To Study The Effect of Bagasse Ash on The Strength Characteristics of Black Cotton Soil

P.Neelima[1], B.Vijaya Lakshmi[2], T.Y.Kishore[3], Seshagiri Rao Boddu[4]
[1, 2, 3] Dept of Civil Engineering
[4]Asst. Professor, Dept of Civil Engineering
[1, 2, 3, 4] Dadi Institute of Engineering & Technology, Anakapalle.

Abstract- *The purpose of soil stabilization is to improve strength and durability for industrial project such as paving, building construction, railway laying and water way improvements .Black cotton soils with high potential for swelling and shrinking as a result of change in moisture content are one of the major soil deposits of India. Bagasse ash is being accumulated in large volume which is deposed into the environment through dumping yards causing damage to the ecosystem. It is estimated that approximately more than 70% of the waste are deposed in improper way in various areas. The performance of bagasse ash stabilized soil was evaluated using physical and strength performance tests namely-Plastic index, Specific gravity, Compaction, California Bearing Ratio (CBR) and Standard proctor test. These tests were conducted in order to evaluate the improvement strength characteristics of the sub grade soil. Hence use of such advanced materials in road construction can prove efficient in increasing the strength of soil in turn reduce the project cost, as well as we can reduce the effect on environment by using bagasse.*

Keywords- Bagasse ash, Black cotton soil, Plastic index, Specific gravity, California Bearing Ratio, Compaction etc.

I. INTRODUCTION

The physical properties of soils, in order of decreasing importance, are texture, structure, density, porosity, consistency, temperature, colour and resistivity. Soil texture is determined by the relative proportion of the three kinds of soil mineral particles, called soil separates: sand, silt, and clay. Soil density, particularly bulk density, is a measure of soil compaction. Soil porosity consists of the void part of the soil volume and is occupied by gases or water. Soil consistency is the ability of soil to stick together.

II. THEORY

Soil stabilization is the process of altering some soil properties by different methods, mechanical or chemical in order to produce an improved soil material which has all the desired engineering properties.

III. ATTERBERG'S LIMITS

LIQUID LIMIT: It is the water content of the soil between the liquid state and plastic state of the soil. It can be defined as the minimum water content at which the soil, though in liquid state, shows small shearing strength against flowing.

PLASTIC LIMIT: The limit lies between plastic and semi-solid state of the soil. It is determined by rolling out a thread of the soil on a flat surface which is non-porous. It is the minimum water content at which the soil just begins to crumble while rolling into a thread of approximately 3 mm diameter. Plastic limit is denoted by w_P.

SHRINKAGE LIMIT: This limit is achieved when further loss of water from the soil does not reduce the volume of the soil. It can be more accurately defined as lowest water content at which the soil can still be completely saturated. It is denoted by ws.

IV. LITERATURE REVIEW

We studied concerned journals from that we take some journals which are related to our project.They are

- **Ankit singh negi** et al [2013] suggested soil stabilization by using lime , this paper deals with the complete analysis of the improvement of soil properties and its stabilization using lime. Lime is used as an excellent soil stabilizing materials for highly active soils which undergo through frequent expansion and shrinkage. Lime acts immediately and improved various property of soil such as carrying capacity of soil, resistance to shrinkage during moist conditions, reduction in plastic index, increase in CBR value and subsequent increase compression resistance with the increase in time.

- **Arshad Husain** et al [2015] suggested soil stabilization by using Rice Husk ash , utilization of waste materials in agriculture products reduces the technical and environmental problems of plant wastes .Although rice husk is a valuable admixture for concrete and soils, only

about 5% of the total available RHA is used for improvement their properties.

- **Dr.M.S.Nagakumar** et al [2014]suggested that soil stabilization by using bagasse ash is a cost effective material , by adding 9% of bagasse ash to the Black cotton soil ,it increases density and decreases OMC. Further addition it decreases density and increases OMC. Compared to other dosage 9% of bagasse ash is preferable because it increases the CBR it indicates reduction in settlement.

V. METHODOLOGY

Collection of materials

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Tests conducted on Black cotton soil and Bagasse ash to determine the Index and Engineering Properties

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Partial replacement of Black cotton soil with Bagasse ash as intervals of 2%, 4%, 6%,8%,10%,12% to get optimum strength compared to 0%.

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Compare the Index, Engineering properties and strength parameter of Black cotton soil, with and without replacement of Bagasse ash

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Results and Discussions

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Conclusion

COLLECTION OF MATERIALS

- Black cotton soil
- Bagasse ash

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BLACK COTTON SOIL

Black soil is formed by the weathering of lava (igneous rocks) and cooling of lava after a volcanic eruption. The soil in the Deccan Plateau consist of black basalt soil, which is rich in humus, iron and also contain high quality of magnesia, lime and alumina.

Black soil in India is rich in metals such as Iron, Magnesium and Aluminum. However it is deficient in Nitrogen, Potassium, Phosphorous and Humus.

BAGASSE ASH

Fig:1 Formation of Bagasse ash

- Bagasse is fibrous residue of sugarcane stalks that remains after extraction of sugar when incinerated gives the ash.
- Bagasse ash is being accumulated in large volume which is deposed into the environment through dumping yards causing damage to the ecosystem.
- Bagasse ash is in black colour and it is odour less.

EXPERIMENTAL INVESTIGATIONS

The experimental works consists of the following steps:

1) Specific gravity of soil
2) Determination of soil index properties (Atterberg's Limits)
    - Liquid limit by Casagrande's apparatus
    - Plastic limit
3) Free swell index
4) Determination of the maximum dry density (MDD) and the corresponding Optimum moisture content (OMC) of the soil by proctor compaction test.
5) California Bearing Ratio

VI. EXPERIMENTS

Fig:2 Specific Gravity, Liquid Limit and Plastic Limit Tests

PROCTOR COMPACTION TEST

Fig:3 Compaction equipment and CBR test

VII. RESULTS AND DISCUSSIONS

BLACK COTTON SOIL

A local expansive soil was used in the experimental programme. The geotechnical properties of soil are:

1. Grain size:
   a) Sand size – 14%
   b) Silt size – 25%
   c) Clay size – 62%

2. Specific Gravity: 2.5

TEST RESULTS

Liquid Limit

For the expansive soils the range of the liquid limits is 50 – 100%.

- Liquid limit for tested Black cotton (B.C) soil is 40-100%
- Liquid limit as obtained from graph = 40.55%(Corresponding to 25 blows)

Plastic Limit

For clay or Black cotton soils the plastic limit ranges from 20-65%.

- Plastic limit tested for Black Cotton soil is 22.64%

Table:1 –CBR Results for Black Cotton soil

PENETRATION IN mm	STANDARD LOAD IN Kg	OBTAINED LOAD IN Kg	CBR(%)
2.5	1370	77.265	5.63
5.0	2055	105.444	5.13

Table:2-Liquid Limit Results

No. of Trails	Weight of soil (gm)	Weight proportion		Liquid Limit
		Black Cotton soil	Bagasse ash	
Trail 2%	120	117.6	2.4	39.29
Trail 4%	120	115.2	4.8	39.10
Trail 6%	120	112.8	7.2	38.03
Trail 8%	120	110.4	9.6	37.42
Trail 10%	120	108	12	36.04
Trail 12%	120	105.6	14.4	40.43

Table:3-Plastic Limit Results

No. of Trails	Weight of sample(gm)	Weight proportion		Plastic Limit
		Black cotton soil	Bagasse ash	
Trail 2%	20	19.6	0.4	21
Trail 4%	20	19.2	0.8	20.93
Trail 6%	20	18.8	1.2	19.90
Trail 8%	20	18.4	1.6	19.45
Trail 10%	20	18.0	2.0	19.03
Trail 12%	20	17.6	2.4	22.10

Table:4 Standard Proctor Test Results

No. of Trails	Weight of soil(kg)	Weight proportion		Maximum Dry Density(g/cc)	OMC (%)
		Black cotton soil	Bagasse ash		
Trail 2%	2500	2450	50	1.56	16
Trail 4%	2500	2400	100	1.58	14
Trail 6%	2500	2350	150	1.59	13
Trail 8%	2500	2300	200	1.62	12
Trail 10%	2500	2250	250	1.73	11
Trail 12%	2500	2200	300	1.5	18

CBR RESULTS MIXING BAGASSE ASH(UN-SOAKED)

Table:5-CBR @2%BA to BC soil

PENETRATION IN mm	STANDARD LOAD IN Kg	OBTAINED LOAD IN Kg	CBR(%)
2.5	1370	79.08	5.772
5.0	2055	108.73	5.291

Table:6- CBR @4%BA to BC soil

PENETRATION IN mm	STANDARD LOAD IN Kg	OBTAINED LOAD IN Kg	CBR(%)
2.5	1370	85.29	6.225
5.0	2055	112.22	5.461

Table:7- CBR @6%BA to BC soil

PENETRATION IN mm	STANDARD LOAD IN Kg	OBTAINED LOAD IN Kg	CBR(%)
2.5	1370	87.01	6.351
5.0	2055	114.97	5.595

Table:8- CBR @8%BA to BC soil

Penetration in mm	Standard load in Kg	Obtained load in Kg	CBR(%)
2.5	1370	89.28	6.516
5.0	2055	113.27	5.611

Table:9- CBR @10%BA to BC soil

Penetration in mm	Standard load IN Kg	Obtained load in Kg	CBR(%)
2.5	1370	92.94	6.784
5.0	2055	118.46	5.764

Table:10- CBR @12%BA to BC soil

Penetrationin mm	Standard load in Kg	Obtained load in Kg	CBR(%)
2.5	1370	86.79	6.347
5.0	2055	109.811	5.344

VIII. CONCLUSION

Based on experimental results we concluded that high expansive black cotton soil can be effectively utilized by as a geotechnical material by addition of 2-10% of bagasse ash. At this dosage of admixture black cotton soil can be behaves as non plastic and non swelling can reduce the problems of volume change. With increasing percentage of Bagasse ash results reduction in liquid limit and plastic limit. A gradual reduction in plasticity index causes significant decreases in swell potential and removal of some water that can be absorbed by clay minerals. By mixing 10% of bagasse ash to the Black cotton soil, it increases density and decreases OMC. Further addition it decreases density and increases OMC. Compared to other dosage 10% of bagasse ash is preferable. By mixing 10% of bagasse ash to the black cotton soil the value of CBR increases it indicates reduction in settlement.

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