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Improvement of Subgrade Soil Characteristics by Utilizing Lime and Rice Husk Ash

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***Abstract*— Getting massive amount of traditional substances is required for development of Subgrade of avenue is winding up difficult in numerous spots because of extraordinary issues. Then once more due to the fact of increasing financial development and industrialization, a large quantity of waste substances generated wants land for disposal and from that generally creates problems for public fitness and environment. Since want has developed for becoming exchange of the waste materials. This Study uncovers that the have an impact on of siliceous compound handy in shapeless shape in consumed Rice Husk Ash, when various costs are blended with feeble soil extends the subgrade soil high-quality characteristics. Geotechnical residences of subgrade soil like liquid restriction plastic restrict compaction traits CBR california bearing ratio estimations of soil have been contemplated in this work. On growth of Rice Husk fiery debris the diffused twofold layer thickness of mixture increments and henceforth water holding restrict of soil blends increments. On expansion of Rice Husk fiery remains, Explicit gravity of mixture diminishes and the degree of soil mixture is unfavorably influenced which leads in limit of dry thickness. Rice Husk cinder is utilized as a respectable stabilizer alongside lime.**

Keywords— : Lime, Rice Husk Ash, CBR, Compaction Characteristics, Subgrade.

I. INTRODUCTION

In the current scenario, India is the third greatest in the world after U.S.A. having a road community of 3.3 million kms. This community has been intensified upon adoption of prestigious duties like pradhan mantri gram sadak yojana pmgsy golden quadlateral as nicely as national highway Development Project (NHDP) with the aid of the Government of India. In recent instances the demand for subgrade material has accelerated due to accelerated constructional activities in the street sector & due to scarcity of reachable nearby land to permit excavate fill materials for making subgrade. In this state of affairs a potential to overcome this problem is to utilize the different choice generated waste materials which cause now not solely environmental dangers and also the disposal problems. Utilizing these materials in the road development, in the wake of enhancing their attributes appropriately can provide useful answer for this issue.

II. RELATED WORK

India is a major rice producing country, Rice managing makes an outcome know as husk this joins the paddy grain. Amidst planning of paddy around 78 % of weight is gotten as rice broken rice and grain remaining 22 % of the heaviness of paddy is gotten as husk. This husk is used as fuel in the rice processing plants to make steam for the gurgling system. This husk contains around 75 % regular capricious issue and the equality 25 % of the weight of this husk is changed over into powder in the midst of the ending method,Is Known as rice husk impacting remains rha this rha contains around 85 % 90 % not well characterized silica So for every 1000 kgs of paddy handled, around 220 kgs (22 %) of husk is made, and when this husk is scorched in the boilers, around 55 kgs (25 %) of RHA is delivered. 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 responds with some other fine pozzolanic segment, (for example, hydrous silica and RHA minerals) to frame calcium silicate hydrate with soil particles. This response is additionally water insoluble. The solidifying specialists are actually the equivalent for normal Portland concrete. The thing that matters is that the calcium silicate gel is framed from the hydration of anhydrous calcium silicate (concrete), while with the lime, the gel is shaped uniquely by the expulsion of silica from the dirt minerals of the dirt. The pozzolanic procedure might be composed as

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

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

Note: C-S-H is cemented material.

The silicate gel continues quickly to coat and tie earth bumps in the dirt and to close off the dirt voids. In time, this gel steadily takes shape into well-characterized calcium silicate hydrates, for example, tobermorite and hillebrandite. The small scale precious stones can likewise precisely interlock. The response stops on drying, and dry soils won't respond with lime or concrete.

Where: $S = SiO_2$, $H = H_2O$, $C = CaO$

Rice Husk cinder containing cementitious material called pozzolana, responds with soils to achieve settled status. Utilization of Rice Husk powder for soil adjustment credits to the synthetic organization and physical qualities of fiery remains, which support pozzolanic responses.

The significant concoction mixes present in Rice Husk Fiery debris contribute dynamic job in synthetic responses with constituents of soil is Silica Si - particles. Calcium is another added substance to frame restricting mixes alongside soil to achieve balanced out stage. Lime is

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added at various rate to enhance calcium Ca + to shape restricting mixes alongside Silica. The ideal fastener blend differs with sort of soil and cover pozzolanic reactivity. The pozzolanic reactivity surveyed on the rate at which the quality giving stages are created because of concoction responses between soil fixings and fastener. Expansion of calcium part through Lime to soil is utilized to misuse concoction mixes development alongside the commitment of siliceous Rice Husk fiery remains.

IV. MATERIALS USED

Soil: In this investigation three kinds of materials utilized are clayey soil, rice husk fiery particles and lime have been utilized. Soil has been gathered from the close-by field in the solapur Area shut tamalwadi. Table -I shows houses of virgin soil.

TABLE I. PROPERTIES OF SOIL

Sl.No	Property		Value
1	Light Compaction	MDD	1.860 gm/cc
		OMC	17.28%
2	Specific Gravity		2.66
3	CBR	Unsoaked	3.27%
		Soaked	2.42%
4	Atterberg Limit	Liquid Limit	38
		Plastic Limit	28
		Plasticity Index	10

TABLE II. CHEMICAL COMPOSITIONS OF SOIL

Sl.No	Property	Value
1	pH value	>7 (Aikaline)
2	Organic content	0.4-20%
3	$CaCO_3$	1-15%
4	SiO_2	50-55%
5	SiO_2 , Al_2O_3	3-5%
6	Montmorrilonite Mineral	30-50%

Rice Husk Ash: Rice husk fiery remains is a prevalently siliceous material gathered from a rice factory which is arranged at solapur in Maharashtra. Table-III shows properties of Rice Husk Fiery debris.

TABLE III. CHEMICAL COMPOSITION OF RHA

Fe_2O_3	0.50
K_2O	0.1-2.44
Sio_2	62.5-96.4
CaO	0.1-1.31
MgO	0.01-1.84
Na_2O	0.01-1.55
P_2O_5	0.01-2.69
SiO_3	0.1-2.3
Carbon	2.23-5.80

The average particle size and Specific gravity of RHA are 63.88 µm and 2.12 respectively

Lime: Lime has been gathered from the adjacent market at solapur , Maharashtra.

TABLE IV. CONSTITUENTS OF LIME BY WEIGHT

K_2O	0.43%
Sio_2	1.85%
CaO	55.48%
MgO	0.10%
Na_2O	0.15%
Al_2o_3	0.31%
LOI	41.23%
Fe_2O_3	0.14%

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. Determination of physical property such as LL, PL, PI, Grain size distribution, MDD and OMC, CBR for the virgin soil sample.
2. Lime content is varied from 0 to 4% 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 40% 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 4% & 0 to 40% 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.

VI. EXPERIMENTAL INVESTIGATIONS

For determining the quantitative facts about the combined soil, RHA was once mixed with the soil sample in increasing percentage of 0%, 10%, 20%, 30%, and 40% by using weight of soil sample. Further for knowing the impact of lime, 0% to 4% lime in dry situation by using weight of soil has been added with the soil blended with RHA varying from 0% to 40%.

Total mixing proportions are proven in the Table-V as sequence 1, 2, 3, 4 and 5. Presently for determining the one of a kind attributes of the dirt blended with rice husk fiery debris and lime, Standard Delegate's compaction (Light Compaction) checks and CBR assessments at OMC both in Splashed and Unsoaked condition have been performed in the lab.

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TABLE-V. MIX PROPORTION OF SOIL, RHA AND LIME

Series	Sl. No.	Soil (%)	RHA (%)	Lime (%)
1	1	100	0	0
	2	90	10	0
	3	80	20	0
	4	70	30	0
	5	60	40	0
2	1	99	0	1
	2	89	10	1
	3	79	20	1
	4	69	30	1
	5	59	40	1
3	1	98	0	2
	2	88	10	2
	3	78	20	2
	4	68	30	2
	5	58	40	2
4	1	97	0	3
	2	87	10	3
	3	77	20	3
	4	67	30	3
	5	57	40	3
5	1	96	0	4
	2	86	10	4
	3	76	20	4
	4	66	30	4
	5	56	40	4

VII. ANALYSIS OF TEST RESULT

Effect on Compaction Characteristics

Number of compaction take a look at has been finished with virgin soil just as Rice Husk powder and Lime, Lime-Soil, RHA-Soil and RHA-Lime-Soil.

Be that as it may, enlargement of lime to virgin soil diminishes the OMC of the combo and builds the MDD esteems. Table-VI demonstrates arrangement of compaction test at exclusive percent of Lime.

TABLE-VI. SERIES OF COMPACTION TEST AT VARIOUS % OF LIME

Soil+Lime			
Soil (%)	Lime (%)	OMC (%)	MDD(gm/cc)
100	0	17.28	1.860
99	1	16.20	1.895
98	2	14.50	1.930
97	3	12.28	2.004
96	4	11.28	2.020

However, expansion of RHA to virgin soil OMC of the blend increments and diminishes in MDD values. Table-VII shows arrangement of compaction test at different % of RHA

TABLE-VII. SERIES OF COMPACTION TEST AT VARIOUS % OF RHA

Soil+RHA			
Soil (%)	RHA (%)	OMC (%)	MDD(gm/cc)
100	0	17.28	1.860
90	10	17.90	1.810
80	20	18.98	1.780
70	30	19.60	1.680
60	40	20.20	1.580

Fig-1 & 2 shows variation of OMC & MDD at various % of Lime & RHA

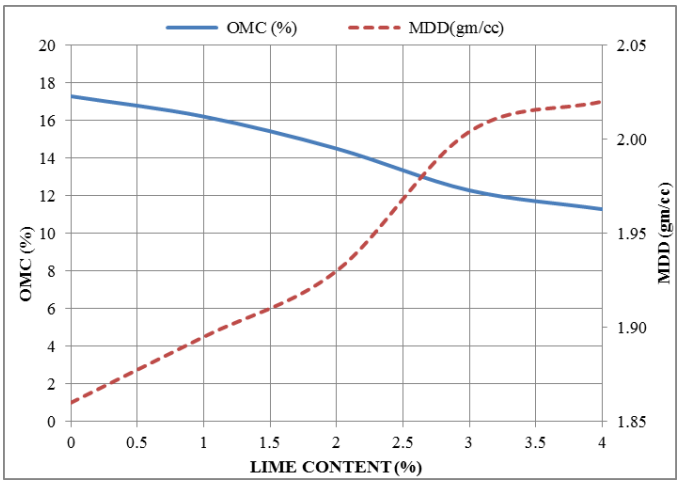

Fig.1.Variation of OMC and MDD with increase in lime content

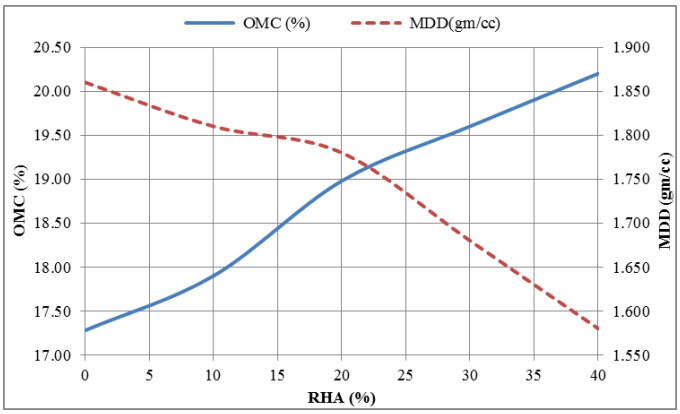

Fig.2.Variation of OMC and MDD with increase in RHA content.

TABLE-VIII. VARIATION OF SUBGRADE CHARACTERISTICS WITH INCREASE IN LIME & RHA CONTENT

Soil+Lime+RHA								
Series	Sl. No.	Soil (%)	RHA (%)	Lime (%)	OMC (%)	MDD (%)	CBR	
							Unsoaked (%)	Soaked (%)
1	1	100	0	0	17.28	1.860	3.27	2.42
	2	90	10	0	17.90	1.810	3.77	2.80
	3	80	20	0	18.98	1.780	4.10	3.20
	4	70	30	0	19.60	1.680	3.80	2.90
	5	60	40	0	20.20	1.580	3.65	2.75

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2	1	99	0	1	16.20	1.895	4.47	3.00
	2	89	10	1	18.18	1.790	5.10	3.80
	3	79	20	1	19.80	1.675	6.00	4.40
	4	69	30	1	21.20	1.585	7.15	5.20
	5	59	40	1	23.50	1.470	7.25	5.65
3	1	98	0	2	14.50	1.930	4.85	4.00
	2	88	10	2	16.20	1.785	5.05	4.26
	3	78	20	2	21.50	1.590	6.25	4.35
	4	68	30	2	23.32	1.510	7.00	5.05
	5	58	40	2	24.98	1.460	7.35	5.25
4	1	97	0	3	12.28	2.004	5.20	4.80
	2	87	10	3	15.50	1.920	6.15	5.75
	3	77	20	3	20.34	1.872	6.45	6.20
	4	67	30	3	23.00	1.800	7.40	6.60
	5	57	40	3	25.10	1.710	7.85	6.95
5	1	96	0	4	11.28	2.020	6.05	5.60
	2	86	10	4	16.50	1.910	6.65	6.05
	3	76	20	4	21.44	1.862	7.05	6.30
	4	66	30	4	24.00	1.798	7.45	6.65
	5	56	40	4	26.10	1.720	8.00	7.00

Fig.3 and 4 shows variation of OMC & MDD of Soil+Lime+RHA mix

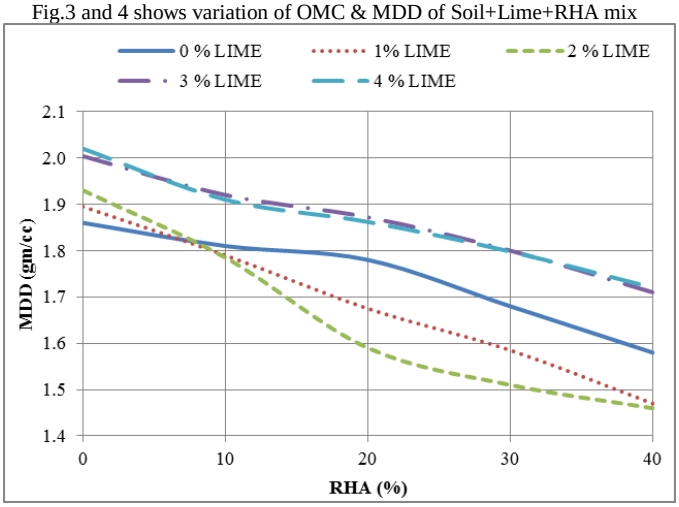

Fig.3 Variation of MDD with increase in Lime & RHA content

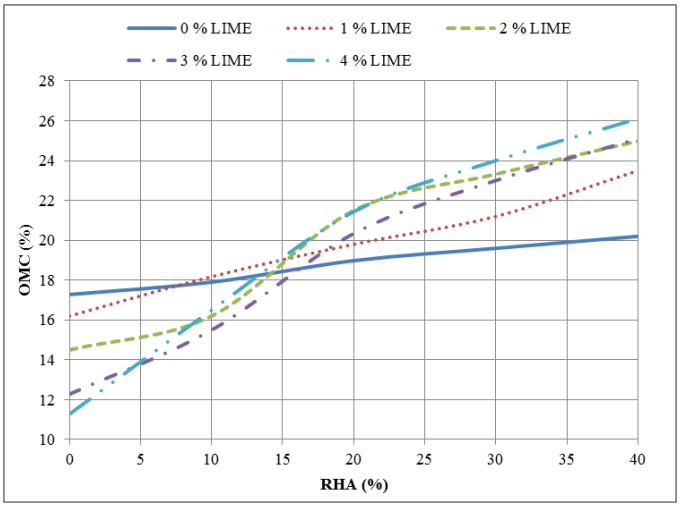

Fig.4. Variation of OMC with increase in Lime & RHA content

EFFECT ON STRENGTH CHARACTERISTICS

CBR tests have been executed to determine the quality homes of the blend. It has been viewed that with increment in RHA content in soil reduce its quality. Be that as it may, growth of a subsequent to no measure of lime has multiplied the fantastic generously each sopping wet and un-doused conditions. At the factor when lime is blended with the filth RHA blend, the satisfactory has been improved impressively. The RHA has incredible pozolonic attributes which with hydrated lime expands the exceptional of the blend.

Fig.5, 6, 7 & 8 shows variation of CBR of Soil with various % of Lime, RHA & Lime + RHA

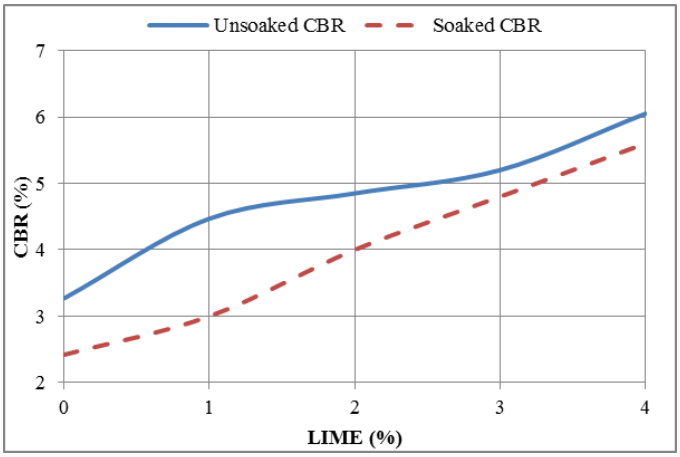

Fig.5.Variation of CBR with increase in Lime content

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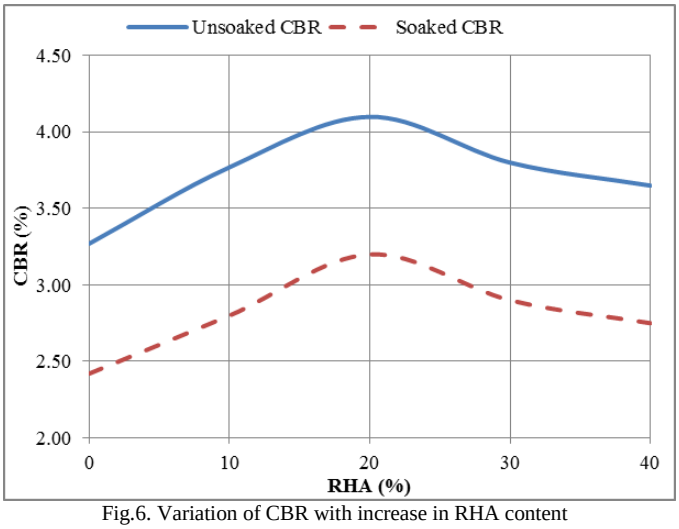

Fig.6. Variation of CBR with increase in RHA content

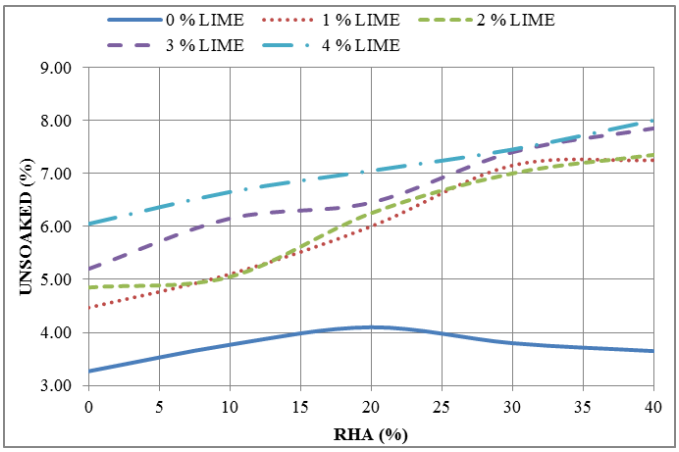

Fig.7. Variation of Unsoaked CBR with increase in Lime + RHA content

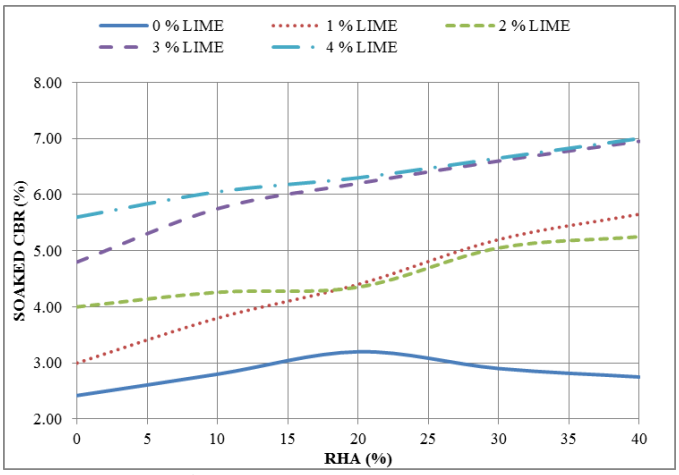

Fig.8. Variation of soaked CBR with increase in Lime + RHA content

VIII. CONCLUSION

From the results the following conclusions may be drawn:

1. To stay away from the weight and transfer issue of RHA, so it tends to be successfully utilized as a stabilizer by somewhat supplanting the dirt with lime..
2. RHA can be utilized in all respects adequately in the inlaying with soil just as making the subgrade of the streets as it is being lighter in weight and if lime can be , it will have a water sealing property also.
3. The Drenched CBR increments by 2.89 occasions at 4 % lime and 40 % R H A substance.
4. The Unsoaked CBR increases by 2.44 times at 4% lime & 40 % R H A content.
5. The MDD of the soil mix decreases as the RHA content increases in soil.
6. The OMC of the Soil mix increases as the RHA content increases in soil..
7. The curing period of the mix may be an important parameter as the hydration of lime depends on curing period of mix. So it is observed that as the curing period increases, the strength the mix will increase..

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