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Effect of Lime and Rice Husk Ash on Index Properties of Black Cotton Soil

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Abstract

This paper present an experimental investigation, carried out to study the effects of Rice Husk Ash on index properties of black cotton soil stabilized with 5%lime.Black cotton soil blended with 5% lime are treated by mixing Rice Husk Ash in 5%, 10%, 15%, and 20% ratio by weight of dry soil as per relevant IS code of practice and tests for index properties are carried out. The results showed a marked change in index properties of soil sample. The liquid limit and plasticity index decrease from 48.5% to 41.8% and 25.8% to 12.3% respectively with increase in rice husk ash from 5% to20%to 5% lime blended black cotton soil whereas plastic limit and shrinkage limit increase from 22.7% to 29.5% and 8.61% to 13.76% respectively. Also the Differential Free Swell decreases from54.3% to 7.1%, showing appreciable decrease in swelling behavior. The improvement in Index properties of soil reveals that Rice Husk Ash is an important material to stabilize the Black Cotton soil and make suitable for construction purpose.

Keywords:-Rice Husk Ash, Black cotton soil, Soil Stabilization, Index properties.

Introduction

In India Black cotton soil covers about 20% percent area of land. Black cotton soils is one of the problematic soils that has great tendency for Shrinking or swelling due to change of water content. Because of its peculiar cyclic swell shrink behavior, these soils increase in volume when comes in contact with water and decrease in volume when water is evaporates out. . Due to this tendency the deformation of soil cannot be predicted. This produces differential settlement and movement in soil and hence in structure which is usually in an uneven manner & is of such magnitude which creates sever damage to structures constructed on the soil. This inadequate natural stability of Black cotton soil needs to be improved to make them suitable for construction ,using some sort of stabilization method. Many stabilization techniques are in practice for improving the characteristics of black cotton soil. Stabilizers such as lime, fly ash, rice husk ash, cement, silica fumes etc. are used toenhance properties of black cotton soil. The selection and the amount of stabilizers to be used depend mainly on the mineralogical composition of soil. 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 55 kgs (25 %) of RHA is generated .This study envies the effect of Rice Husk Ash on the Index properties and Differential Free Swell of Black Cotton Soil mixed with lime and 0% to 20% Rice Husk Ash by weight of dry soil

Materials and Methodology

A series of laboratory tests were conducted on 5%lime mixed BC Soil blended with Rice Husk Ashin 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.-

- Grain size distribution
- Specific Gravity
- Liquid limit
- Plastic limit
- Plasticity Index
- Shrinkage limit
- Differential free swell (DFS)

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, and Dist.

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Jabalpur (M.P.). The properties of RHA is presented in Table- 1

Table-1propertiesof Rice Husk Ash

S.N0	Parameters	Test value
I)	**Chemical Properties**	
1.	Silica (SiO2)%w/w	85.14%
2.	Lime (CaO) %w/w	3.08%
3.	Alumina (Al2O3)%w/w	2.07%
4.	Iron Oxide (Fe2O3)%w/w	1.43%
5.	Magnesia (MgO)%w/w	4.03%
6.	Loss On Ignition% w/w	5.08%
II)	**Physical Properties**	
1.	Specific Gravity g/cc	1.81
2.	Particle Size,% w/w	13.2

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-2

Table-2 Properties of Black Cotton Soil

S.No	Particulars	Test Results
1.	Specific Gravity g/cc	2.56
2.	Plastic limit %	22.7%
3.	Liquid limit %	48.5%
4.	Plasticity Index%	25.8%
5.	Shrinkage limit %	8.61%
6.	Grain Size Distribution%	89.783%
7.	Differential Free Swell	54.3%

Resusts and Discussin

All the tests were conducted on black cotton soil mixed with 5% lime and blended with differentpercentage of RHA as per relevant IS code of practice. The results are summarized in Table -3. The variation in values of specific gravity, Liquid Limit, Plastic Limit, Plasticity Index, Shrinkage Limit and DFS are in figure 1 to 6.

Table -3. Summary of results

SNo	PARAMETERS	BCS	SAM0	SAM5	SAM10	SAM15	SAM20
1	Specific Gravity	2.56	2.54	2.52	2.47	2.43	2.40
2	Liquid Limit	48.5%	37.5%	38.3%	39.4%	40.80%	41.80%
3	Plastic Limit	22.7%	23.5%	24.8%	26.0%	28.2%	29.5%
4	Plasticity Index	25.8%	14.0%	13.8%	13.4%	12.6%	12.3%
5	Shrinkage Limit	8.61%	10.23%	11.14%	12.03%	12.95%	13.76%
6	Differential Free Index	54.3%	27.3%	19.04%	13.70%	9.09%	7.10%

BCS=Black Cotton Soil SAM0=BCS+5%Lime SAM5=SAM0+5%RHA
SAM10=SAM0+10%RHA SAM15=SAM0+15%RHA SAM20=SAM0+20%RHA

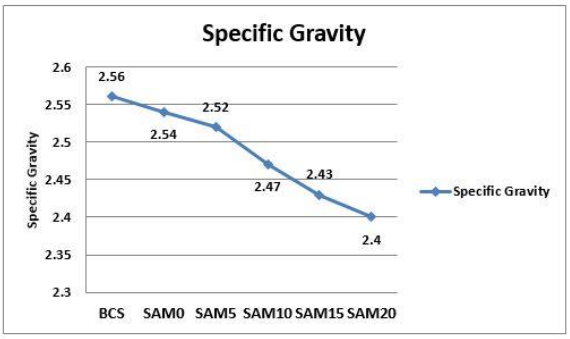

Fig.1—Variation in Specific Gravity

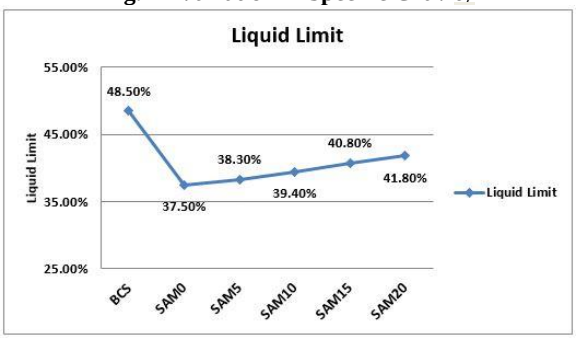

Fig.2—Variation in Liquid Limit

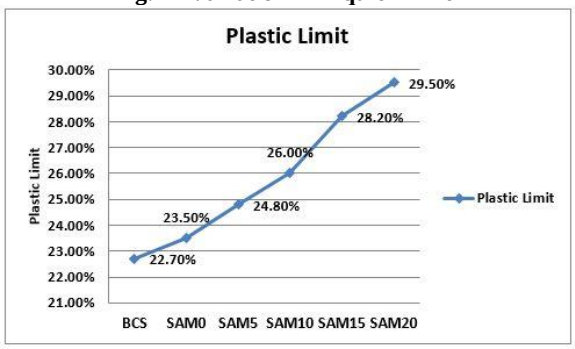

Fig.3—Variation in Plastic Limit

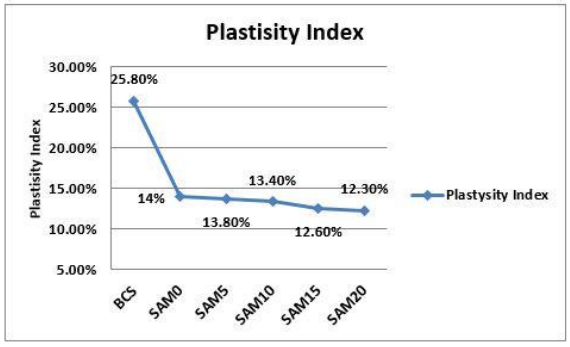

Fig.4—Variation in Plasticity Index

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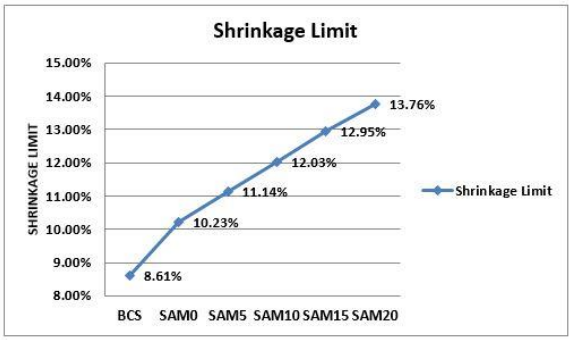

Fig.5—Variation in Shrinkage Limit

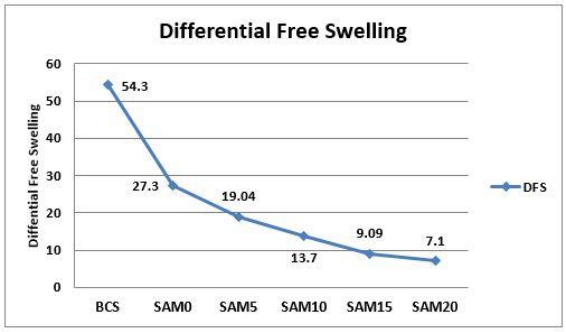

Fig.6—Variation Differential Free Index

Conclusion

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

1. With the increase in Rice husk ash Specific Gravity decreases from 2.56 to 2.40.
2. Liquid Limit decreases from 48.5% to 37.5%in mixing 5%lime but increases from 37.5% to41,8%with addition of Rice Husk Ash from 5% to 20%
3. Plastic Limit increases from22.7% to29.5%.Shrinkage Limit also increases from8.61%to13.76% but Plasticity index decreases from 25.8%to 12.3%.
4. Differential Free Index decreases from 54.3%to 7.10%. From the test results it can be concluded that the addition of Rice husk ash to lime stabilized black cotton soil decreases its swelling behavior to a great extent.

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