Impact on the CBR Behaviour of Soil Using Rice Husk Ash and Sugarcane Bagasse Ash

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Abstract— The objective of this work is to utilize the effectiveness of Rice Husk Ash (RHA) & SCBA material to enhance the properties of natural soil used for subgrade material in pavement. The quality of a flexible pavement depends on the strength of its sub-grade soil. In view of the above the present investigation has been carried out with rice husk ash & SCBA (Sugarcane Bagasse Ash) mixed individually and also in combination with locally available natural soil in different proportions stepped concentration of 5%, 10%, 15%, 20%, 25% and 30% by dry weight of the soil individually are used to stabilized of Natural Soil (CL) and to evaluate its properties like Grain Size Distribution, LL, PL, PI, OMC, MDD, CBR and Swelling Pressure. The test results indicate that the addition of RHA enhances the percentage of grain size distribution, but with addition of RHA till 10% the LL, PL, PI and swelling pressure decreases, while these parameters further increases in this limit beyond i.e. 10% to 30% of RHA while enhancement is observed above 20% to 30%, Specific Gravity and Maximum Dry Density (MDD) decrease with addition of RHA, for all percentage values, whereas OMC increases in each material. The CBR value increases with the addition of RHA till 10%, while it decreases beyond the limit 10% to 30% with addition of RHA. the addition of BA enhances the percentage of partial size distribution, but with addition of BA till 20% the L.L, PL, PI and swelling pressure decreases, while these parameters further increases in this limit beyond i.e. 20% to 30% of BA, Specific Gravity and MDD decrease with addition of BA, for all percentage values, whereas optimum moisture content increases in each material. The CBR value increases with addition of BA till 20%, the CBR value increases and it is decreases with further addition of BA beyond 20% to 30% for both condition (soaked and Unsoaked).

Keywords: Sugarcane Bagasse Ash, Subgrade, Rice Husk Ash, LL, PL, PI, MDD, OMC, CBR

I. INTRODUCTION

India has a road network of in excess of 33 lakhs km which is the second biggest street interfacing framework in a nation on the planet. About 65% of cargo and 80% of traveler traffic are conveyed by the streets. Streets are probably the most grounded proportion of monetary action and the advancement of any country. The nature of an adaptable asphalt relies upon the quality of its sub-grade. The sub-level goes about as a help for the whole asphalt framework. If there should be an occurrence of the adaptable asphalt the sub-grade must be uniform as far as properties like list, compaction and quality and so forth. Materials chose for use in the development of sub-grade must be of sufficient quality and simultaneously it must be affordable for use. On the off chance that the common soil is delicate and feeble it needs some improvement for use as sub-grade. It is, along these lines, expected to balance out the current powerless soil to accomplish expanded quality and decreased compressibility. Today, world faces a major issue of removal of enormous amounts of farming and modern waste like Rice husk debris, Sugarcane bagasse debris and so on. The removal of these losses without appropriate consideration makes dangerous effect on ecological wellbeing. So Rice husk debris and Sugarcane bagasse debris utilized right now these waste materials are likewise minimal effort. The extent of this investigation is that Sugarcane Bagasse Ash (SCBA) is the loss by sugar ventures. It's sheltered removal and usage is important in any case these make condition contamination issue. It tends to be use as an admixture to balance out the normal soil for the development of sub grade. SCBA increment the bearing limit of soil and lessen its expanding. Just as removal of SCBA is likewise sort out.

II. RELATED WORK

Various specialists have reads on soil adjustment throughout the previous barely any years. Some notable works are as per the following; In 1995, Raza and Chandra utilized were performed utilized alluvial soil, Rice husk debris and geo-texture to balance out extensive soil. For this examination, they were performed different test such has Compaction, Swelling, CBR and UCS tests. The outcome demonstrates that dirt treated with Rice husk debris gave extensive improvement in CBR estimation of soil. With consolidation of geofabric CBR esteem additionally expanded. In 2004, Phanikumar and Sharma utilized far reaching soil, Rice husk debris to balance out extensive soil properties. For This examination, the accompanying exploratory program was done, for example, Free Swell Index, Swelling potential, Atterberg's breaking point, Compaction, UCS, Hydraulic conductivity. The water driven conductivity of broad soils diminishes when blended in with Rice husk debris.

At the point when the Rice husk debris content expands, there is a reduction in the ideal dampness substance and therefore most extreme dry unit weight increments. The undrained shear quality of the sweeping soil mixed with Rice husk debris increments with the expansion in the debris content. In 2006, Edil et al. utilized delicate fine grain soil, Rice husk debris for development of soil properties. For This examination, atterberg's cutoff points and CBR test were directed. The outcomes showed that, expansion of Rice husk debris considerably expanded CBR and flexible modulus of soils. In 2006, J.N. Jha utilized delicate earth soil and Sugarcane bagasse debris and RHA for the improvement soil properties. For This investigation, compaction, USC and CBR test were led. The outcome shows that expansion of RHA improves just quality advancements yet in addition strength of Sugarcane bagasse debris balanced out soils. In

2002, Pandian et.al. Rice husk debris is utilized for the improvement of soil properties of dark cotton soil. For This examination, CBR test was directed. The outcomes showed that, expansion of Rice husk debris obviously expands CBR estimations of broad soil.

Impact of (RHA +Sugarcane bagasse debris) on soil was concentrated by J.N. Jha (2006). The tests like Compaction, CBR and UCS test were directed .Evaluates the adequacy of utilizing rice husk debris as a puzzuolanae to upgrade the Sugarcane bagasse debris treatment of soil. The Studies completed to consider the impact of various blended extents of Sugarcane bagasse debris and RHA on different properties of the dirt. The outcome shows that expansion of RHA upgrades quality advancements as well as it builds solidness of Sugarcane bagasse debris balanced out soils.

III. MATERIAL USED

The materials used in the present investigation were Rice husk ash and locally available natural soil. The physical properties of these materials are summarized in the following sections.

A. Soil:

The Natural soil sample is used in this study were taken from Lakshmi Narain College of Technology (LNCT) Campus Bhopal (M.P) from depth of 2.5 m from ground level. It contains deleterious substances and of various sizes. The soil was air dried and pulverized manually. This natural soil is grey and black in colour.

B. Rice Husk Ash (RHA):

Rice husk ash is basically agricultural waste products obtained from the rice milling. Rice milling generates a byproduct know as husk. During milling of paddy about 78/% of weight is received as rice, broken rice and bran, and rest 22% of the weight of paddy is received as husk. This was obtained from local rice mill at Sawstik krishi farm in Mandideep (Near the Bhopal).

C. Sugarcane Bagasse Ash (SCBA):

Sugarcane bagasse ash which is utilized in this project is taken from Shakti Sugar (Mill) Pvt Ltd Narsinghpur (M.P). The burning of bagasse of sugarcane produces bagasse ash which is a waste material. Presently in sugar factories bagasse is burnt as a fuel so as to run their boilers. This bagasse ash is generally spread over farms and dump in ash pond which causes environmental problems also research states that Workplace exposure to dusts from the processing of bagasse can cause the chronic lung condition pulmonary fibrosis, more specifically referred to as bagassosis. So there is great need for its reuse, also it is found that bagasse ash is high in silica and is found to have pozollinic property so it can be used as substitute to construction material.

IV. METHODOLOGY & TEST PROGRAMME

All the tests of soil before and after stabilization with different mixtures of NR & NS Sample were carried out as per the Indian standard. For laboratory tests specimens of soil with and without admixtures were prepared by thorough mixing the required quantity of soil and stabilizers in pre-selected proportions in dry state and then required quantity of water was added and mixed thoroughly to get a homogeneous and uniform mixture of soil and RHA & SCBA. There are various test performed in laboratory as per IS code standards like test Grain size distribution, LL,PL,PI, specific gravity, compaction, OMC, MDD, swelling and California CBR and their result are discusses by graph and tables which are given below.

The samples used in the research work are Natural Soil, Rice Husk Ash (RHA) & SCBA and Natural Soil stabilized with varying percentages i.e. (5, 10, 15, 20, 25 & 30%) of RHA & SCBA individually for the construction of sub grade soil. These parents samples i.e. Natural soil, Rice husk ash & Sugarcane Bagasse Ash are named as N, R & S notation respectively in further research work. The artificial Mix Samples i.e. NR which are mix of Natural Soil plus Rice Husk Ash, NS which are mix of Natural Soil plus Sugarcane Bagasse Ash.

Material	Tests conducted
Natural Soil or B.C soil only	Grain size Analysis- (mechanical Method), Specific Gravity Consistency Indices (L.L. , P.L. , P.I.) Compaction Test (Light Compaction) CBR Test (Soaked & Un-soaked)
Natural Soil with 05 % RHA & SCBA	
Natural Soil with 10% RHA & SCBA	
Natural Soil with 15 % RHA & SCBA	
Natural Soil with 20 % RHA & SCBA	
Natural Soil with 25 % RHA & SCBA	
Natural Soil with 30 % RHA & SCBA	

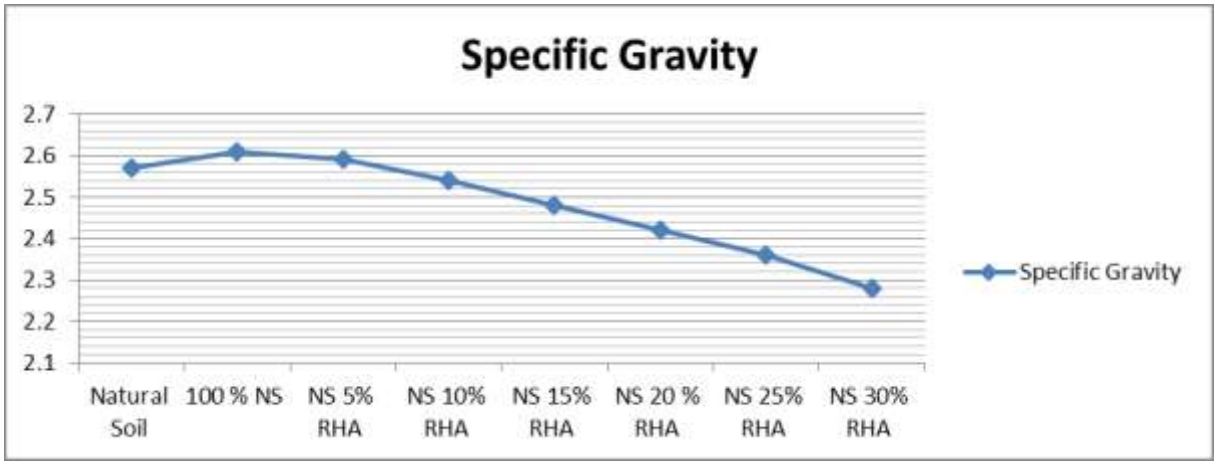
Table 1: Tests conducted for Prepared Samples

V. RESULTS & DISCUSSION

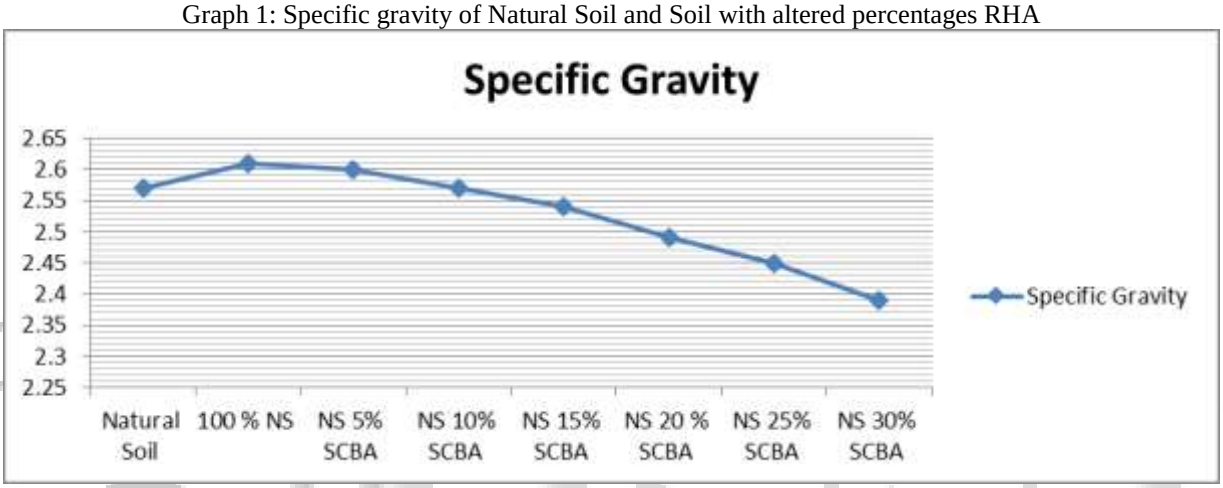
The laboratory test results for different parameters of NR & NS Sample are presented in Sample The different properties of soil like Liquid Limit and Plastic Limit, Maximum Dry Density and Optimum Moisture Content and California Bearing Ratio are obtained after carrying out tests and different change of these soil properties with addition of SCBA Mix are studied as follows. The different properties of NS Sample like Liquid Limit and Plastic Limit, Maximum Dry Density and Optimum Moisture Content and California Bearing Ratio are obtained after carrying out tests and different change of these Natural soil (N) properties with addition of SCBA (S) & RHA ® are studied as follow.

A. Index Properties (Grain Size Distribution, LL, PL, PI and Specific Gravity)

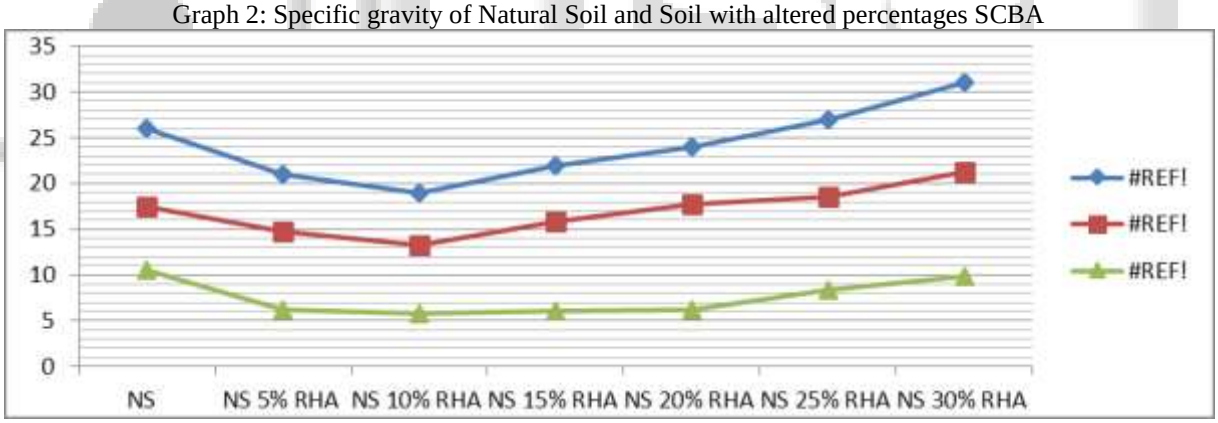
The results of Index Properties tests on the Natural Soil with the different percentage of RHA & SCBA are shown inTable.1. The nature of changes of GSD, LL, PL, PI and Specific Gravity with the different percentage of SCBA also presented in Figure 1-6 respectively given below:



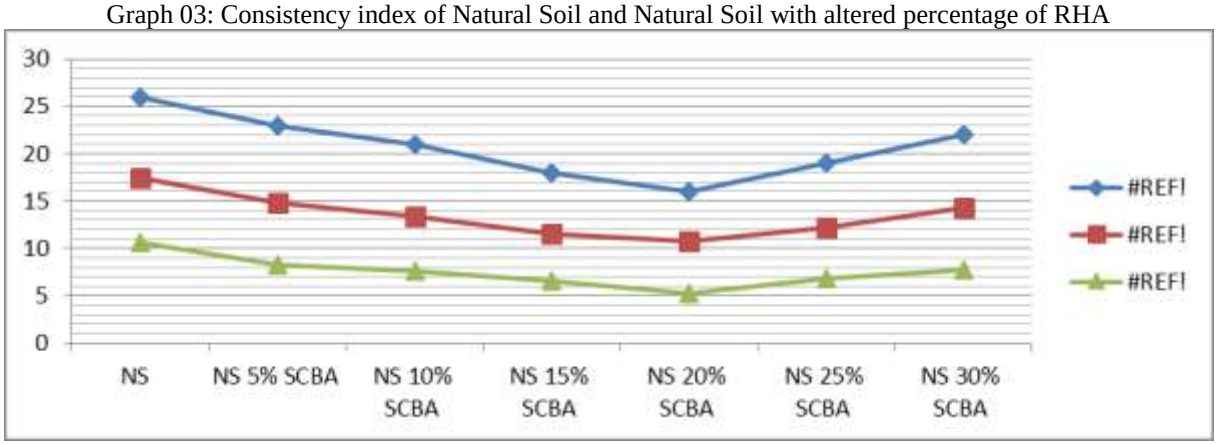
Graph 1: Specific gravity of Natural Soil and Soil with altered percentages RHA



Graph 2: Specific gravity of Natural Soil and Soil with altered percentages SCBA



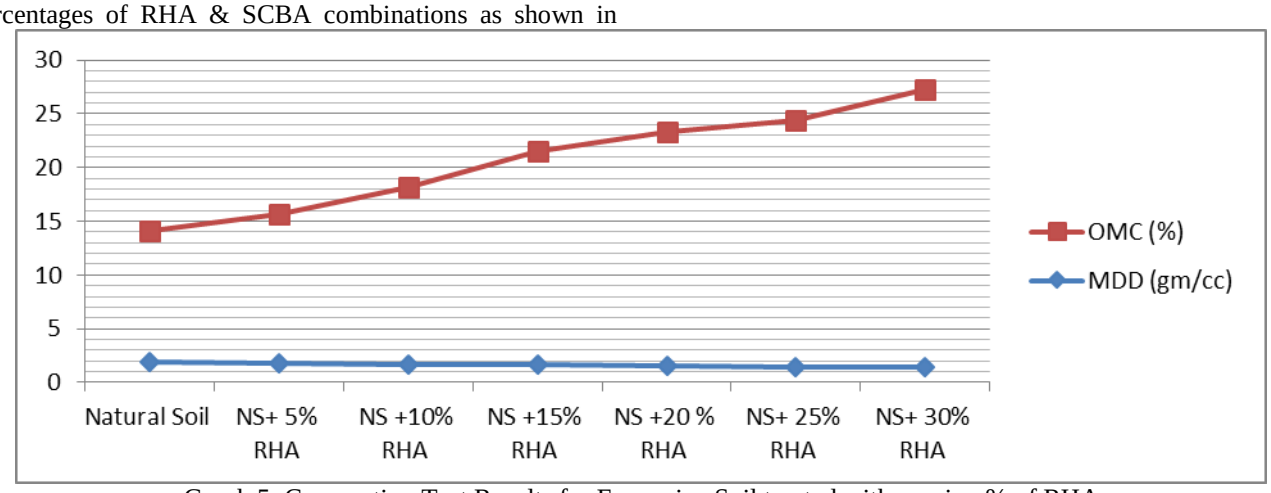
Graph 03: Consistency index of Natural Soil and Natural Soil with altered percentage of RHA



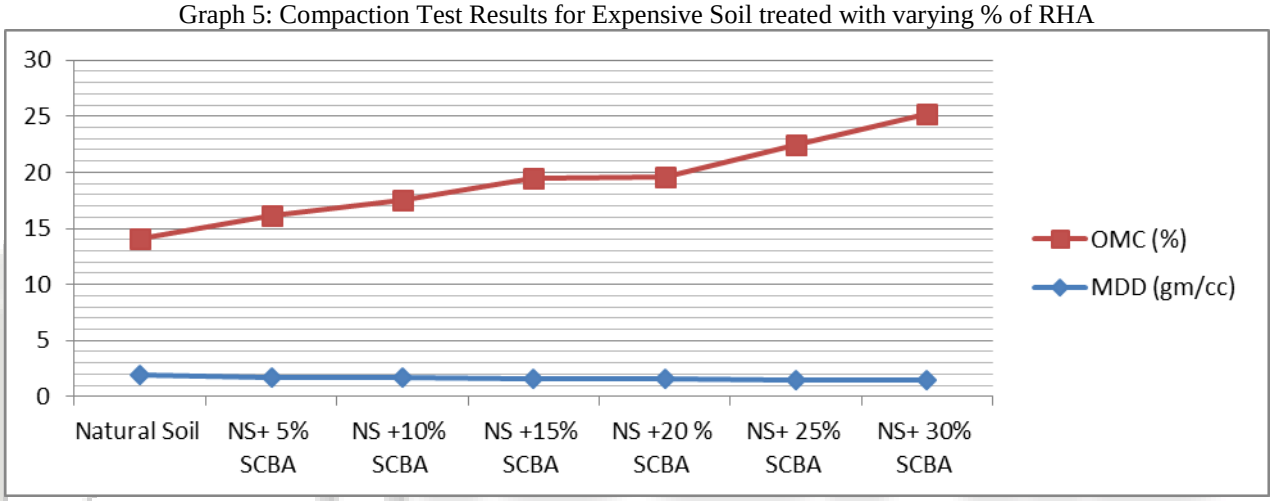
Graph 04: Consistency index of Natural Soil and Natural Soil with altered percentage of SCBA

B. Compaction Properties (OMC and MDD)

The variation of OMC and MDD with the different percentages of RHA & SCBA combinations as shown in Figure respectively shown by below and their details are given in



Graph 5: Compaction Test Results for Expensive Soil treated with varying % of RHA



Graph 6: Compaction Test Results for Natural soil treated with varying % of SCBA

C. Strength Properties (CBR and Swelling Pressure)

The results of California Bearing Ratio tests on the Natural Soil with the various mix proportions of RHA & SCBA in Unsoaked and soaked conditions as shown in Table. The different changes of CBR values with different mix proportions in Unsoaked, soaked and swelling conditions are also presented in Fig. 9,10,11 and Fig. The comparative Effect in CBR value of NS & NR Sample towards Natural Soil are also presented.

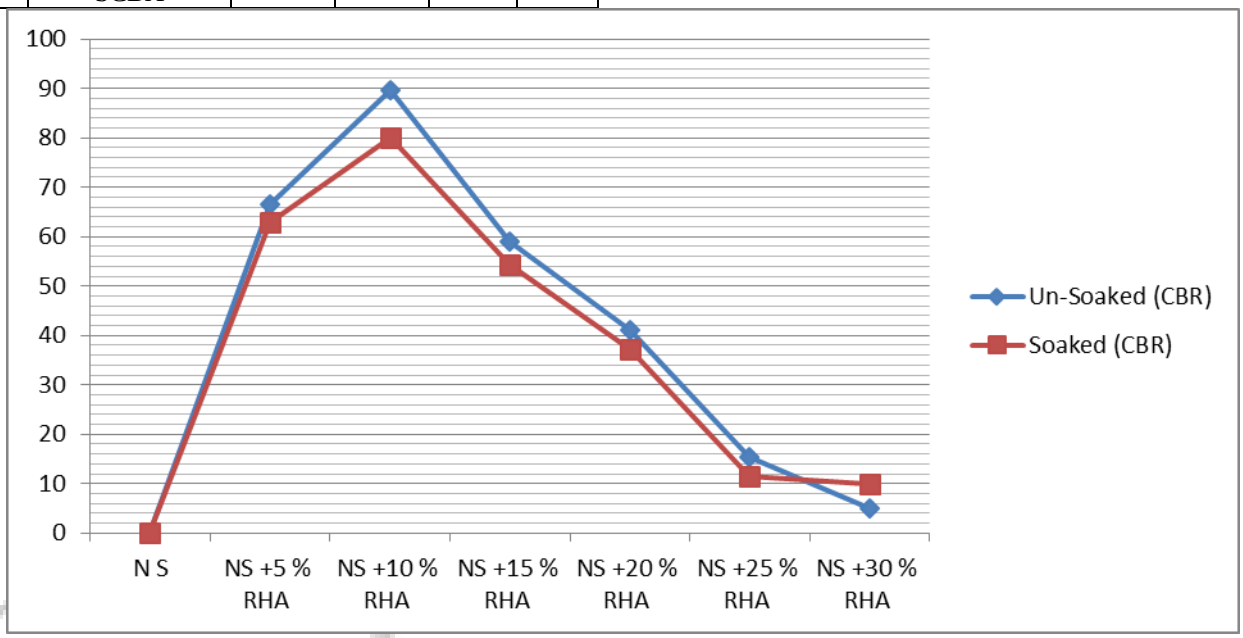
S. No.	Material	CBR (UN-Soaked)		CBR (Soaked)	
		2.5 mm	5 mm	2.5 mm	5 mm
1	Natural Soil	5.42	5.30	2.53	2.41
2	Natural soil with 05 % RHA	11.73	11.58	6.86	6.53
3	Natural soil with 10 % RHA	13.36	13.17	7.58	7.24
4	Natural soil with 15 % RHA	11.19	11.02	6.50	6.32
5	Natural soil with 20 % RHA	9.93	9.52	5.78	5.64
6	Natural soil with 25 % RHA	8.12	7.89	4.69	4.51
7	Natural soil with 30 % RHA	6.68	6.28	3.79	3.53

Table 2: CBR Test Results for Natural soil with varying percentages of RHA

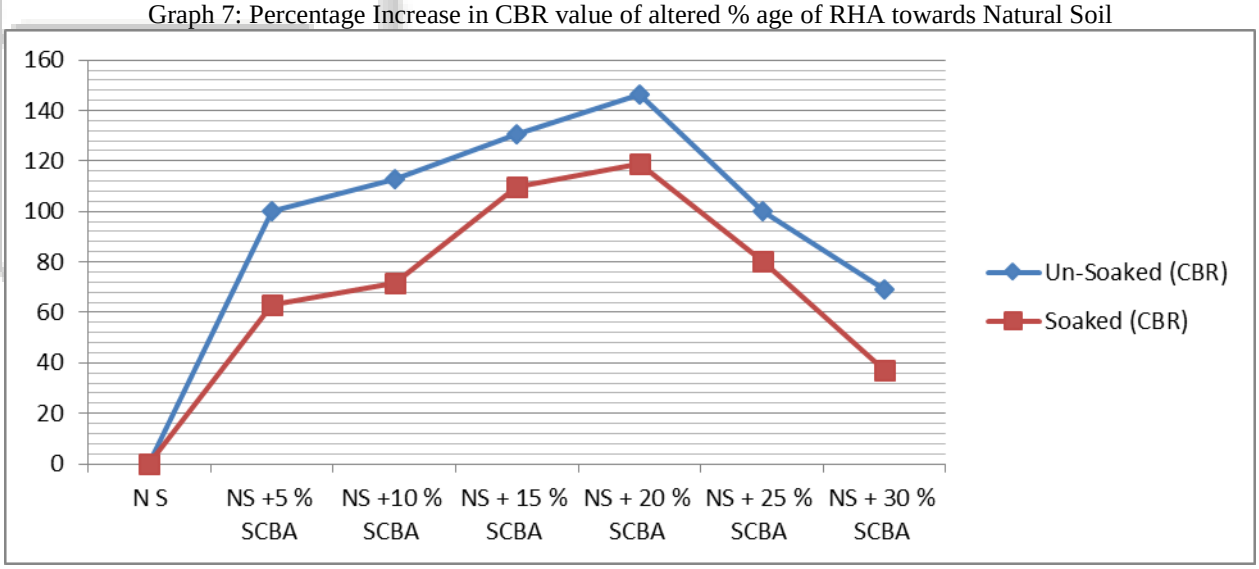
S. No.	Material	CBR (UN-Soaked)		CBR (Soaked)	
		2.5 mm	5 mm	2.5 mm	5 mm
1	Natural Soil	5.42	5.30	2.53	2.41
2	Natural soil with 05 % SCBA	14.08	13.85	6.86	6.65
3	Natural soil with 10 % SCBA	14.98	14.65	7.22	7.03
4	Natural soil with 15 % SCBA	16.24	15.93	8.84	8.56

5	Natural soil with 20 % SCBA	17.33	17.05	9.21	8.95
6	Natural soil with 25 % SCBA	14.08	13.52	7.58	7.34
7	Natural soil with 30 % SCBA	11.91	11.24	5.78	5.42

Table 3: CBR Test Results for Natural soil with varying percentages of SCBA



Graph 7: Percentage Increase in CBR value of altered % age of RHA towards Natural Soil



Graph 8: Percentage Increase in CBR value of altered % age of SCBA towards Natural Soil

VI. CONCLUSIONS

The conclusions drawn from these studies are as follows:-

- In Grain Size Distribution, major part of the soil belong to sand, it has been observed that increasing percentage of RHA and SCBA decreases the gravel content and increases the silt and clay content in soil mixture. Investigation also shows that all soil mixture belongs to CL class according to IS classification and A-6 Class under AASHTO classification.
- The results of Liquid Limit tests on CL soil goes on decreasing from 26 to 19%, when RHA Sample is increased from 0 to 10%, increase in from 19% to 31% when RHA Sample is increased from 10 to 30% and further increase of value for 100% RHA is sample shows non plastic behavior. However in Sugarcane Bagasse Ash (SCBA) the LL of CL soil goes on decreasing from 26 to 16%, when SCBA Sample is increased from 0 to 20% and increases from 16% to 22% when SCBA Sample is increased from 20 to 30% and further the value for 100% SCBA, the sample shows non plastic behavior same as for RHA.
- The results of Plastic Limit tests on CL soil goes on decreasing from 17.4 to 13.20%, when RHA Sample is increased from 0 to 10%and increase from 13.20 to 21.20% when RHA Sample is increased from 10% to 30%. However in SCBA it goes on decreasing from 17.40% to 10.70%, when SCBA Sample is increased

from 0 to 20%, is increases from 10.70 to 14.30% when SCBA Sample is increased from 20% to 30%.

- The results of Plasticity Index tests on CL soil goes on decreasing from 8.60 to 5.80 %, when RHA Sample is increased from 0 to 10% and is increases from 5.80 to 9.80% when RHA Sample is increased from 10% to 30% However in SCBA it goes on decreasing from 8.60% to 5.30%, when SCBA Sample is increased from 0 to 20 % and is increases from 5.30 to 7.70% when SCBA Sample is increased from 20% to 30%.
- The results of Specific Gravity tests on CL soil goes on decreasing from 2.63 to 2.28 with increase in percentage of RHA from 0 to 30% and 1.64 for 100% RHA. However in SCBA, The Specific Gravity decreases from 2.63 to 2.39 with increase in percentage of SCBA from 0 to 30% and 1.87 for 100% SCBA.
- The results of OMC of CL Soil continuously increases from 12.18 to 25.78% from 0 to 30% of RHA and for 100% RHA its value is 66.57% and MDD decreases from 1.88 g/cc to 1.43 g/cc from 0 to 30% of RHA and 0.76 for 100% RHA. However in SCBA Samples, its continuously increases from 12.18 to 23.80% and for 100% SCBA, value of OMC is 47.22% and MDD decreases from 1.88 g/cc to 1.44 g/cc from 0 to 30% of SCBA and the value are 0.98 g/cc for 100% SCBA.
- The results of Unsoaked CBR of CL Soil goes on increasing from 7.04 to 13.36% when RHA is increased from 0 to 10% and is decreases from 13.36 to 6.68% when RHA waste is increased from 10% to 30% and for 100% RHA is 11.19% and in Soaked CBR of soil goes on increasing from 4.21 to 7.58% when RHA is increased from 0 to 10% is and is decreases from 7.58 to 3.79% when RHA Sample is increased from 10% to 30% and for 100% RHA is 6.68%. In Soaked and Unsoaked CBR test on soil sample it has been observed that Natural Soil with 10% RHA mix gives maximum value of CBR in both soaked and unsoaked condition.
- The results of Unsoaked CBR of CL Soil goes on increasing from 7.04 to 17.33% when SCBA is increased from 0 to 20% and is decreases from 17.33 to 11.91% when SCBA Sample is increased from 20% to 30% and for 100% SCBA is 7.95% andthe Soaked CBR of soil goes on increasing from 4.21 to 9.21% when SCBA is increased from 0 to 20% and is decreases from 9.21 to 5.78% when SCBA Sample is increased from 20% to 30% and for 100% SCBA is 5.41%. In Soaked and Unsoaked CBR test on soil sample it has been observed that Natural Soil with 20% SCBA mix gives maximum value of CBR in both soaked and unsoaked condition.
- The results of Swelling Pressure on CL Soil goes on decreasing from 2.15 to 1.40 when RHA is increased from 0 to 10% and is increases from 1.40 to 2.18 when RHA Sample is increased from 10% to 30% and for 100% RHA is 1.49. However in SCBA the Swelling Pressure of soil goes on decreasing from 2.15 to 0.67 when SCBA is increased from 0 to 20% and is increases in Swelling Pressure of soil from 0.67 to 1.42 when SCBA Sample is increased from 20% to 30% and for 100% SCBA is 1.95.
- The results of percentage increment in Unsoaked CBR goes on increasing from 66.62 to 89.77% with respect to Natural Soil when RHA is increased from 0 to 10% and is decreases from 89.77 to -5.11% when RHA Sample is increased from 10% to 30% and for 100% RHA is 58.95%. However in Soaked CBR it increases from 62.95 to 80.05% when RHA is increased from 0 to 10% and is decreases from 80.05 to -9.98% when RHA Sample is increased from 10% to 30% and for 100% RHA is 58.67%.
- The results of percentage increment in Unsoaked CBR goes on increasing from 100 to 146.16% with respect to Natural Soil when SCBA is increased from 0 to 10% and is decreases from 146.16 to 69.18% when SCBA Sample is increased from 10% to 30% and for 100% SCBA is 12.93%. However in Soaked CBR it increases from 62.95 to 118.76% when SCBA is increased from 0 to 10% and is decreases from 118.76 to 37.29% when SCBA Sample is increased from 10% to 30% and for 100% SCBA is 28.50%.

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