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LABORATORY TEST ON SOIL STABILIZATION USING DIFFERENT MATERIALS

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Abstract: - India has a total road network of about 4.7million kilometers. 53 percent of the total road network is paved. The budgeted amount spent over roads is Rs.14, 90,925 Crore. The durability and serviceability of pavements depend mainly on strength of sub grade, which can be enhanced by ground improvement techniques. The field of ground improvement by the use of waste rice husk ash for this purpose.. In recent times the demands for sub grade materials has increased due to increased constructional activities in the road sector and due to paucity of available nearby lands to allow excavate fill materials for making sub grade. In this situation, a means to overcome this problem is to utilize the different alternative generated waste materials, which cause not only environmental hazards and also the depositional problems. Keeping this in view stabilization of weak soil in situ may be done with suitable admixtures to save the construction costconsiderably.Also, due to the large production of agricultural wastes, the world is facing a serious problem of its handling and disposal. The disposal of agricultural wastes has a potential negative impact on the environment causing air pollution, water pollution and finally affecting the local ecosystems. So it is mandatory to make these agricultural wastes eco- friendly. By using them as soil stabilizers, these agricultural wastes improve the strength of soil and its characteristics without causing any harm to the environment. The objective of this study is toupgrade soil as a construction material using Rice Husk Ash (RHA) and Sugar Bagasse Ash (SBA) which is a waste material. The cost of construction of stabilized road have been keeping financially high due to the over dependency on the utilization of industrially manufactured soil improving additives (cement, lime etc.). By using the agricultural waste the cost of construction will be considerably reduced as well reducing the environmental hazards theycause. Silica produced from Rice Husk Ash and Sugar Bagasse Ash have investigated successfully as a pozzolanic material in soil stabilization. Due tovarious construction development projects undertaken all over the world there is a potential to use waste materials like Rice Husk and Sugar Bagasse which create disposal problems. Rice husk waste is produced in large quantity in rice husk mills and is disposed in open land. Therefore use of rice husk in foundation of buildings and in road constructions to improve bearing capacity of soil and to reduce the area of open land needed for its disposal and to preserve environment through resource conservation.

The performance of the soil- RHA and soil-SBA was investigated with respect to Standard Proctor Test, Liquid Limit Test, Plastic Limit Test and California Bearing Ratio (CBR) test. The results obtained, indicates a considerable decrease in the maximum dry density (MDD), an increase in optimum moisture content (OMC) and a superficial improvement in the CBR with the increase in the RHA and SBA content.

Keywords: - *Plastic Limit Test, California Bearing Ratio (CBR) test, maximum dry density (MDD), Plastic limit*

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I INTRODUCTION

Black cotton soil causes many problems to road constructed on it. About 20% of the soil found in India is expansive in nature. Roads on black cotton soils are known for bad condition. In rainy season black cotton soil absorbs water heavily which results into swelling and softening of soil. In addition to this it also loses its strength and becomes easily compressible.

According to Geo technology, soil improvement can either be by modification or by stabilization, or by both. Soil modification is the process of addition of a modifier (cement, lime, etc.) to the soil to change its index properties, while soil stabilization is the treatment of soils to increase their strength and durability so that they are suitable for construction beyond their original classification. In most of the situations, soils in natural state do not possess proper geotechnical properties to be used as road service layers, foundation layers and as a construction material. In order to make them useful and meet the requirements of geotechnical engineering design, researchers have concentrated more on the use of cost effective materials that are available locally from industrial and agricultural wastes in order to increase the properties of deficient soils and also to reduce the cost of construction. Due to the large production of agricultural wastes, the world is facing a serious problem of its

handling and disposal. The disposal of agricultural wastes has a potential negative impact on the environment causing air pollution, water pollution and finally affecting the local ecosystems. Hence the secure disposition of agricultural wastes has become a challenging task for engineers. The main aim of the study is to investigate the use of Rice Husk Ash and Sugar Bagasse Ash which is an agricultural waste to stabilize the weak sub grade soil. This hitherto have continued to impede the poor and underdeveloped nations of the world from providing accessible roads to their rural inhabitants who contribute to the major percentage of their population and are mostly, agriculturally dependent. Thus by using the agricultural waste the cost of construction will be considerably reduced as well reducing the environmental hazards they cause. It has been identified that Portland cement, with respect to its chemistry, produces large amounts of CO 2 for each ton of its final product. Hence by replacing proportions of the Portland cement with a secondary cementations material like RHA and SBA in soil stabilization will reduce the overall negative environmental impact of the stabilization process.

SoilStabilization:

Soil stabilization is the process of improving its geotechnical properties of soil. Soil stabilization involves the use of stabilizing agents (binder materials) in weak soils to improve its geotechnical properties such as compressibility, strength, permeability and durability. The components of stabilization technology include soils and or soil minerals and stabilizing agent or binders, soil stabilization aims at improving soil strength and increasing resistance to softening by water through bonding the soil particles together.

Scope and Objectives:

This study was oriented towards improving the strength of soil by using locally available agricultural wastes to reduce the construction cost. The different stabilizing agents are used Rice Husk Ash (RHA) and Sugar Bagasse Ash (SBA). The present study was undertaken with the following objectives:

· To explore the possibility of using rural waste materials like RHA and SBA, in soil stabilization.

· To investigate the physical and engineering properties of natural soil and stabilized soil by adding 7%, 9% and 11% of ash in soil.

· To analyze which is better option for stabilizing black cotton soil among Sugar Bagasse Ash (SBA) and Rice Husk Ash (RHA).

II LITERATUREREVIEW

Expansive Soil Stabilization Using Waste From Sugar Industry Z. ROHIT, G.ABHIJIT, J.AJINKYA , V.PURUSHOTTAM.

In this research paper, soil stabilization is done by using agricultural waste i.e. sugarcane bagasse ash. The aim of this research paper is to make economic and to maintain the environmental balance for the ash disposal. Different percentages of sugar bagasse ash i.e. 2%, 4%, 6%, 8%, and10% were used to stabilize the soil.

Black Cotton Soil Stabilization Using Bagasse Ash AndLime Z. ROHIT, G.ABHIJIT, J.AJINKYA , V.PURUSHOTTAM.

The aim of this journal or review is to enhance the engineering properties of black cotton soil by use of Bagasse ash and lime as an admixture. In this study test results of various soil samples are compared which includes normal black cotton soil sample and black cotton soil mixed with varying percentages of Bagasse ash and lime. The various test performed on these samples are liquidlimit,plastic limit,plasticity index, Differential free swell test,Standard Proctor Compaction Test, optimum moisture content, maximum dry density and California Bearing Ratio (CBR test). These tests were performed on normal BCS sample & soil containing Bagasse and lime in varying percentage [BA: L (1:4), BA: L (2:3), BA: L (3; 2), BA: L(4:1)].

Stabilization Of Soil By Using Agricultural Waste Z. ROHIT, G.ABHIJIT, J.AJINKYA , V.PURUSHOTTAM.

In this literature review soil stabilization is done with the use of rice husk and sugarcane straw ash as an admixture. The study is done by varying the percentage of rice husk used for improving the properties of soil. In this literature review it is planned to add admixture at the dosage of 2%, 4%6%, 8% by the weight of soil and the engineering and index properties of soil is compared with the properties of normal soil. The materials used in this literature review are lateritic soil, rice husk, sugarcane straw ash. The various tests performed are liquid limit, plastic limit, plasticity index, optimum moisture content and MDD. These various tests are performed on normal soil and the soil containing rice husk and sugarcane straw ash.

Soil Stabilization Using Rice Husk Prof. Hindola shava

In this literature review soil stabilization is done by the use of rice husk ash (RHA). The paper therefore takes the review of use of rice husk ash on the engineering and index properties of soil. The various test performed on both normal soil and mixture of soil and rice husk ash. The effect on the properties of soil is studied by varying the percentage of rice husk ash by the weight of soil. The different percentages of rice husk ash are 10% 20 % and a small amount of additives is also added such as lime and gypsum. The various tests, which are performed in this paper, are Maximum Dry Density, Optimum Moisture Content, California Bearing Ratio (soaked and unsoaked).

III SOIL TESTING

After a comprehensive analysis of the research papers above we finalized and performed the following tests with various variations and the comparative study has been presented:

·The Proctor test wasperformed for determining Optimum Moisture Content and Maximum DryDensity

O 5 samples for plainsoil

O 5 samples each for Sugar Bagasse Ash and lime(2:3) replaced soil at 7, 9 and11 %

O 5 samples each for Rice Husk Ash and lime (2:3) replaced at 7,9 and11%

·LiquidLimit

O 4 samples for plainsoil

O 4 samples each for Sugar Bagasse Ash and lime(2:3) replaced soil at 7, 9 and11 %

O 4 samples each for Rice Husk Ash and lime (2:3) replaced at 7,9 and11%

· PlasticLimit

O 2 samples for plainsoil

O 2 samples each for Sugar Bagasse Ash and lime(2:3) replaced soil at 7, 9 and11 %

O 2 samples each for Rice Husk Ash and lime (2:3) replaced at 7,9 and11%

· California BearingRatio

O 1 samples for plainsoil

O 1 samples each for Sugar Bagasse Ash and lime(2:3) replaced soil at 7, 9 and11 %

O 1 samples each for Rice Husk Ash and lime (2:3) replaced at 7,9 and11%

3.1 STANDARD PROCTORTEST

Objective:

To determine optimum moisture content and maximum dry density of given soil.

Need and Scope:

Compaction is the process of densification of soil by reducing air voids. The degree of compaction of a given soil is measured in terms of its dry density. The dry density is maximum at the optimum water content. A curve is drawn between the water content and the dry density to obtain the maximum dry density and the optimum watercontent.

Dry density of soil:

Where M = total mass of the soil, V= volume of soil, w= water content.

Result:

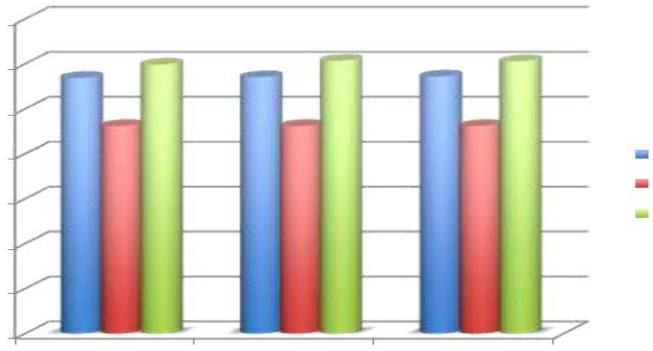

Fig 1 Optimum Moisture Content

There is an increase of 23.18 % and 29.57 % in OMC by adding 7 % Sugar Bagasse Ash and Rice Husk Ash respectively.

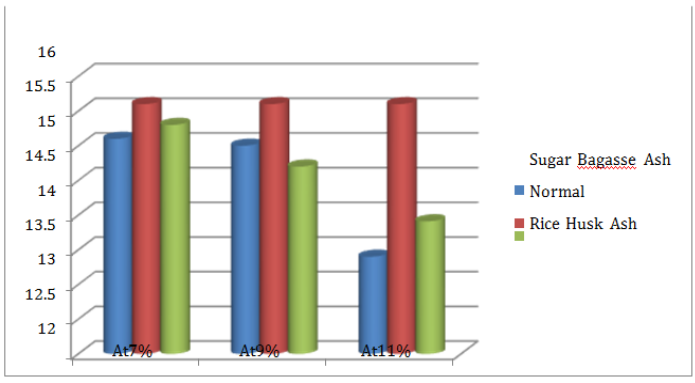

Fig 2 Maximum Dry Density(KN/m3)

There is an decrease of 3.3 % and 1.96 %in MDD by adding 7 % Sugar Bagasse Ash and Rice Husk Ash respectively.

Fig 3 Compaction Apparatus

3.2 LIQUIDLIMIT

The liquid limit of a soil is the water content at which the soil behaves practically like a liquid, but has small shear strength. It flows to close the groove in just 25 blows in Casagrande's liquid limit device.

As it is difficult to get exactly 25 blows in a test, 3 to 4 tests are conducted and the number of blows (N) required in each test is determined. A semi- log plot is then drawn between log N and the water content (w). The liquid limit is the water content corresponding to N=25, as obtained from the plot.

Result:

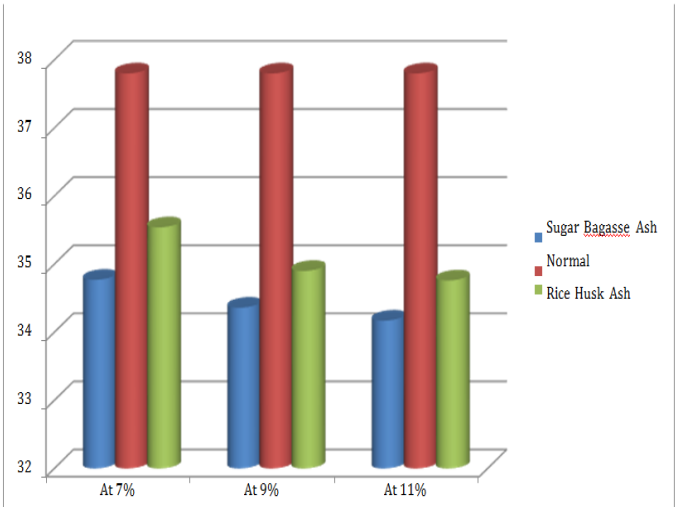

Fig 4 Liquid Limit was found out for all the seven specimens. A fall of 8% and 5.9% in liquid limit is observed by adding 7 % Sugar Bagasse Ash and Rice Husk Ash respectively.

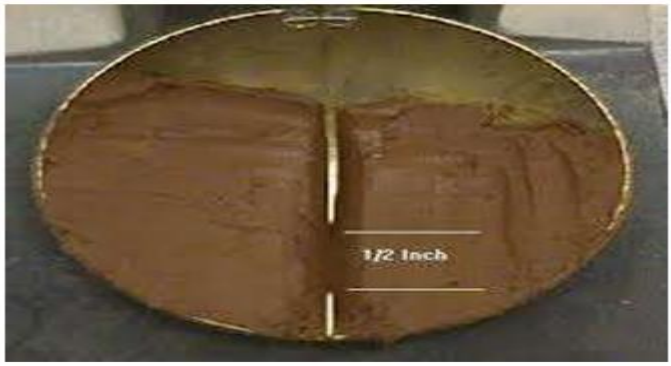

Fig 5 Sample after testing Per

3.3 PLASTICLIMIT

The plastic limit of a soil is the water content of the soil below which it ceases to be plastic. It begins to crumble when rolled into threads of 3mm diameter.

Result:

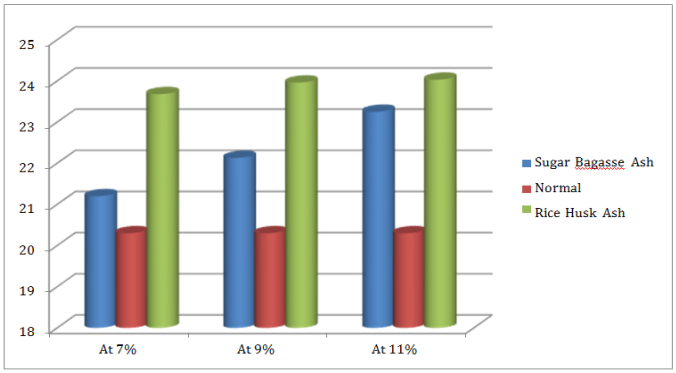

Fig 5 Plastic Limit was found out for all the seven specimens. A increase of 4.4% and 16.15% in liquid limit is observed by adding 7 % Sugar Bagasse Ash and Rice Husk Ash respectively.

Fig 6 Performing Plastic Limit

3.4 CALIFORNIA BEARING RATIOTEST

Objective:

To determine the California bearing ratio by conducting a load penetration test in the laboratory.

Need and Scope:

The California bearing ratio test is penetration test meant for the evaluation of sub grade strength of roads and pavements. The results obtained by these tests are used with the empirical curves to determine the thickness of pavement and its component layers. This is the most widely used method for the design of flexiblepavement.

Definition of C.B.R.:

It is the ratio of force per unit area required to penetrate a soil mass with standard circular piston at the rate of 1.25 mm/min. to that required for the corresponding penetration of a standard material.

C.B.R. = {Test load/Standard load} x 100

The following table gives the standard loads adopted for different penetrations for the standard material with a C.B.R. value of 100%

Penetration of plunger (mm)	Standardload (kg)
2.5	1370
5.0	2055
7.5	2630
10.0	3180
12.5	3600

Result :

The C.B.R. values are usually calculated for penetration of 2.5 mm and 5 mm. Generally the C.B.R. value at 2.5 mm will be greater that at 5 mm and in such a case/the former shall be taken as C.B.R. for design purpose. If C.B.R. for 5 mm exceeds that for 2.5 mm, the test should be repeated. If identical results follow, the C.B.R. corresponding to 5 mm penetration should be taken fordesign.

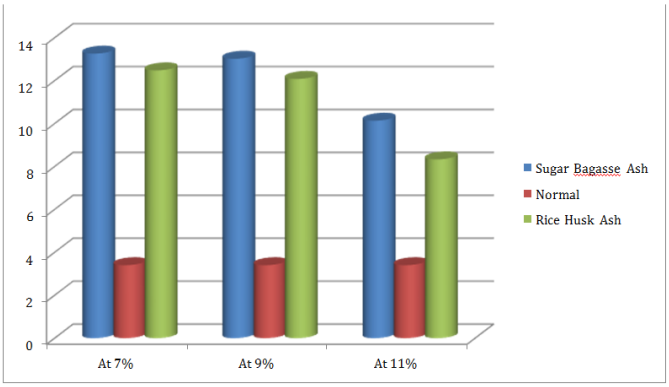

Fig 7 CBR was found out for all the seven specimens. A fall of 290% and 267%in CBRisobserved by adding 7%SugarBagasseAshandRiceHuskAshrespectively.

Fig 8 CBR testing machine

Advantages Of Sugar Baggese Ash And RiceHusk Ash

· Addition of Sugar Bagasse Ash and Rice Husk Ash decreases Liquid Limit of soil.

·Addition of Sugar Bagasse Ash and Rice Husk Ash increases Plastic Limit of soil.

·The ash has high angle of internal friction which results in morestability.

·Addition of Sugar Bagasse Ash and Rice Husk Ash increases California Bearing Ratio content ofsoil.

·Use of Sugar Bagasse Ash and Rice Husk Ash for soil stabilisation help in reducing the burden of disposing Sugar Bagasse and RiceHusk.

·Sugar Bagasse and Rice Husk is a waste that is being utilised to its maximum when used for soilstabilisation.

·Selling of Sugar Bagasse provide a extra income to small juicevendor.

·Selling of Rice Husk for soil stabilisation help small in earning small extra money as it is waste tothem.

Disadvantages Of Sugar Baggese Ash And RiceHusk Ash

·Sugar Baggese and Rice Husk is burnt for conversion to ash that result in the loss of heat energy.

·Sugar Baggese and Rice Husk is burnt which contributes to airpollution.

·Transportation of Sugar Baggese and Rice Husk from place of production to place of its utilisation isexpensive.

·Due to lack of cohesiveness of ash there might be problem in construction like erosion and shearing where heavy rolling isdone.

·Addition of Sugar Bagasse Ash and Rice Husk Ash increases Optimum Moisture Content ofsoil.

·Addition of Sugar Bagasse Ash and Rice Husk Ash decreases Maximum Dry Density of soil.

IV CONCLUSION

·Treatment of black cotton soil with Sugar Bagasse Ash and Rice Husk Ash showed a gradual decrease in Maximum Dry Density (MDD) and increase in Optimum Moisture Content(OMC).

·Improved value of California Bearing Ratio (CBR) was observed at 7% addition Sugar Bagasse Ash and Rice Husk Ash as compared to natural black cottonsoil.

·There is significant improvement in plasticity index of the black cottonsoil.

·Reduction in overall cost of construction by the use of Sugar Bagasse Ash and Rice Husk Ash in black cottonsoil.

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