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Experimental Study on the Effect of Bagasse Ash on Soft Clayey Soil

Sruthimol P. R
M. Tech. Geomechanics & Structures,
Saintgits College of Engineering,
Kottayam, Kerala, India.

Sindhu A. R
Assistant Professor,
Dept. of Civil Engg.
Saintgits college of Engineering
Kottayam, Kerala, India

***Abstract*— The construction of structures on soft clay soil is a challenging task and therefore considered as one of the biggest concerns in geotechnical engineering. However, in most geotechnical projects, it is not possible to obtain a construction site that will meet the design requirements without ground modification. Modification of clay using bagasse ash is studied in this work. Soil stabilization is a procedure in which existing properties of soil are improved by means of addition of cementing materials or chemicals. The current practice is to modify the engineering properties of the native problematic soil to meet the design specifications. . In this work an attempt has been made to utilize agricultural waste (bagasse ash) to stabilize weak soil. Bagasse shows the presence of amorphous silica, which is an indication of pozzolonic properties, responsible in holding the soil grains together for better shear strength. In this study laboratory experiments were conducted on soft clay with percentage increase by Bagasse Ash (3%, 6%, 9%, 12%, 15% &18%). The study indicates improvement in shear strength characteristics of clay with the addition of bagasse ash on triaxial compression test. It is observed that there was a decrease in liquid limit value with increase in bagasse ash content .**

***Keywords*—Bagasse Ash, Pozzolonic property, Triaxial Compressoin test,Stabilization,Amorphous silica, Soft Clay**

I. INTRODUCTION

Soft clay deposits, which are inherently very low in strength, are widespread in coastal and low land regions. Construction of civil engineering projects on such soil is risky because such soil is highly susceptible to differential settlements, having poor shear strength and high compressibility. This problem is normally faced by soft soil such as organic clay. Effective utilization of local weak soil by imparting additional strength using stabilization enables reduction in construction and improves performances for the projects related to civil engineering. Soil stabilization aims at improving soil strength and increasing resistance to softening by water through bonding the soil particles together, water proofing the particles or combination of the two.

Kuttanad, which is a unique agricultural land in Kerala, has got one of the problematic soils in this world. So construction in this area without applying stabilization technique will result in failure of structures.

Sugarcane Bagasse Ash (SCBA) is the organic waste obtained from the burning of bagasse in sugar producing factories. The by-product or residue of milling sugarcane is bagasse (the fiber of the cane) in which the residual juice and the moisture from the extraction process remain.

II. EXPERIMENTAL PROGRAM

A. Soil

For the present study, clay was collected from Koduppuna region near Alappuzha district of Kerala. Kuttanad clays are dark grey colored medium sensitive alluvial deposits spread over the Kuttanad region in the state of Kerala in India. The soil samples were collected in polythene bags and kept in laboratory. The sample was then air dried before conducting the basic laboratory tests. Preliminary laboratory test were done as per IS specifications

B. Reinforcing Material

Bagasse is collected from sugarcane factory nearby Kottayam. After air drying these were burnt to produce ash. Bagasse is the fibrous matter that remains after sugarcane stalks are crushed to extract their juice. It is currently used as a biofuel and in the manufacture of pulp and paper products and building materials. For each 10 tons of sugarcane crushed, a sugar factory produces nearly 3 tons of wet bagasse which is a byproduct of the cane sugar industry. Six different percentage combinations of bagasse ash were used.

Fig: 1 Bagasse Ash

III. TESTING PROGRAM

- Basic laboratory test (Atterberg's limit,compaction, Specificgravity,Grainsize distribution, triaxial compression test) were carried out on soft clayey soil to determine the basic properties of soil sample.
- The clay sample which is determined for the basic properties are classified according to IS classification.
- Then the stabilization of soft clay sample with bagasse ash is carried out by blending the soil with different percentages of bagasse ash (3%, 6%, 9%, 12%, 15% & 18% and then

optimum percentage of bagasse ash can be added have determined.

- To determine the strength behaviour of clay sample with bagasse ash,the laboratory test (Triaxial compression test & liquid limit test) were carried out.

Table: 1 Physical properties of clayey soil

Properties Of soil		Values
Natural Moisture Content (%)		46.6
Specific Gravity		2.68
Liquid Limit (%)		89
Plastic Limit (%)		53.2
Shrinkage Limit (%)		25.4
Plasticity Index		33.8
Classification (ISC System)		CH
Standard proctor test	Optimum Moisture Content (%)	38
	Maximum dry density	1.32
Cohesion, c (kN/m^2)		5
Angle of internal friction		1

Table: 2 Chemical composition of Bagasse ash

Sl.No	Chemical Element	% by weight
1	Silica (SiO2)	62.43
2	Fe_2O_3	6.98
3	Al_2O_5	4.38
4	K_2O	3.53
5	CaO	2.51
6	SO3	1.48
7	Mn	0.5
8	Zinc (Zn)	0.3
9	Cu	0.1

IV. RESULTS AND DISCUSSIONS

A. *Grain size distribution curve*

The grain size distribution curve for the given clay sample is given in figure 3. The curve is obtained by conducting sieve analysis and hydrometer analysis.

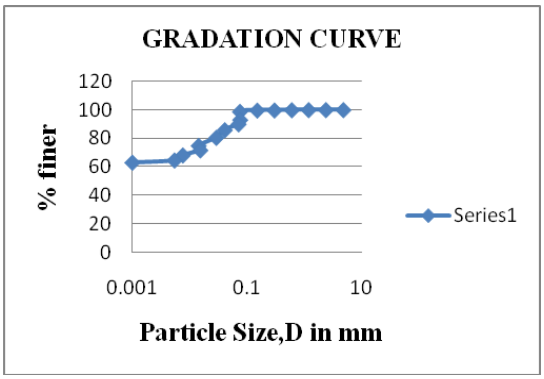


Fig: 3 Grain size distribution curve

Result of Grain size analysis:

- Gravel = 0%
- Sand = 16%
- Silt = 21%
- Clay = 63%

V. TEST RESULT AFTER STABILIZATION

Clay sample was mixed with varying percentages of bagasse ash, ranging from 3% to 18%.

a) Following graph shows the result of triaxial compression test after reinforcing with bagasse ash for varying percentages.

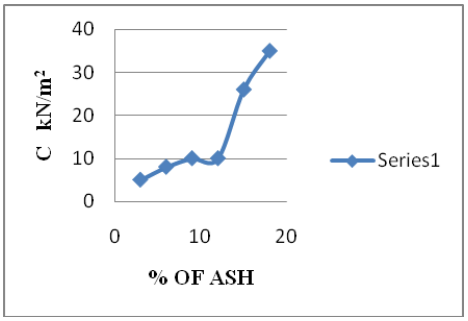


Fig: 4 Variation of C with percentage increase in bagasse ash

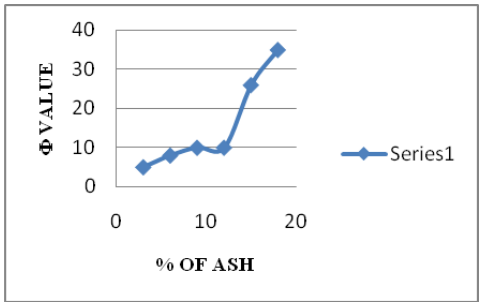
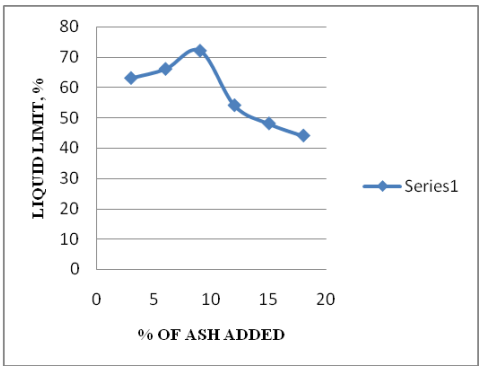


Fig: 5 Variation of Φ with percentage increase in bagasse ash

b) Result of liquid limit test for soft clay stabilized with Bagasse Ash



VI. CONCLUSION

The following conclusion can be drawn from the above experimental investigation.

1. The results showed that stabilization of soft clayey soil like Kuttanad clay using Bagasse Ash is an efficient and economic method for improving the shear strength characteristics of the soil.
2. With an increase in bagasse ash content, liquid limit increases up to 9% & after that it decreases.
3. When the bagasse ash content changes from 3 to 18 %, there is a constant increase in both C & ϕ values.
4. Therefore shear strength of the soil has been improved by further addition of bagasse ash.
5. Usage of bagasse ash is a satisfactory solution to some of the environmental concerns and problems associated with waste management.

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