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Research Paper

EFFECT OF LIME AND RICE HUSK ASH ON ENGINEERING PROPERTIES OF BLACK COTTON SOIL

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Black Cotton Soils exhibit high swelling and shrinking when exposed to changes in moisture content and hence have been found to be most troublesome from engineering considerations. This behavior is attributed to the presence of a mineral montmorillonit. The wide spread of the black cotton soil has posed challenges and problems to the construction activities. To encounter with it, innovative and nontraditional research on waste utilization is gaining importance now a days. Soil improvement using the waste material like Slags, Rice husk ash, Silica fume etc., in geotechnical engineering has been in practice from environmental point of view. The main objective of this study is to evaluate the feasibility of using Rice Husk Ash with lime as soil stabilization material. A series of laboratory experiment has been conducted on5%lime mixed black cotton soil blended with Rice Husk Ash in 5%, 10% 15% and 20% by weight of dry soil. The experimental results showed a significant increase in CBR and UCS strength. The CBR values increases by 287.62% and UCS improved by30%.The Differential free swell of the black cotton soil is reduced by 86.92% with increase in Rise Husk Ash content from 0% to 20% respectively. From this investigation it can be concluded that the Rice Husk Ash has a potential to improve the characteristics of black cotton soil.

Keywords: Black cotton soil, Soil Stabilization, Rice husk ash, Engineering Properties

INTRODUCTION

The wide spread of the black cotton soil has posed challenges and difficulties in the construction activities because of its shrink-swell behavior and low strength. The inadequate natural stability of black cotton soil can be reduced using various techniques; one of them is through admixtures. Stabilization techniques can be adopted on large scale when the treatment is low cost and durable. Rice husk ash is one of the major wastes found abundantly. The annual production of paddy is one of the major wastes found abundantly. In India, the annual production of paddy is about 100 million tones. The burning of rice husk generates about 20% of its weight as ash.Thereby generating more than 4 million tons of rice husk ash. Hence research work is done on utilization of rice husk ash in improvement of geotechnical characteristics of black cotton soil. In the present investigation, an attempt has been made to evaluate the changes in the compaction and strength characteristics of black cotton soils such as optimum moisture content, maximum dry density, CBR and UCS in addition of 5% lime and rice husk ash in different proportions.

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LITERATURE REVIEW

Satyanarayan *et al*., 2004 studied the effect of FA and lime on the expansive soil used for construction of road base, sub base (Satyanarayan *et al*., 2004). Stabilization of expansive soil using rice husk ash (RHA) as a pozzolanic material along with a binder has been studied by researchers a number of times (N K Bhasin *et al*., 1988), (A S Muntohar and G Hantoro, 2000), Effect of RHA with cement (E A Basha *et al*., 2003), (A N Ramakrishna and A V Pradeep Kumar, 2006), effect of RHA with calcium chloride (R S Sharma, 2008), effect of RHA with with marble dust (A K Sabat and R P Nanda, 2011), effect of RHA and lime with gypsum (D K Rao *et al*., 2011) etc. Similarly the mixing of lime sludge along with a pozzolanic material has also been studied. Some are bagasse ash with lime sludge (A K Sabat, 2012), fly ash with lime sludge (R K Srivastava *et al*., 1997). Chandra et al. had stabilized a non-expansive clayey soil with RHA and lime sludge (S Chandra *et al*., 2005). RHA added to soil was from 5 to 20% in steps of 5% and lime sludge from 4 to 16% in steps of 4%. Properties of the stabilized soil studied were, Atterberg's limits, maximum dry density (MDD), optimum moisture content (OMC), unconfined compressive strength (UCS) and soaked California bearing ratio (CBR) of soil. Sabat (A K Sabat, 2012) had studied the stabilizing effects of bagasse ash and lime sludge on compaction properties, UCS, CBR and swelling pressure of an expansive soil , Brooks (2009) studied the potential of Rice Husk Ash (RHA)and fly ash (FA) blended soil as a swell reduction layer between the footing of a foundation and subgrade. He recommended 12% and 25%, RHA and FA, respectively, for modifying the expansive subgrade soil. Ali et al. (2004) studied the effect of RHA and lime on characteristics of bentonite. (Ali M and Sreenivasulu V, 2004).

MATERIALS AND METHODS

A series of laboratory tests were conducted on 5%lime mixed BC Soil blended with RSA in various percentages i.e. 0%, 5%, 10%, 15% and 20% by weight of dry soil. The following tests were conducted on 5%lime mixed BC soil and Rice mixes; as per relevant IS Code. The tests are

1. Compaction Test
2. California Bearing Ratio
3. Unconfined Compressive Strength
4. Differential Free Index

BLACK COTTON SOIL

The black cotton soil used in this study was collected from Bilhari area of Jabalpur (M. P.) The physical characteristics of clay sample is given in Table 1.

RICE HUSK ASH

The stabilizer materials used in this study was Rice Husk Ash. Rice Husk Ash used in this study collected from Rice Mill, Shahpura, Dist. Jabalpur (M. P.) The properties of RHA is presented in Table 2.

The black cotton soil was mixed with 5%lime and soaked for four days. After oven drying, the following samples are prepared by mixing different percentage of rice husk ash to it.

Table 1: Properties of Black Cotton Soil

S.N.	Particulars	Test Value
1.	Specific Gravity	2.56
2.	Liquid Limit %	48.5%
3.	Plastic Limit %	22.7%
4.	Plasticity Index %	25.8%
5.	Shrinkage Limit %	8.61%
6.	Grain Size distribution %	89.783%

BCS - Black cotton soil

SAM0 - Black cotton soil+5% lime

SAM5 - SAM0 +5% Rice husk ash

SAM10 - SAM0+10% Rice husk ash

SAM15 - SAM0+15% Rice husk ash

SAM20 - SAM0+20% Rice husk ash

Table 2: Properties of Rice Husk Ash

S.N.	Parameters	Test Value
I)	**Chemical Properties**	
	Silica	85.14%
	Lime	3.08%
	Alumina	2.07%
	Iron Oxide	1.43%
	Magnesia	4.03%
	Loss on Ignition % w/w	5.08%
II)	**Physical Properties**	
	Specific Gravity	1.81 gm/cc
	Particle Size	13.2%

RESULTS AND DISCUSSION

The tests results are summarized in Table 3. The variation in the Optimum moisture contents, Maximum dry density, California bearing ratio, Unconfined compressive strength and Differential free index are shown in Figures 1 to 5.

Table 3: Summary of Results

Mix	OMC %	MDD gm/ Cm3	CBR %	UCS Kg/ cm2	DFS %
BCS	18.25	1.68	1.94	1.10	54.30
SAM0	17.75	1.65	3.87	1.17	27.30
SAM5	19.20	1.62	4.99	1.24	19.04
SAM10	20.00	1.58	6.10	1.30	13.70
SAM15	20.50	1.54	6.92	1.36	9.09
SAM20	22.00	1.51	7.52	1.43	7.10

1. OMC- Optimum moisture contents, 2. MDD - Maximum dry density, 3. CBR-California bearing ratio, 4. UCS - Unconfined compressive strength, 5. DFS-Differential free index.

Figure 1: Variation in OMC

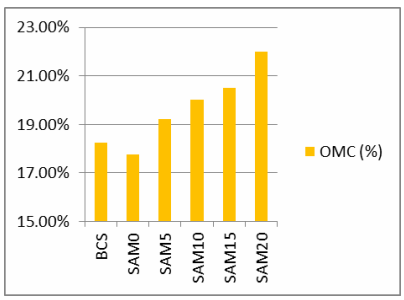


Figure 2: Variation in MDD

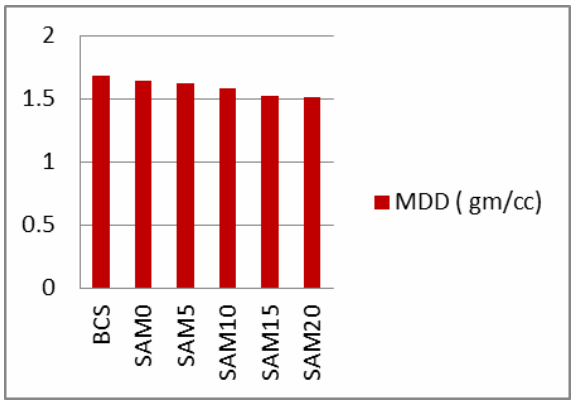


Figure 3: Variation in CBR

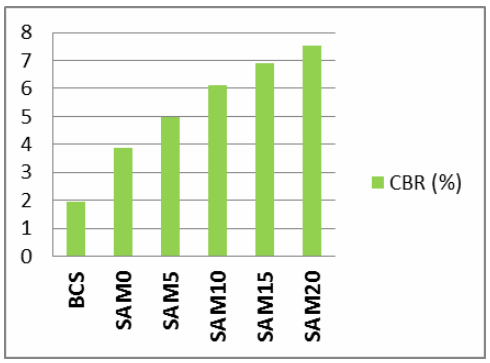


Figure 4: Variation in UCS

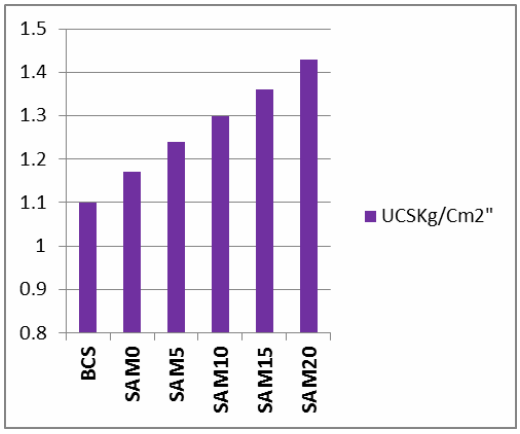
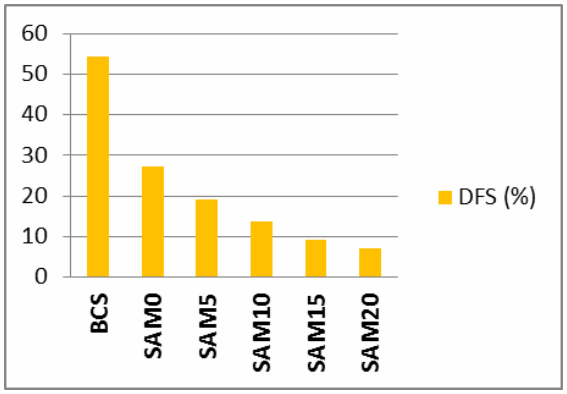


Figure 5: Variation in DFS



CONCLUSION

From the results of the investigation carried out within the scope of the study the following conclusion can be drawn

1. With the increase in Rice husk ash percentage the Optimum moisture content increases from 18.25%to 22.00%
2. Maximum dry density decreases from 1.68gm/cm^3 to 1.51 gm/cm^3.
3. There is significant increase in the values of California bearing ratio and Unconfined Compressive Strength. California bearing ratio increases from1.94%to 7.52% and Unconfined strength increases from 1.10 Kg/cm^2 to 1.43Kg/cm^2.

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