Stabilization of Clayey Soil Using Sugarcane Bagasse Ash

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Abstract- *A large part of our country covers the area (about 1/5th) by expansive soil which lacks enough geotechnical properties which results in sudden failure of structures in conditions like heavy rainfall drought or any change in water level in the form of settlement, cracks, etc. So it is required to make some kind of material which is effective and easily available from any industrial or agricultural waste as a stabilizer to improve the properties of soil and also reduce the construction cost. A solid waste product of sugar mills sugarcane bagasse when burnt, results in bagasse ash which has silica (Sio2) which can be used for improving the geotechnical properties. We can decrease the cost of construction by choosing local material. The aim of this study is to investigate reliability of using sugarcane bagasse ash to improve the geotechnical properties with different percentages (5%, 10%, 15%, 20%, 25% and 30%) and with all the required tests like Atterberg's limit Standard Proctor Test, CBR Test, have been performed. SPT results indicate OMC increment with increase in ash percentage and maximum dry density decreases with increase in percentage of ash. CBR indicates that CBR value increases upto 20% of bagasse ash which shows that the sugarcane bagasse ash acts as a stabilizer with its optimum moisture content percentage that is 20% SCBA and 80% clayey soil.*

Keywords- OMC, MDD, CBR and Clayey Soil

I. INTRODUCTION

India has different types of soil and the soils have different characteristics due to their structural composition and minerals in it. About 35 % of land is agricultural and approximately 65% of states produce sugarcane in India. These resources produced huge amount of waste product in the form of ash, on the other hand India is a developing country and it has a need of stable and reliable roadway network like National Highways, Expressways and also state highways which is a challenge to make this network efficient and cost effective in a country like India where every step has different soil with different characteristics. Expansive soil is nearly all over India except some areas and dealing with its strength properties is quite difficult and making it cost effective also is a herculean task. Using waste materials of good stabilization properties meet the needs. Stabilization of soil is a type of soil improvement technique in which existing properties of soil are improved by adding any kind of cementing material or chemical which is good for increasing the soil strength. Different methods of soil stabilization are mechanical stabilization, cement stabilization and chemical stabilization. Mechanical methods contain rollers, larger rammers etc and called mechanical stabilization. Cementing materials like cement, lime, bitumen are used for increasing the strength than this stabilization is called cementing stabilization and when calcium chloride, sodium chloride etc chemicals are used for this purpose then it is called chemical stabilization. Now a day's research are based on the economical use of resources and hence the scientists are more attracted towards the cost effective and locally available materials from different kind of industries, agricultural waste or any kinds of waste for improving the soil properties. The sugarcane bagasse ash is a waste material which is generally in powder form, derived from sugarcane mills. The industries and agricultural areas produce large amount of waste as ash which is a serious problem and headache for farmers and also it is harmful for environment. This ash has fibrous structure of SiO2; it is the amorphous silica present in it which is pozzolanic ingredient responsible for strength of required soil. This ash is going through the different kinds of strength tests such as SPT, CBR and Atterberg's limit before using it as a stabilizing material in the soil. The stabilization soils are not latest technique but it is used from Christian area. Since expansive soil has swelling and shrinkage property which result different types of failure like as settlement in foundation pavement and building structure. Here, in his project stabilization is done with the help of sugarcane bagasse ash, because sugarcane bagasse ash is cheap material and easily available. This additive can change the strength of soil by increase of bagasse ash CBR value are increase. This is an effective method of stabilization of soil.

II. OBJECTIVE OF THIS STUDY

Different ground improvement techniques are used for improving the soil strength properties and one of the methods are soil stabilization. The improvement of soil

depends upon a lot of factors like the quality of cementing agent, its composition with soil, the depth of soil strata.

- To make the sugarcane waste from mills a soil stabilizing material with cementing properties.
- Solving the waste disposal problem of sugarcane waste for the farmers.
- To analyze the compaction properties of clay soil by mixing it adequate amount with different percentages of sugarcane bagasse ash.
- Analysis of clay soil strength properties like CBR, OMC etc. with different ash percentages.
- To increase the strength of soil sub-grade by sugarcane bagasse ash.
- To increase tensile strength of soil and decrease the plastic.

III. MATERIAL USED

Following material used in the present study:

A. Clayey soil

B. Sugarcane Bagasse ash

(A) Clayey Soil

In this study soil sample is basically collected from a field near to the village road. Soil sample is collected from village kharagpur of faizabad district with the help of fawda (hoe) from the depth of nearly equal to 30 cm to 45 cm below the ground surface and in this process soil sample becomes disturbed. Soil sample collection area is 4 km away from the Mashaudha sugarcane mills and 10 km away from the Lucknow Gorakhpur link highway.

It is an aggregate of mineral particles of microscopic and sub-microscopic range. The soil may be organic or inorganic. The inorganic clays are generally more plastic than organic clays; whereas, the organic clays are more compressible because of the presence of finely divided organic matter. Soils of organic origin are generally formed by growth and subsequent decay of plants, such as peat mosses. They may also be formed by the accumulation of fragments of the inorganic skeletons or shells of organism. Hence, a soil of organic origin can be either organic or inorganic. Clay is a fine grain and cohesive soil of particle size is less than 0.002 mm.

S. No.	Properties	Value
1	I.S. Classification	CL
2	Plastic Limit	20.45
3	Liquid Limit	31.5
4	Plasticity index	11.05
5	MDD, gm/cc	1.80
6	OMC %	15.8
7	Specific Gravity, G	2.64
8	CBR	3.723

Table 1: Engineering properties of soil

(B) Sugarcane Bagasse Ash (SCBA)

It is organic waste material obtained from sugar mills and domestic of jaggery. Since it a type of waste material so it creates huge problem of handling. It requires large area to dispose it which is mostly not possible in commercial area. If it is dispose in open environment it becomes harmful for environment.

S. NO.	Chemical Element	% By weight
1	Silica	62.43
2	Iron Oxide	6.98
3	Loss on Ignition	4.73
4	Aluminum Oxide	4.38
5	Potassium Oxide	3.53
6	Calcium Oxide	2.51
7	Sulphur Trioxide	1.48
8	Manganese	0.5
9	Zinc	0.3
10	Copper	0.1

Table 2: Chemical properties of Sugarcane Bagasse Ash

IV. METHODOLOGY

Following methodology is used for stabilization of clayey soil:

A. Standard Proctor Test

B. California Bearing Ratio Test

(A) Standard Proctor Test

The aim of this test is to find out the optimum moisture constant .Standard proctor test is a laboratory method by which we determine the optimum moisture content at which soil achieve its maximum dry density. This test is based on compaction. Compaction may be defined as the process of packing the soil particles by reducing the air voids in the soil, by mechanical means. If the soil below any structure and pavement is not compacted then it will settle after few year and structure may fail.

(B) California Bearing Ratio Test

California Bearing Ratio Test was developed by the California division of highways, air fields as a method for determining the stability of soil sub-grade and other foundation materials. California Bearing Ratio test results have been correlated with pavement thickness requirements for Highways and air fields. The CBR test is conducted in the laboratory. This test has standard load of 1370 and 2055 corresponding to 2.5 mm and 5.0 mm penetration. In some CBR machine CBR value is maximum at 2.5 mm penetration and also in some CBR machine; CBR value is maximum at 5.0 mm penetration. In our lab CBR value is obtain maximum at 5.0 mm penetration. If we got CBR value is maximum at 2.5 mm penetration then we have to repeat this process again and again until we got CBR value maximum at 5.0 mm penetration.

V. EXPERIMENTAL RESULT AND DISCUSSION

1. Effect of sugarcane bagasse on MDD and OMC of clayey soil

By mixing of SCBA with parent soil with various percentage like
(CS=100%+SCBA=0%
CS=95%+SCBA=5%,CS=90%+SCBA=10%,CS=85%+SCBA =15%,CS=80%+SCBA=20%,CS=75%+SCBA=25%,
CS=70%+SCBA=30%)
maximum dry density decrease and optimum moisture content are increase which are shown in following figure:1,figure2,figure3

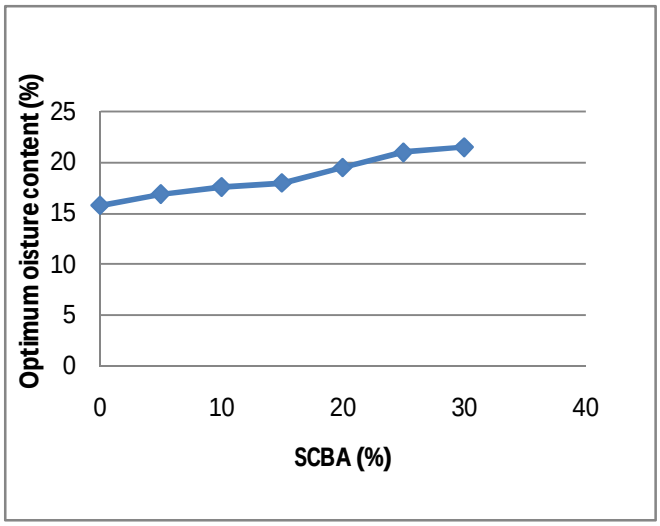

Fig.1: Graph b/w various % of SCBA and OMC

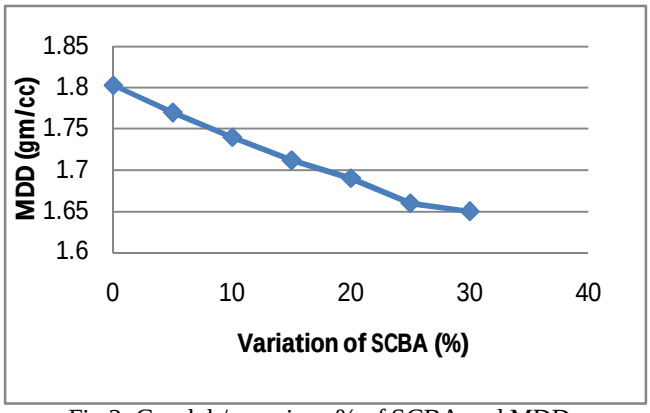

Fig.2: Graph b/w various % of SCBA and MDD

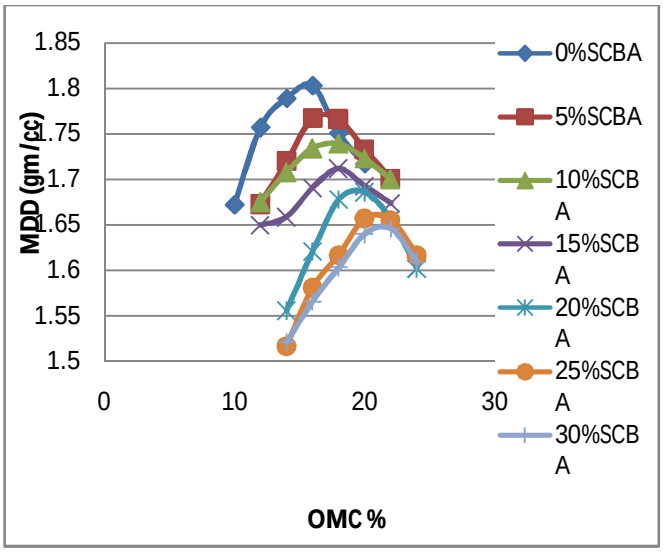

Fig.3: Graph b/w OMC and MDD with various % of SCBA

2. Effect of mixing of SCBA in clayey soil on California Bearing Ratio Value

Mixing of SCBA in the soil in the laboratory with various composition to obtained strength (CS=100%+SCBA=0%CS=95%+SCBA=5%,CS=90%+SCBA=10%,CS=85%+SCBA=15%,CS=80%+SCBA=20%,CS=75%+SCBA=25%,CS=70%+SCBA=30%) The value of California Bearing Ratio is initially increase by mixing SCBA in soil with various percentages (0%, 5%, 10%, 15% and 20%) and after 20% CBR value is decrease. CBR value is increase from 3.723% (CS=100%+SCBA=0%) to 9.927% (CS=80%+SCBA=20%) after this Proportion CBR value is decreasing continuously upto 8.934(CS=70%+SCBA=30%). After investigating all experimental values of soil with SCBA.

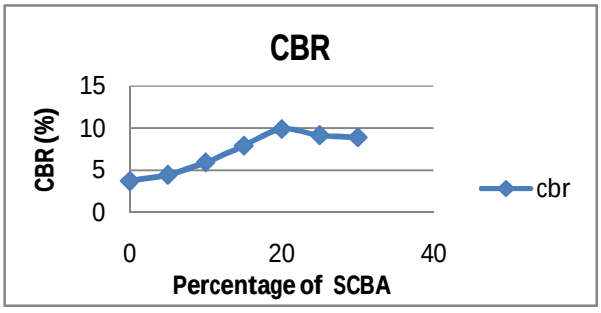

Fig. 4: Graph b/w CBR percentage and SCBA

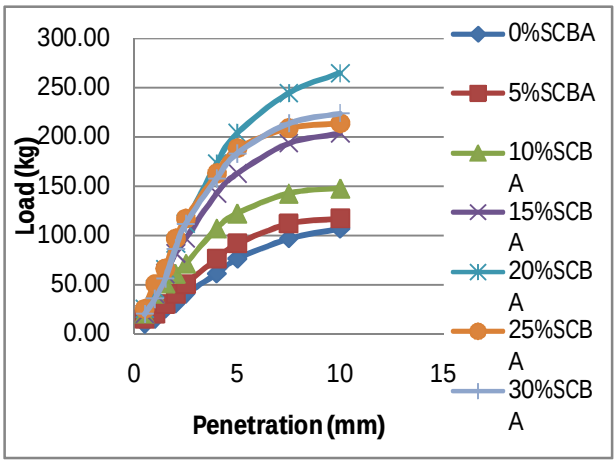

Fig.5: Graph b/w load and penetration (Soil +SCBA)

VI. CONCLUSION

The aims of experimental work were to find out the stabilization of low compressible clayey soil by mixing SCBA with soil. By mixing SCBA with various percentages like 0%, 5%, 10%, 15%, 20%, 25%, 30% with the soil in the laboratory following conclusions are drawn:

- By mixing of SCBA in soil with percentage (0%, 5%, 10%, 15%, 20%, 25%, 30%) maximum dry density were decrease and optimum moisture content were increase.
- The value of MDD is decrease from 1.80gm/cc to 1.65gm/cc. and value of OMC is increase from 15.8% to 21.5%.
- The value of California Bearing Ratio is initially increase by mixing SCBA in soil with various percentages (0%, 5%, 10%, 15% and 20%) and after 20% CBR value is decrease.
- CBR value is increase from 3.723% (CS=100%+SCBA=0%) to 9.927% (CS=80%+SCBA=20%) after this Proportion CBR value is decreasing continuously upto 8.934 (CS=70%+SCBA=30%).
- After investigating all experimental values of soil with SCBA, It has been found that we can use optimum value of soil sub-grade stabilization is equal to (CS=80%+SCBA=20%).

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