International Journal of Civil Engineering (IJCE)
ISSN(P): 2278-9987; ISSN(E): 2278-9995
Vol. 5, Issue 4, Jun - Jul 2016; 1-8

International Academy of Science, Engineering and Technology
Connecting Researchers; Nurturing Innovations

IMPROVEMENT IN PROPERTIES OF SUBGRADE SOIL BY USING RICH HUSK ASH AND MOORUM

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ABSTRACT

The technology of road construction is subjected to changes to cope up with changing vehicular pattern, construction materials and sub-grade conditions. Rice Husk is a waste material produced in rice industry. Rice Husk can be used in various geotechnical constructions like embankments, soil stabilization, and sub grades etc. 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.

KEYWORDS: Black Cotton Soil, Moorum, Rise Husk Ash &Stabilization

INTRODUCTION

The design of the pavement layers laid over the subgrade soil starts off with the determination of subgrade strength and the traffic volume which is to be carried. The design of pavement is very much dependent on the subgrade strength of soil. Design criteria mainly needs thickness of layers. Weaker subgrade needs thicker layers whereas stronger subgrade needs thinner pavement layers. The Indian Road Congress (IRC) provides the exact procedures for the pavement layers design which is based upon the subgrade strength. The strength of a subgrade soil is normally expressed in terms of the California Bearing Ratio (CBR). According to their study the poor subgrade soil having soaked CBR value less than 2% is to be replaced by good quality subgrade materials or to be replaced by good quality subgrade material or to be stabilized by any of the means[1]. In his experimental work he used RBI Grade 81 as an additive to improve the properties of subgrade soil, since RBI Grade 81 is a costlier additive which will increase the construction cost of the road he also used locally available moorum which may reduce the construction cost upto certain extent[7].

MATERIALS AND PROPERTIES

Black Cotton Soil

The soil sample is collected from Navegao, District Gadchiroli in Maharashtra state, India. Soil Sample is collected 1 meter below the original depth then collected into bag and send into the laboratory for examination.

Rice Husk Ash

For the present work, the RHA was obtained from the open clay brick kill at Pardi, District Gadchiroli, Maharashtra.

Moorum

The weathered rock fragments which are gravelly and non-plastic in nature are locally called as Moorum. The granular moorum is collected from Bhagwanpur, District Gadchiroli, Maharashtra.

METHODOLOGY

The technique of stabilizing the soil with locally available moorum is being carried since long time. Mixing Rice Husk Ash, Moorum and pulverized black cotton soil with the optimum moisture content and compacting the mix to attain required density. The material obtained by mixing soil, Rice Husk Ash and Moorum is known as stabilized soil. Many researchers have worked extensively on the utilization of Agricultural waste product RHA in road construction techniques and found that 10% RHA mixed with the natural soil gives optimum result. Hence for the present study, fixed 10% RHA was added to the natural soil sample. Similarly increasing proportion of moorum as stabilizer also improves the properties of soil.

Sample No. 1: Natural soil + 10% RHA + 20% Moorum

Sample No. 2: Natural soil + 10% RHA + 30% Moorum

RESULTS AND DISCUSSIONS

PROPERTIES OF SOIL + 10% RHA+ 20% MOORUM

Liquid Limit of Soil

Table 1: Liquid Limit of Soil + 10% RHA+ 20% Moorum

Sr. No.	Particulars	Trial- 1	Trial- 2	Trial-3	Trial- 4	Trial- 5
1	No. of Blows	35	29	26	20	15
2	Container No.	9	10	11	12	13
3	Wt of container + Wet Soil	40.005	45.515	47.785	48.720	52.345
4	Wt of container + Dry Soil	34.865	37.115	38.795	38.825	40.080
5	Loss of Moisture	8.325	9.720	10.225	10.995	12.465
6	Wt of container in gm	15.470	15.270	15.990	15.730	15.560
7	Wt of Dry Soil	19.395	21.845	22.805	23.095	24.520
8	Moisture Content %	42.923	44.495	44.837	47.608	50.836

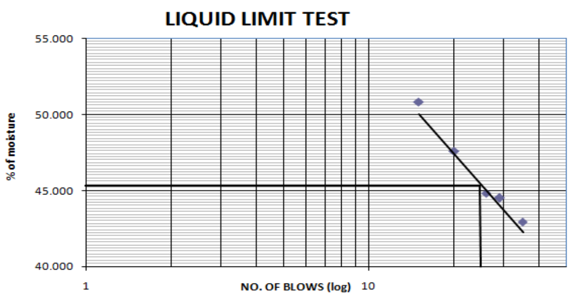

Figure 1: % of Moisture vs. No. of Blows

Liquid limit = 45.6%

Plastic Limit of Soil

Table 2: Plastic Limit of Soil + 10% RHA+ 20% Moorum

Sr. No.	Particulars	Trial- 1	Trial- 2	Trial- 3
1	Container No	14	15	16
2	Wt of container + Wet Soil	23.370	24.825	26.965
3	Wt of container + Dry Soil	20.810	22.605	24.380
4	Loss of Moisture	2.560	2.220	2.585
5	Wt of container in gm	11.970	15.200	15.510
6	Wt of Dry Soil	8.840	7.405	8.870
7	Moisture Content %	28.959	29.980	29.143
	Average plastic limit %		29.36	

Plastic Limit = 29.36 %

Plasticity Index = Liquid Limit – Plastic Limit

Plasticity Index = 45.60 – 29.36

= 16.24 %

Compaction Test

Table 3: Compaction Test of Soil + 10% RHA+ 20% Moorum

Sr. No.	Weight of Mould + Compacted Soil W2 (gms)	Weight of Wet Soil W2-W1 (gms)	Wet Density (gms/cm^3)	Moisture Content Determination: Wt of Container + Wet Soil (gms)	Wt of Container + Wt of Dry Soil (gms)	Weight of Water (Ww) (gms)	Weight of Dry Soil (Ws) (gms)	Moisture Content (%) (W)	Dry Density (gm/cm^3)
1	6562	1870	1.87	1336	1228	108	892	12.11	1.67
2	6592	1900	1.90	1338	1229	109	891	12.23	1.69
3	6696	2004	2.00	1358	1232	126	874	14.42	1.75
4	6702	2010	2.01	1326	1194	132	868	15.21	1.74
5	6680	1988	1.99	1342	1206	136	864	15.74	1.72
6	6638	1946	1.95	1352	1202	150	850	17.65	1.65

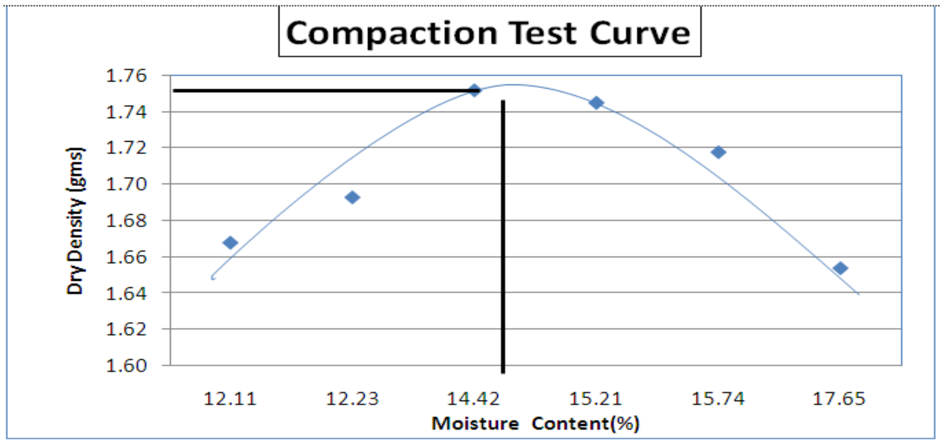

Figure 2: Dry Density vs. Moisture Contain

M. D. D = 1.75 O. M. C = 14.42 %

C.B.R. Test of Soil

Table 4: C.B.R. Test of Soil + 10% RHA+ 20% Moorum

Penetration (mm)	Load (Kg)		
	Trial- I	Trial- II	Trial- III
0.0	0	0	0
0.5	45.8	39.2	32.7
1.0	65.4	52.3	39.2
1.5	71.9	65.4	52.3
2.0	78.5	78.5	65.4
2.5	85.0	85.0	78.5
3.0	98.1	98.1	91.6
4.0	111.2	111.2	104.6
5.0	117.7	117.7	117.7
7.5	143.9	137.3	137.3
10.0	163.5	157.0	163.5
12.5	170.0	170.0	176.6

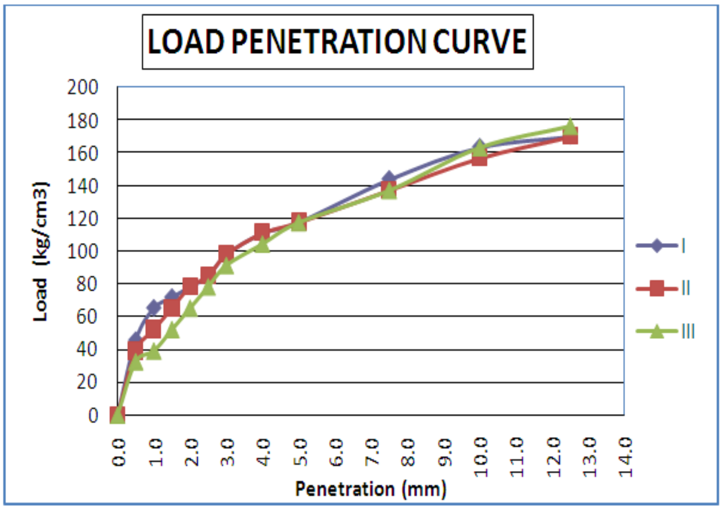

Figure 3: Load vs. Penetration

Average C.B.R. at 2.5mm = 6.05 %

Average C.B.R. at 5.0mm = 5.73 %

PROPERTIES OF SOIL + 10% RHA+ 30% MOORUM

Liquid Limit of Soil

Table 5: Liquid Limit of Soil + 10% RHA+ 30% Moorum

Sr. No.	Particulars	Trial- 1	Trial- 2	Trial-3	Trial- 4	Trial- 5
1	No. of Blows	34	27	23	19	14
2	Container No.	9	10	11	12	13
3	Wt of container + Wet Soil	32.845	33.140	33.400	34.035	35.345
4	Wt of container + Dry Soil	28.395	28.415	28.750	28.925	29.595
5	Loss of Moisture	4.450	4.725	4.650	5.110	5.750
6	Wt of container in gm	15.470	15.270	15.990	15.730	15.560
7	Wt of Dry Soil	12.925	13.145	12.760	13.195	14.035
8	Moisture Content %	34.429	35.945	36.442	38.727	40.969

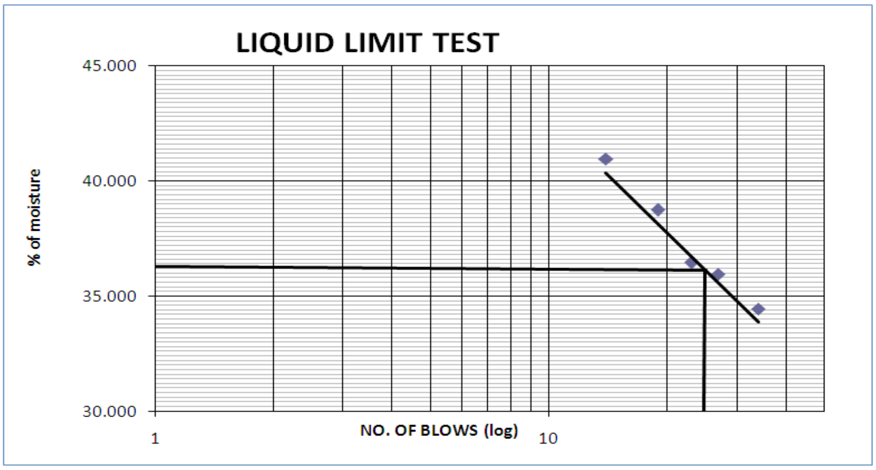

Figure 4: % of Moisture vs. No. of Blows

Liquid Limit = 36.60 %

Plastic Limit of Soil

Table 6: Plastic Limit of Soil + 10% RHA+ 30% Moorum

Sr. No.	Particulars	Trial- 1	Trial- 2	Trial- 3
1	Container No	14	15	16
2	Wt of container + Wet Soil	26.155	27.910	28.200
3	Wt of container + Dry Soil	23.670	25.715	25.995
4	Loss of Moisture	2.485	2.195	2.205
5	Wt of container in gm	11.970	15.200	15.510
6	Wt of Dry Soil	11.700	10.515	10.485
7	Moisture Content %	21.239	20.875	21.030
	Average plastic limit %	21.05		

Plastic Limit = 21.05 %

Plasticity Index = Liquid Limit – Plastic Limit

Plasticity Index = 36.60 – 21.05

= 15.55 %

Compaction Test of Soil

Table 7: Compaction Test of Soil + 10% RHA+ 30% Moorum

Sr. No.	Weight of Mould + Compacted Soil W2 (gms)	Weight of Wet Soil W2 - W1 (gms)	Wet Density (gms/ cm^3)	Moisture Content Determination					
				Wt of Container + Wet Soil (gms)	Wt of Container + Wt of Dry Soil (gms)	Weight of Water (Ww) (gms)	Weight of Dry Soil (Ws) (gms)	Moisture Content (%) (W)	Dry Density (gm $/cm^3$)
1	6525	1833	1.83	1336	1236	100	900	11.11	1.650
2	6555	1863	1.86	1338	1235	103	897	11.48	1.671
3	6632	1940	1.94	1326	1219	107	893	11.98	1.732
4	6699	2007	2.01	1340	1228	112	888	12.61	1.782
5	6586	1894	1.89	1350	1236	114	886	12.87	1.678
6	6520	1828	1.83	1352	1232	120	880	13.64	1.609

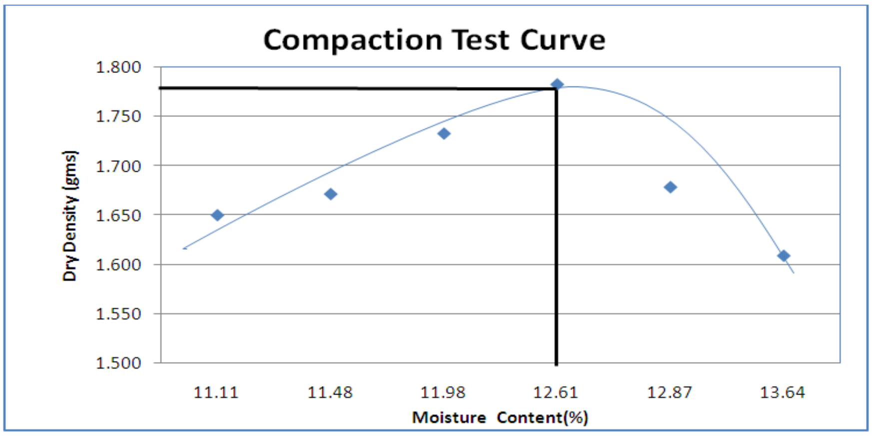

Figure 5: Dry Density vs. Moisture Contain

M. D. D = 1.78 O. M. C = 12.60 %

C.B.R. Test of Soil

Table 8: C.B.R. Test of Soil + 10% RHA+ 30% Moorum

Penetration (mm)	Load (Kg)		
	Trial- I	Trial- II	Trial- III
0.0	0	0	0
0.5	39.2	52.3	52.3
1.0	58.9	58.9	58.9
1.5	78.5	71.9	71.9
2.0	85.0	85.0	85.0
2.5	98.1	98.1	98.1
3.0	111.2	111.2	111.2
4.0	124.3	124.3	124.3
5.0	137.3	130.8	130.8
7.5	143.9	143.9	143.9
10.0	150.4	150.4	150.4
12.5	157.0	157.0	163.5

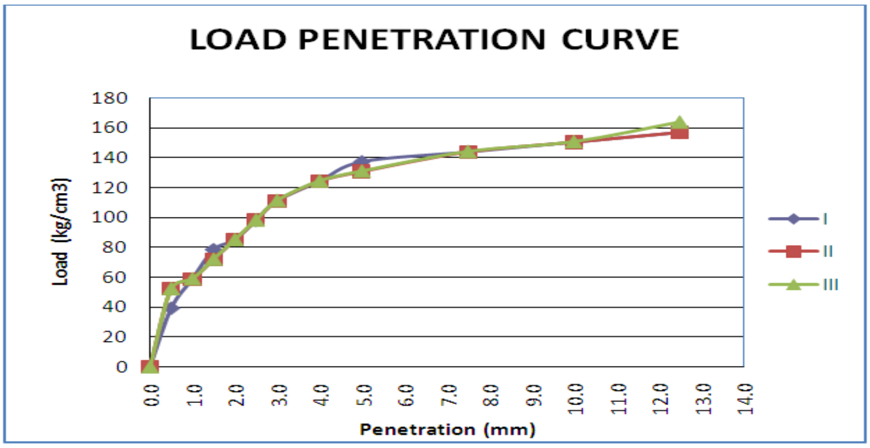

Figure 4.17: C.B.R. of Three Trials of Soil + 10% RHA+ 30% Moorum

Average C.B.R. at 2.5mm = 7.16 %

Average C.B.R. at 5.0mm = 6.47 %

CONCLUSIONS

Based on the investigation, following conclusions are drawn:

- Addition of stabilizer (RHA and Moorum) in the BC soil improves the Engineering properties of the soil.
- Addition of RHA lowers down the Maximum Dry Density of B.C. Soil owing to lesser specific gravity.
- Addition of RHA improves the CBR value of Natural B.C. Soil.

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