Study on utilization of agricultural waste as soil stabilizer

Shriganesh S.Shinde
Assistant professor
Civil engineering department
M.S Bidve Engineering College, Latur, India

Abstract—In India the production of agricultural products are of huge quantity, but the creation of wastes from these agricultural products are not disposed properly. Which creates adverse effects on the environment such as air pollution, water pollution, which effect on human health? Hence the proper disposal of such wastes becomes necessary for ecosystem and it became challenge for engineers. The aim of this paper is to utilize the agricultural wastes such as Rise husk, ground nut shell & sugar cane baggage but due to its property of decomposing it is not possible to utilize it in its pure form hence we have to use ashes of these waste materials separately at 3%, 6%, 9%, 12%and 15% and carried out tests such as Liquid Limit, Plastic Limit, Plasticity Index, Free Swell Index, Maximum Dry Density, Optimum Moisture Content and CBR for each percent. Hence there is a value addition to these three agricultural wastes serving the three benefits of Safe disposal of wastes, using as a stabilizer and return of income on it.

KEYWORDS: RHA, GNSA, SCBA, CBR, MDD, OMC

I. INTRODUCTION

All the countries are growing so rapidly, this growth will clearly see by the improvement in infrastructural facilities and transportation facilities. Foundation & Pavement is very sensitive to the characteristics which provide the support for pavement or structure and problems associated with this further become far more critical, particularly in regions where the black cotton soils are there.

All the soils are not expansive soil and all expansive soils are not black cotton soil. Black cotton soil is considered as non-suitable for construction due to high swelling and shrinkage behavior of soil. The soil poses problems to the structure founded on them. Very destructive results caused by this type of soil have been reported in many countries. The disadvantages of black cotton soil can be overcome by improving with suitable materials and if these materials are of waste from any source then that will help to disposal from that source.

II. MATERAIALS

Soil: The basic material used for experiment is Black Cotton soils, which are having main characteristics as swelling and shrinkage. They are very sensitive to changes in environment. Mostly such soil is not suitable for construction purpose, following are the basic properties of soil which is used for this project.

Table 1 properties of soil before modification

SR. NO.	PROPERTY	VALUE (%)
1	Specific Gravity	2.662
2	Liquid Limit	66
3	Plastic Limit	26.62
4	Plasticity Index	39.39
5	Free Swell Index	23.08
6	Optimum Moisture Content	26.11
7	Maximum Dry Density (g/cm3)	1.445
8	California Bearing Ratio Value	2.39

Rise husk ash: Rice milling industry generates a lot of rice husk during milling of paddy which comes from the fields. This rice husk is mostly used as a fuel in the boilers for processing of paddy. Rice husk is also used as a fuel for power generation. Rice husk ash (RHA) is about 25% by weight of rice husk when burnt in boilers. It is estimated that about 70 million tons of RHA is produced annually worldwide

During milling of paddy about 78 % of weight is received as rice, broken rice and bran .Rest 22 % of the weight of paddy is received as husk. This husk is used as fuel in the rice mills to generate steam for the parboiling process. This husk contains about

75 % organic volatile matter and the balance 25 % of the weight of this husk is converted into ash during the firing process, is known as rice husk ash (RHA). This RHA in turn contains around 85 % - 90 % amorphous silica.

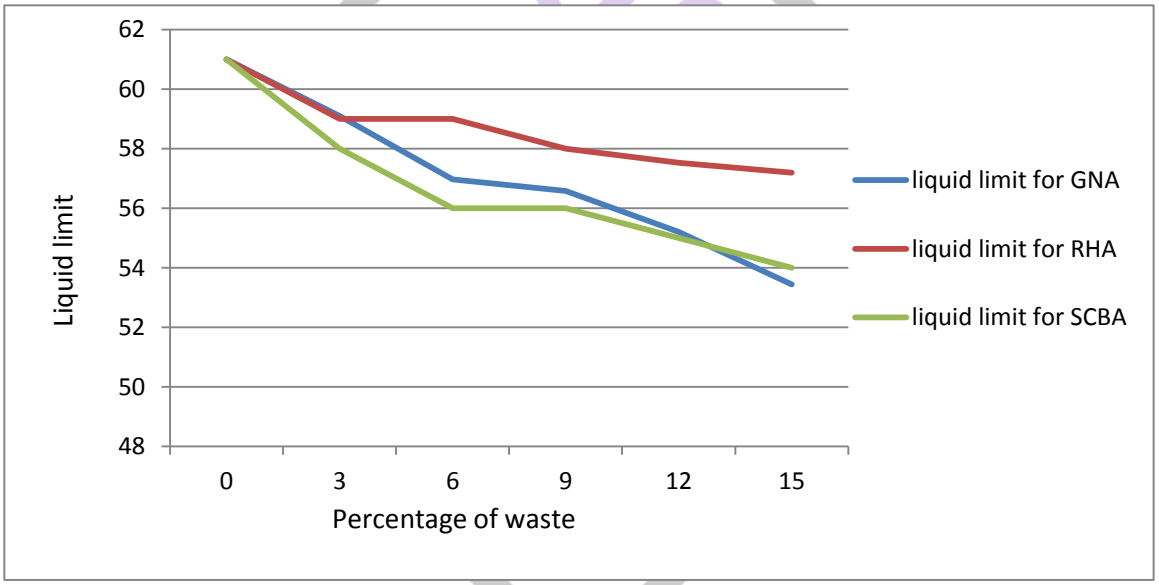
Ground nut shell ash: The groundnut shell obtained worldwide. The next stage is to heat the groundnut shell in an electric muffle furnace at a temperature of 500˚C to 600˚C for 4hours in order to produce the groundnut shell ash.

III. METHOD AND DISCUSSION

The weak subgrade soil is treated with the two wastes at 3%, 6%, 9%, 12%and 15% separately and for each per liquid limit, plastic limit, plasticity index, free swell index, maximum dry density, optimum moisture content and CBR test is carried out .The results of these tests showed improvement in CBR value with the increase in percentage of waste, also the value of maximum dry density will also increases while the value of optimum moisture content will reduces with increase in the Percentage of waste, it also increases the plastic limit and reduces the percentage of liquid limit, plasticity index and free swell index.

Table 2 Comparison of Liquid Limit for Various Percentages of RHA, GNSA & SCBA

% of waste	liquid limit for GNA	liquid limit for RHA	liquid limit for SCBA
0	61	61	61
3	59	59	58
6	57	59	56
9	57	58	56
12	55	58	55
15	53	57	54

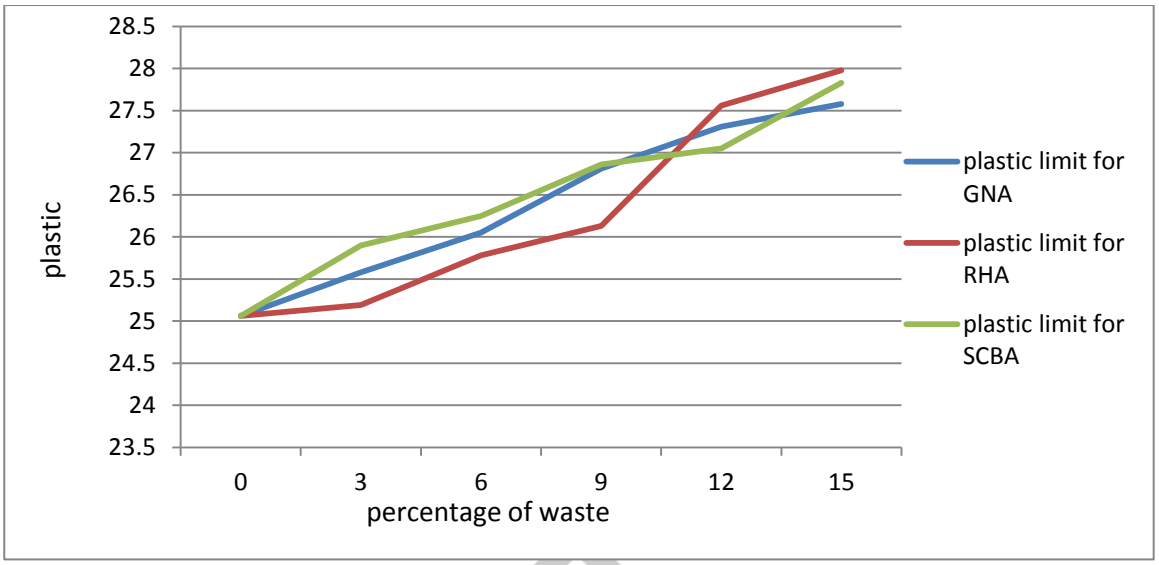


Graph 1 Comparison of Liquid Limit for Various Percentages of RHA, GNSA & SCBA

From above graph it is seen that the liquid limit reduces as the percentage of waste increases. Maximum Liquid limit is observed for rise husk ash.

Table 3 Comparison of Plastic Limit for Various Percentages of RHA, GNSA & SCBA

% of waste	Plastic limit for GNA	Plastic limit for RHA	Plastic limit for SCBA
0	25.06	25.06	25.06
3	25.58	25.19	25.9
6	26.05	25.78	26.25
9	26.81	26.13	26.86
12	27.31	27.56	27.05
15	27.58	27.98	27.83

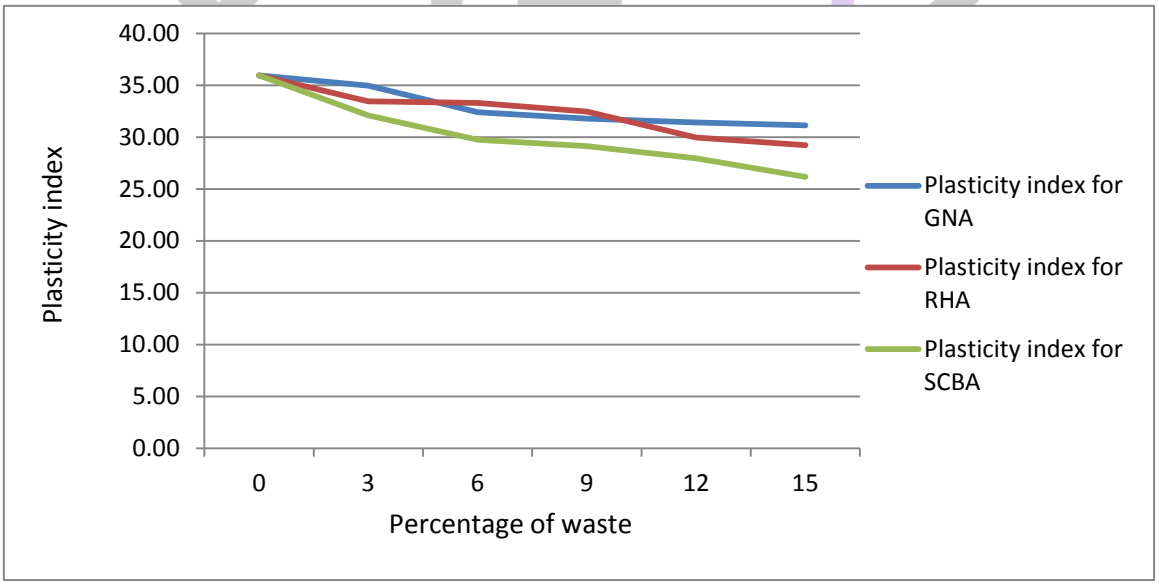


Graph 2 Comparison of Plastic Limit for Various Percentages of RHA, GNSA & SCBA

From above graph it is seen that the plastic limit increases as the percentage of Rise Husk Ash, Ground Nut Shell Ash and Sugar Cane Baggage Ash increases. Maximum increase observed for rise husk ash.

Table 4 Comparison of Plasticity index for Various Percentages of RHA, GNSA & SCBA

% of waste	Plasticity index for GNA	Plasticity index for RHA	Plasticity index for SCBA
0	25.06	25.06	25.06
3	25.58	25.19	25.9
6	26.05	25.78	26.25
9	26.81	26.13	26.86
12	27.31	27.56	27.05
15	27.58	27.98	27.83

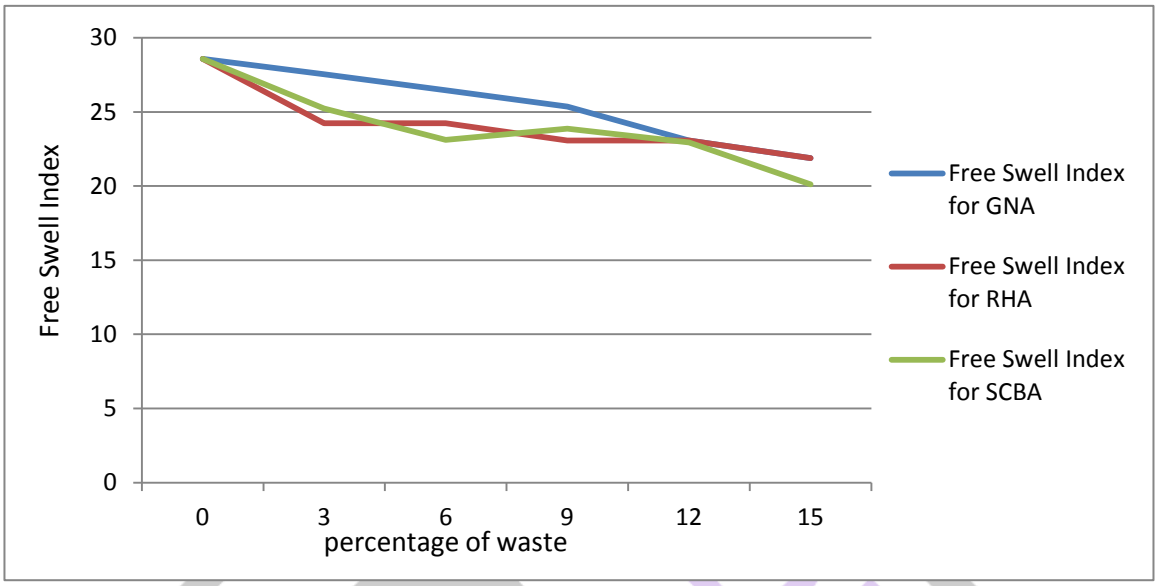


Graph 3 Comparison of Plasticity index for Various Percentages of RHA, GNSA & SCBA

From above graph it is seen that plasticity index reduces as the percentage of Rise Husk Ash, Ground Nut Shell Ash and Sugar Cane Baggage Ash increases. Maximum decrease in plasticity index is observed for sugar cane baggage ash.

Table 5 Comparison of Free Swell Index for Various Percentages of RHA, GNSA & SCBA

% of waste	Free Swell Index for GNA	Free Swell Index for RHA	Free Swell Index for SCBA
0	28.57	28.57	28.57
3	27.54	24.24	25.23
6	26.47	24.24	23.12
9	25.37	23.08	23.88
12	23.08	23.08	22.95
15	21.88	21.88	20.11

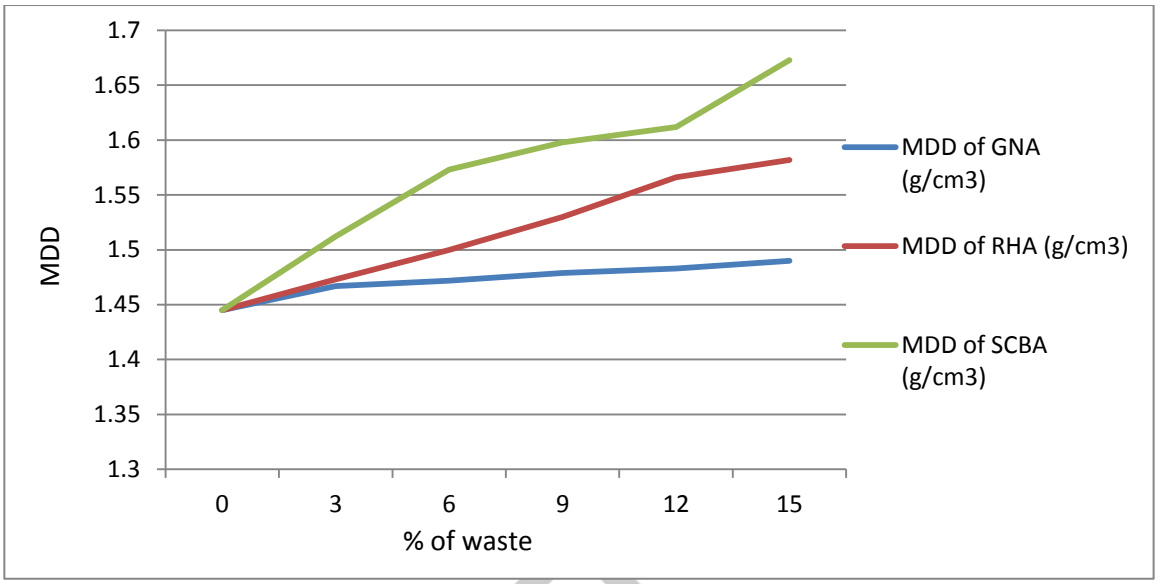


Graph 4 Comparison of Free Swell Index for Various Percentages of RHA, GNSA & SCBA

From above graph it is seen that Free Swell Index reduces as the percentage of Rise Husk Ash, Ground Nut Shell Ash and Sugar Cane Baggage Ash increases. Maximum decrease in plasticity index is observed for sugar cane baggage ash.

Table 6 Comparison of Maximum Dry Density for Various Percentages of RHA, GNSA & SCBA

% of waste	MDD of GNA (g/cm3)	MDD of RHA (g/cm3)	MDD of SCBA (g/cm3)
0	1.445	1.445	1.445
3	1.467	1.473	1.512
6	1.472	1.500	1.573
9	1.479	1.530	1.598
12	1.483	1.566	1.612
15	1.490	1.582	1.673

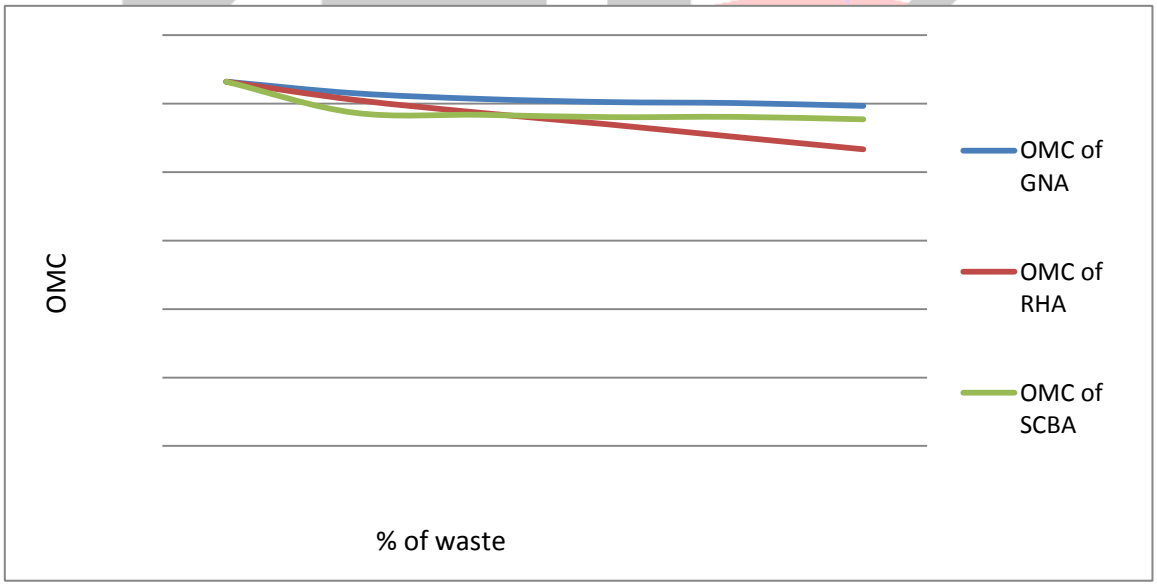


Graph 5 Comparison of Maximum Dry Density for Various Percentages of RHA, GNSA & SCBA

From above graph it is seen that maximum dry density increases as the percentage of Rise Husk Ash, Ground Nut Shell Ash and Sugar Cane Baggage Ash increases. Maximum increase in maximum dry density is observed for sugar cane baggage ash.

Table 7 Comparison of Optimum Moisture content for Various Percentages of RHA, GNSA & SCBA

% of waste	OMC of GNA	OMC of RHA	OMC of SCBA
0	26.61	26.61	26.61
3	25.77	25.29	24.35
6	25.35	24.33	24.19
9	25.12	23.49	24.02
12	25.05	22.57	24.04
15	24.84	21.67	23.86

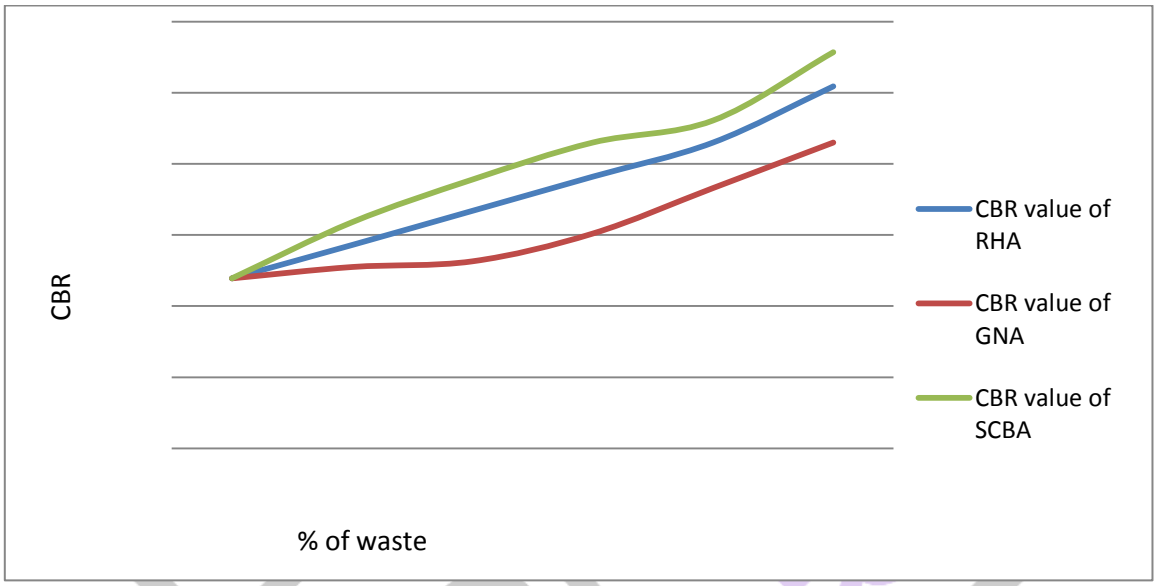


Graph 6 Comparison of Optimum Moisture Content for Various Percentages RHA, GNSA & SCBA

From above graph it is seen that Optimum Moisture Content decreases as the percentage of Rise Husk Ash, Ground Nut Shell Ash and Sugar Cane Baggage Ash increases. Maximum decrease in Optimum Moisture Content is observed for rise husk ash.

Table 8 Comparison of California bearing ratio for Various Percentages of RHA, GNSA & SCBA

% of waste	CBR value of RHA	CBR value of GNA	CBR value of SCBA
0	2.39	2.39	2.39
3	2.86	2.55	3.18
6	3.34	2.63	3.78
9	3.82	3.02	4.30
12	4.3	3.66	4.61
15	5.09	4.3	5.57



Graph 7 Comparison of California bearing ratio for Various Percentages of RHA, GNSA & SCBA

From the above graph it is seen that, for comparison of rise husk ash, ground nut shell ash and sugar cane baggage ash the value of California bearing ratio increases. Maximum increase in CBR is observed for sugar cane baggage ash.

IV. CONCLUSIONS

In India Production of large quantity of Agricultural wastes faces serious problems of handling and disposal. For doing Safe disposal of Agricultural wastes without adversely affecting the environment and the large storage area required are major concerns. Hence in our investigation an attempt has been made to utilize certain agricultural wastes such as RHA & GNSA to stabilise weak subgrade soil. Use of these Agricultural wastes improves the Subgrade strength of the weak soil. Hence there is a value addition to these agricultural wastes serving the three benefits of Safe disposal of effluent, Using as a stabilizer and Return of income on it.

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