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Optimal Machining Conditions For Turning Of AlSiC Metal Matrix Composites Using ANOVA

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ABSTRACT: Procurement of conventional materials in huge quantity required for construction of Subgrade of road is becoming very difficult in many locations due to various problems. On the other hand due to increasing economic growth & industrialization, a huge quantity of waste materials generated needs land for disposal & from that generally creates problems for public health & ecology. So need has arisen for proper disposal of the waste materials. Study brings out the effect of siliceous compound available in amorphous form in burnt Rice Husk Ash, when different doses are mixed with weak soil increases the subgrade strength characterstics. Geotechnical engineering properties like Liquid limit, Plastic limit, Compaction characteristics, CBR values of soil have been studied in this work. On addition of Rice Husk ash the diffused double layer thickness of mixture increases and hence water holding capacity of soil mixtures increases. Specific gravity decreases on addition of ash. On addition of Rice Husk ash the gradation of mixture is adversely affected which leads in reduction of dry density. Rice Husk ash can be used as a good stabilizer along with lime.

KEYWORDS: Rice Husk Ash, Lime, CBR, Compaction Characteristics, Subgrade.

I. INTRODUCTION

In the present scenario, India is the third largest in the world after U.S.A. having a road network of 3.3 million kms. This network has been intensified upon adoption of prestigious projects like Pradhan Mantri Gram Sadak Yojana (PMGSY), Golden Quadlateral, as well as National Highway Development Project by the Government of India. In recent times the demand for subgrade material has increased due to increased constructional activities in the road sector & due to paucity of available nearby land to allow excavate fill materials for making subgrade. In this situation a means to overcome this problem is to utilize the different alternative generated waste materials which cause not only environmental hazards & also the disposal problems. Utilizing these materials in the area of road construction, after improving their characteristics properly can provide useful solution to this problem.

II. RELATED WORK

India is a major rice producing country, Rice milling generates a byproduct know as husk. This surrounds the paddy grain. 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 contains around 85 % - 90 % amorphous silica. So for every 1000 kgs of paddy milled, about 220 kgs (22 %) of husk is produced, and when this husk is burnt in the boilers, about 55 kgs (25 %) of RHA is generated. About 20 million tons of Rice Husk Ash (RHA) is produced annually. This RHA is a great environment threat causing damage to the land and the surrounding area in which it is dumped.

III. MECHANISM INVOLVED IN STABILIZATION

Lime reacts with any other fine pozzolanic component (such as hydrous silica and RHA minerals) to form calcium-silicate hydrate with soil particles. This reaction is also water insoluble. The cementing agents are exactly the same for ordinary Portland cement. The difference is that the calcium silicate gel is formed from the hydration of anhydrous *calcium silicate* (cement), whereas with the lime, the gel is formed only by the removal of silica from the clay minerals of the soil. The pozzolanic process may be written as

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$$Ca(OH)_2 + SiO_2 = C\text{-}S\text{-}H$$
$$Ca(OH)_2 + Al_2O_3 = C\text{-}S\text{-}H$$

Note: C-S-H is cemented material).

The silicate gel proceeds immediately to coat and bind clay lumps in the soil and to block off the soil voids in the manner shown by Figure. In time, this gel gradually crystallizes into well-defined *calcium silicate hydrates* such as *tobermorite* and *hillebrandite*. The micro-crystals can also mechanically interlock. The reaction ceases on drying, and very dry soils will not react with lime or cement. The mechanism of the reaction can be represented as

$$NAS_4H + CH \text{ ® } NH + CAS_4H \text{ ® } NS + \text{degradation product}^*$$

$$< NH + C_2SH^* \; 8 \; (2CH)$$

Where: $S = SiO_2$, $H = H_2O$, $A = Al_2O_3$, $C = CaO$, $N = Na_2O$

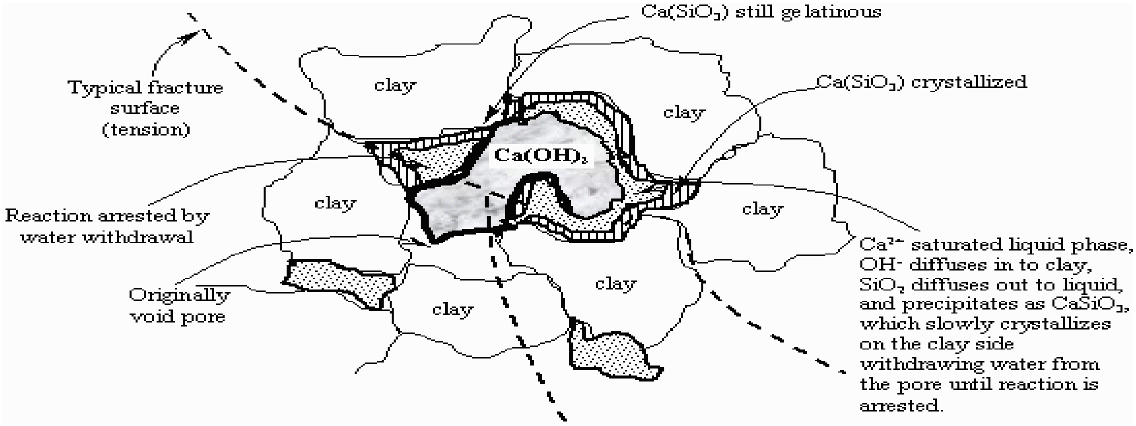

Figure 1:- Reaction mechanism of stabilization on clay soils (Ingles, 1972)

Rice Husk ash containing cementitious material called pozzolana, interact with soils to attain stabilized status. Use of Rice Husk ash for soil stabilization attributes to the chemical composition and physical characteristics of ash, which favour pozzolanic reactions.

The major chemical compounds present in Rice Husk Ash contribute active role in chemical reactions with constituents of soil is Silica Si - ions. Calcium is another additive to form binding compounds along with soil to reach stabilized stage. Lime is added at different doses to supplement calcium Ca + to form binding compounds along with Silica. The optimum binder combination varies with type of soil and binder pozzolanic reactivity. The pozzolanic reactivity assessed on the rate at which the strength imparting phases are produced due to chemical reactions between soil ingredients and binder. Addition of calcium component through Lime to soil is used to exploit chemical compounds formation along with the contribution of siliceous Rice Husk ash.

IV. MATERIALS USED

Soil: In these study three types of materials namely clayey soil, rice husk ash and lime have been used. Soil has been collected from the shallow depth of the nearby field in the Lambua near Sultanpur District. Table -1 shows properties of virgin soil.

Table 1-Properties of Soil

Sl.No	Properties		Soil
1	Light Compaction	MDD	1.876 gm/cc
		OMC	16.28%
2	Specific Gravity		2.67
3	CBR	Unsoaked	6.95 %
		Soaked	3.86 %
4	Atterberg Limit	Liquid Limit	27
		Plastic Limit	21
		Plasticity Index	6

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Rice Husk Ash: Rice husk ash, a predominantly siliceous material is collected from a rice mill which is situated at Lucknow in Uttar Pradesh. Table-2 shows properties of Rice Husk Ash.

Table 2-Chemical Composition of RHA

Fe_2O_3	0.54
K_2O	0.1-2.54
Sio_2	62.5-97.6
CaO	0.1-1.31
MgO	0.01-1.96
Na_2O	0.01-1.58
P_2O_5	0.01-2.69
SiO_3	0.1-2.3
Carbon	2.71-6.42

The average particle size and Specific gravity of RHA are 63.8 µm and 2.11 respectively

Lime: Lime has been collected from the nearby market at Lucknow, Uttar Pradesh. Table 3 shows the constituents of lime by weight .

Table 3-Chemical Composition of Lime

SiO_2	1.85%
Al_2O_3	0.31%
Fe_2O_3	0.14%
CaO	55.48%
MgO	0.10%
Na_2O	0.15%
K_2O	0.43%
LOI	41.23%

V. SCOPE AND OBJECTIVES

In the present study, an attempt is made to identify how Rice Husk ash (RHA) may be effectively utilized in combination with clayey soils to get an improved soil material which may be utilized in various soil structures. Following are the objectives of the present work:-

1. Determine physical property such as LL,PL,PI ,Grain size distribution, determine the MDD and OMC,CBR for the virgin soil sample.
2. Lime content is varied from 0 to 3% in steps of 1% to optimize its value on maximum dry density and CBR value of suitable Soil-Lime mixes.
3. RHA content is varied from 0 to 30% in steps of 10% to optimize its value on maximum dry density and CBR value of suitable Soil-RHA mixes.
4. Lime and RHA were added in virgin soil sample in varied percentage 0 to 3% & 0 to 30% respectively to optimize its value on maximum dry density and CBR value of suitable Soil+Lime+RHA Mixes.
5. Relationship have been developed showing the variation of MDD, OMC & CBR (unsoaked & soaked) at various percentage of lime, MDD , OMC & CBR (unsoaked & soaked) at various percentage of RHA, variation of OMC, MDD & CBR at various percentage of Soil+RHA+Lime.
6. To study the influence of mixing on subgrade strength.

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VI. EXPERIMENTAL INVESTIGATIONS

For determining the quantitative information about the mixed soil, RHA was mixed with the soil sample in increasing proportion of 0%, 10%, 20%, and 30% by weight of soil sample. Further for knowing the effect of lime, 0% to 3% lime in dry condition by weight of soil has been added with the soil mixed with RHA varying from 0% to 30%.

Total mixing proportions are shown in the Table-4 as series 1, 2, 3 and 4. Now for determining the various characteristics of the soil mixed with rice husk ash and lime, Standard Proctor's compaction tests and CBR tests at OMC both in unsoaked and soaked have been performed in the laboratory.

Table-4 Mix Proportion of Soil, RHA and Lime

Series	*Sl. No.*	*Soil (%)*	*RHA (%)*	*Lime (%)*
1	1	100	0	0
	2	100	10	0
	3	100	20	0
	4	100	30	0
2	1	100	0	1
	2	100	10	1
	3	100	20	1
	4	100	30	1
3	1	100	10	2
	2	100	10	2
	3	100	20	2
	4	100	30	2
4	1	100	0	3
	2	100	10	3
	3	100	20	3
	4	100	30	3

VII. ANALYSIS OF TEST RESULT

Effect on Compaction Characteristics

Series of compaction test have been carried out with virgin soil as well as Rice Husk ash and mix of soil, RHA-Soil, Lime-Soil & RHA-Lime-Soil.Table-5 shows series of compaction test at various % of Lime.

Table-5 Series of Compaction test at various % of Lime

SOIL+LIME			
SOIL (%)	**LIME (%)**	**OMC (%)**	**MDD(gm/cc)**
100	0	16.28	1.876
100	1	15.20	1.906
100	2	12.50	2.000
100	3	10.90	2.020

But adding RHA to virgin soil increased the OMC of the mix and decreased MDD value.Table-6 shows series of compaction test at various % of RHA

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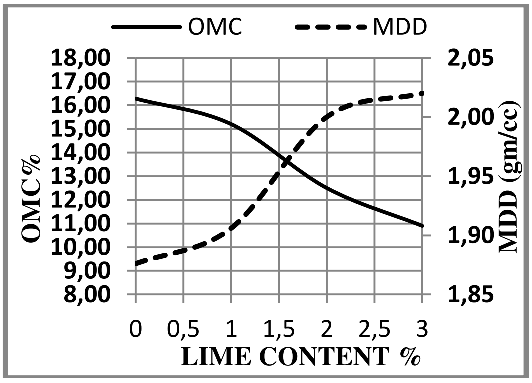
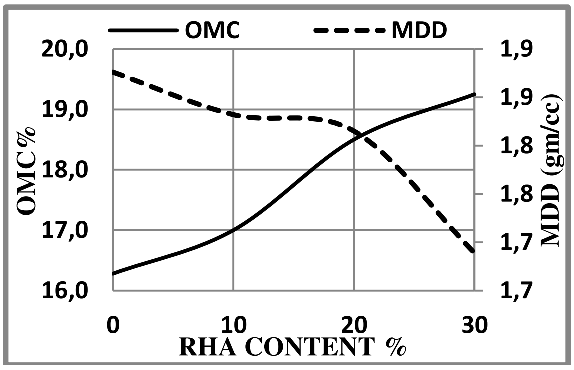
Table-6 Series of Compaction test at various % of RHA

SOIL+RHA			
SOIL (%)	RHA (%)	OMC (%)	MDD(gm/cc)
100	0	16.28	1.876
100	10	17.00	1.832
100	20	18.50	1.815
100	30	19.25	1.689

In **Figure-2** shows variation of OMC & MDD at various % of Lime & RHA **(a)** Variation of OMC & MDD with increase in lime content **(b)** Variation of OMC & MDD with increase in RHA content.





(a) (b)

Table-7 shows variation of subgrade characteristics with increase in Lime & RHA content

SOIL+LIME+RHA								
Series	Sl. No.	Soil (%)	RHA (%)	Lime (%)	OMC (%)	MDD(gm/cc)	CBR	
							Unsoaked(%)	Soaked(%)
1	1	100	0	0	16.28	1.876	6.95	3.86
	2	100	10	0	17.00	1.832	7.38	4.23
	3	100	20	0	18.50	1.815	7.73	4.72
	4	100	30	0	19.25	1.689	6.78	4.46
2	1	100	0	1	15.20	1.906	7.15	5.92
	2	100	10	1	17.18	1.823	7.90	6.78
	3	100	20	1	19.06	1.715	8.93	7.47
	4	100	30	1	22.15	1.649	10.13	8.24
3	1	100	0	2	12.50	2.000	7.21	6.27
	2	100	10	2	15.24	1.834	7.38	6.52
	3	100	20	2	21.50	1.620	8.76	7.30
	4	100	30	2	23.32	1.600	9.53	7.81
4	1	100	0	3	10.90	2.020	7.98	7.12
	2	100	10	3	15.50	1.910	9.10	8.15
	3	100	20	3	20.34	1.862	9.53	8.67
	4	100	30	3	23.10	1.791	10.73	9.18

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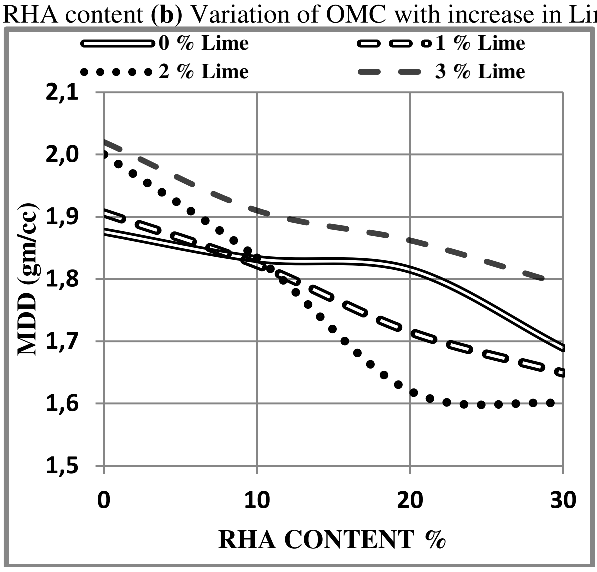
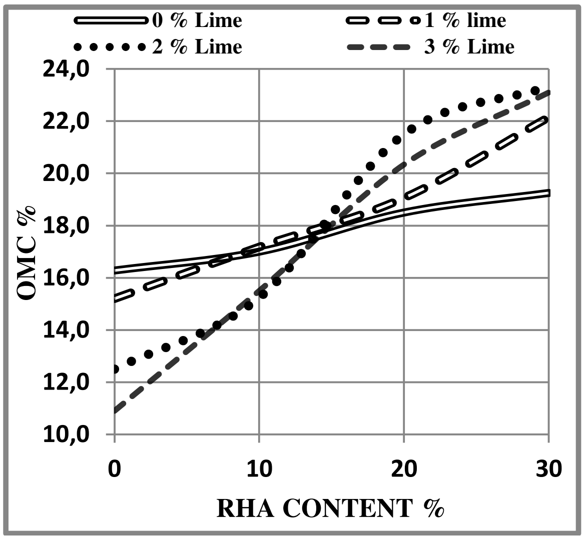
Figure-3 shows variation of OMC & MDD of Soil+Lime+RHA mix **(a)** Variation of MDD with increase in Lime & RHA content **(b)** Variation of OMC with increase in Lime & RHA content.



(a)

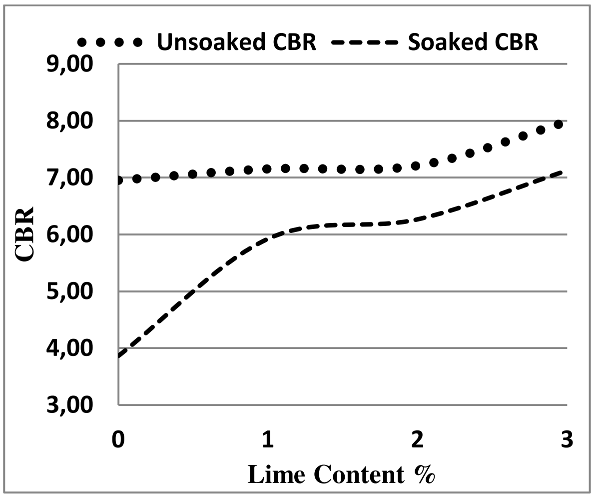


(b)

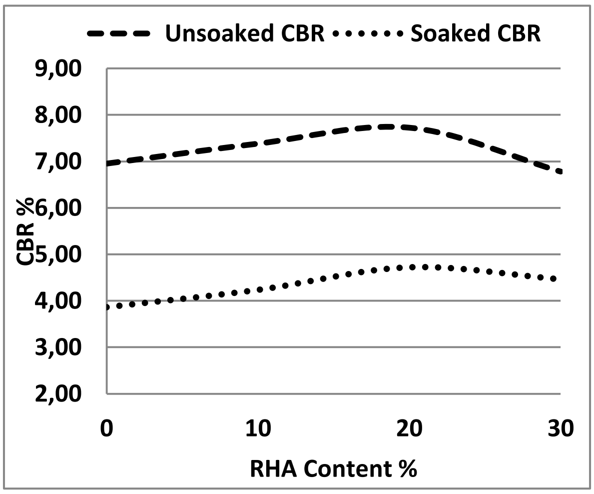
Effect on Strength Characteristics

CBR tests were performed to evaluate the strength properties of the mix. It has been seen that with increase in RHA content in soil reduce its strength. But adding a very little amount of lime has increased the strength substantially both soaked and un-soaked conditions. When lime is mixed with the soil-RHA mix, the strength has been increased considerably. The RHA has good pozolonic characteristics which with hydrated lime improves the strength of the mix.

Figure-4 shows variation of CBR of Soil with various % of Lime, RHA & Lime + RHA **(a)** Variation of CBR with increase in Lime content **(b)** Variation of CBR with increase in RHA content **(c)**Variation of Unsoaked CBR with increase in Lime + RHA content **(d)** Variation of soaked CBR with increase in Lime + RHA content



(a)



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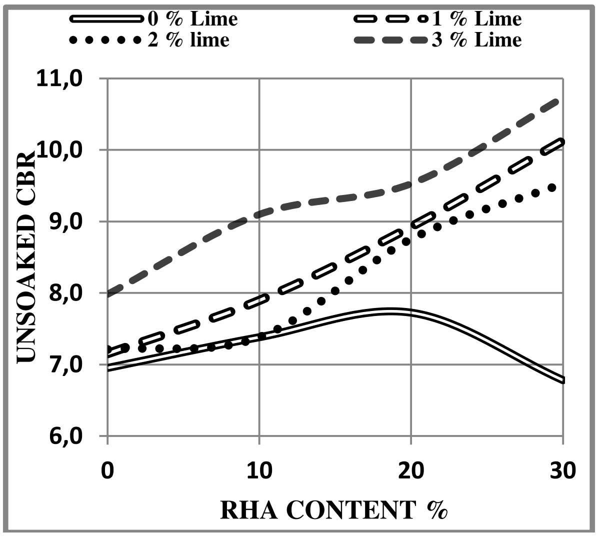

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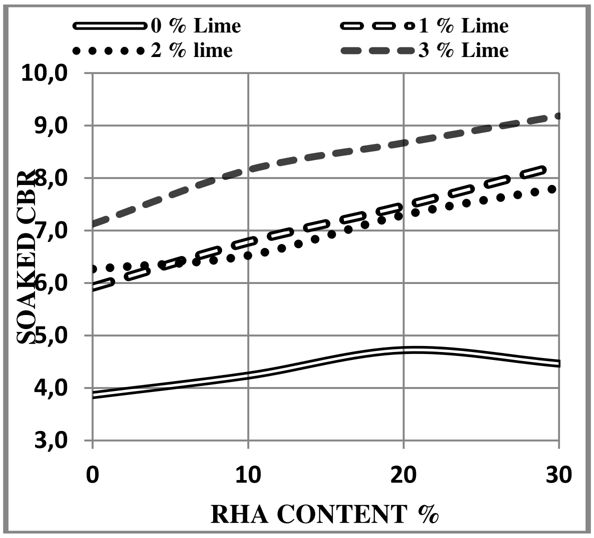

(D)

VIII.CONCLUSION

From the experimental study the following conclusions may be drawn:

1. RHA can be used to reduce the burden of waste material which can be very effectively done by use it as a soil stabilizer by partially replacing the soil with lime.
2. RHA can be used very effectively in the backfilling with soil as well as making the subgrade of the roads as it is being lighter in weight and if lime can be added, it will have a water proofing property as well.
3. The Soaked CBR increases by 2.37 times at 3% lime & 30% RHA content.
4. The Unsoaked CBR increases by 1.54 times at 3% lime & 30% RHA content.
5. The MDD of RHA – soil mix decreases as the RHA content increases in soil.
6. The OMC of RHA-Soil mix increases as the RHA content increases in soil.
7. The curing period of the mix may be a governing parameter as the hydration of lime depends on it. So it is expected that as the curing period increases, the strength will increase.

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