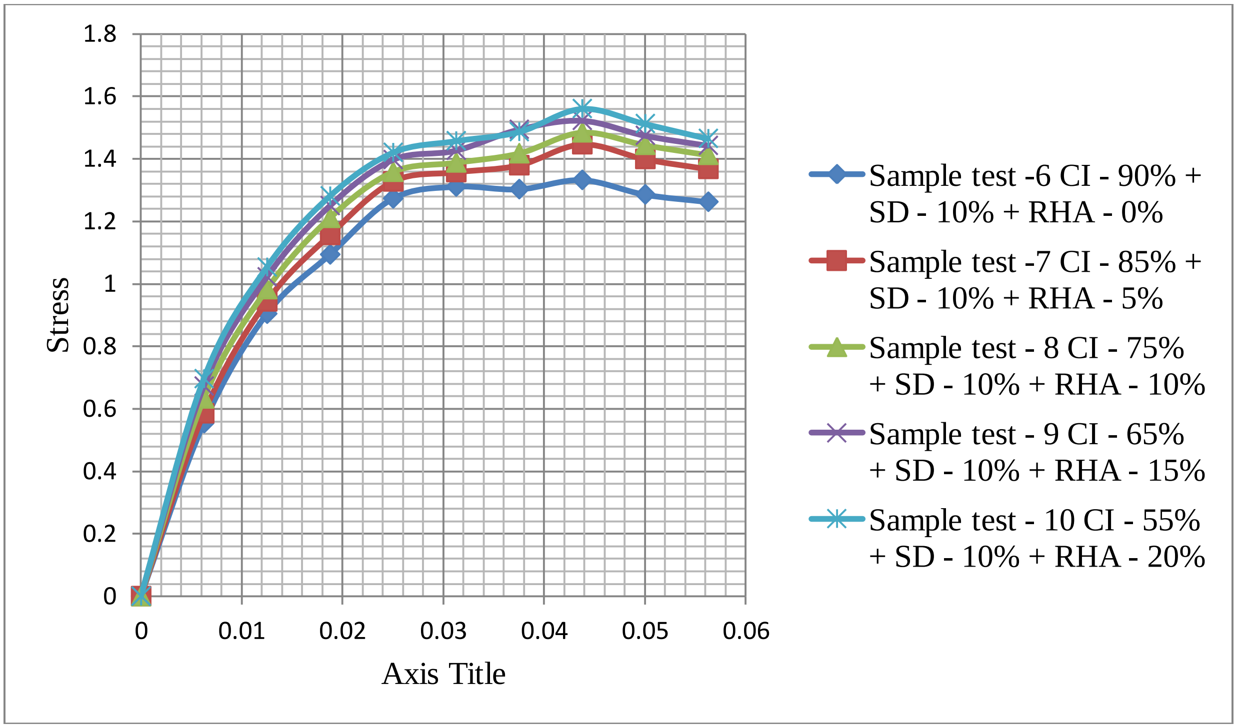
B. Unconfined Compression Test Comparison

The unconfined compressive tests were conducted on the rice husk ash and stone dust clay soil samples. it is noted that unconfined compressive value of the rice husk ash and stone dust in various proportions has increased gradually from 0kg/mm2 to maximum compressive strength and materials combinations is optimum percentages of unconfined compressive value is find out. The various results for Unconfined Compressive Test are compared in graphical presentation in below graph.

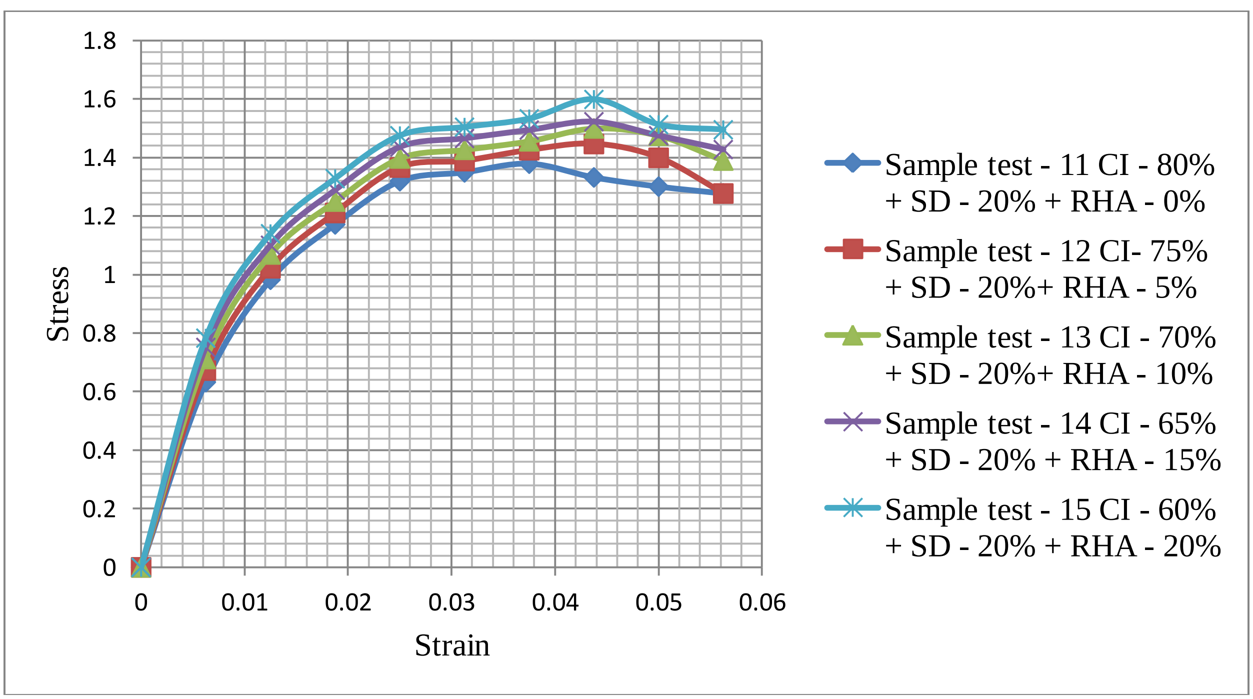
Graph no 4 Graphical presentations of comparison between Maximum Stress and maximum Strain for SD – 0 %, RHA-(0.0, 5.0, 10.0, 15.0, and 20.0) %



Graph no 5 Graphical presentations of comparison between Maximum Stress and maximum Strain for SD – 10 %, RHA-(0.0, 5.0, 10.0, 15.0, and 20.0) %



Graph no 6 Graphical presentations of comparison between Maximum Stress and maximum Strain for SD – 20%, RHA-(0.0, 5.0, 10.0, 15.0, and 20.0) %



Combined result for Mechanical properties of Soil with varying composition of additional contents

Table no. 5 Comparison of mechanical properties

Description of sample	Mechanical properties	Percentage of rice husk ash				
		0%	5%	10%	15%	20%
SD - 0 %	Strain	0.0375	0.0438	0.0438	0.0438	0.0438
	Stress	1.280	1.370	1.416	1.447	1.485
SD - 10 %	Strain	0.0438	0.0438	0.0438	0.0438	0.0438
	Stress	1.332	1.447	1.485	1.523	1.612
SD - 20 %	Strain	0.0375	0.0438	0.0438	0.0438	0.0438
	Stress	1.379	1.447	1.500	1.523	1.599

Conclusions

During test performance we found that Standard Proctor Test (SPT) and Unconfined Compression Test (UCS) are very important for testing the properties of used soil for the construction process. All the results were described above in detail, some conclusion were taking out from this study are given below:-

- The dry density of the sample is increases with decreases in water content.
- Maximum water content during performing SPT excepting parent soil is 25.5 at 1.73 dry density
- Minimum water content during performing SPT excepting parent soil is 23 at 1.79 dry density
- Mixing materials like Stone Dust and rice husk ash must be available in high potential for this type of soil treatment.
- Maximum strength of mixture 1.612 with 0.0438 strain that is from the composition of 10% SD and 20% RHA
- The compressive strength of used mixture is increases for a particular composition after that it goes falling down.
- For this kind of soil treatment mixing of soil with right composition is not very easy process it is also a very important process for best performance at lowest coast.

References

[1] **IS-2720 (part VIII) 1980 Methods of Test for soil** "Determination of optimum moisture content & maximum dry density of soil by Standard Proctor Test (light Compaction)"

[2] **BIS 2720 (Part VII)**, Method of tests for Soils-Part 7, "Determination of water content-dry density relation using light compaction", Second Revision, New Delhi, (1980).

[3] **Bhasin, N. K., Goswami, N. K., Oli, P., Krishan, N. and Lal, N.B. (1988)** "A Laboratory Study on the Utilisation of Waste Materials for the Construction of Roads in Black Cotton Soil Areas," Highway Research Bulletin, 36, 1-11.

[4] **Muntohar, A.S. and Hantoro, G. (2000)** "Influence of Rice Husk Ash and Lime on Engineering Propert

[5] **Basha, E.A. Hashim, R. and Muntohar, A.S. (2003)** 'Effect of the Cement- Rice Husk Ash on the Plasticity and Compaction of soil," Electronic Journal of Geotechnical Engineering, 8 (A).

[6] **Ramkrishna, A.N. and Pradeepkumar, A.V. (2006)** "Stabilization of Black Cotton Soil using Rice Husk Ash and Cement," Proceedings of National conference, Civil Engineering meeting the challenges of Tomorrow, 215-220

[7] **Sharma, R.S., Phanikumar, B.R. and Rao, B.V. (2008)** "Engineering Behaviour of a Remolded Expansive Clay Blended with Lime, Calcium Chloride and Rice- Husk Ash," Journal of Materials in Civil Engineering, 20(8), 509-515.

[8] **Rao, D.K., Pranav. P.R.T., and Anusha, M. (2011)** "Stabilisation of Expansive Soil using Rice Husk Ash, Lime and Gypsum-an Experimental Study," International Journal of Engineering Science and Techology, 3(11), 8076-8085

[9] **Sabat, A.K. (2012)** "Effect of Polypropylene Fiber on Engineering Properties of Rice Husk Ash – Lime Stabilized Expansive Soil," Electronic Journal of Geotechnical Engineering, 17(E), 651-660.

[10] **Sabat, A.K. (2013)** "Engineering Properties of an Expansive Soil Stabilized with Rice Husk Ash and Lime sludge," International Journal of Engineering and Technology, 5(6), 4826-4833.

[11] **Ashango, A.A. and Patra, N.R. (2014)** "Static and Cyclic Properties of Clay Subgrade Stabilised with Rice Husk Ash and Portland Slag Cement," International Journal of Pavement Engineering, DOI: 10.1080/10298436.2014.893323.