

# STUDY OF BAGASSE ASH STABILISED WITH BLACK COTTON SOIL

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**Abstract** – Soil is a base of structure, which actually supports the structure from beneath and distributes the load effectively. If the stability of the soil is not adequate then failure of structure occurs in form of settlement, cracks etc. Expansive soil also known as black cotton soil is more responsible for such situations and this is due to presence of montmorillonite mineral in it, which has ability to undergo large swelling and shrinkage. To overcome this, properties of soil must be improved by artificial means known as ‘Soil Stabilization’. It is a technique which improvises one or more soil properties by mechanical, cementing and chemical use. Many research has been conducted for stabilization of soil by using cementing, chemical materials e.g. fly ash, cement, Calcium chloride, Sodium chloride etc. Toady world is facing serious problem of disposal of agricultural waste. Western Maharashtra is popular for production of sugar cane in large quantity. Sugar factories produces waste after extraction of sugar cane in machines that waste when burnt, the resultant ash is known as ‘Bagasse Ash’. It is a fibrous material with presence of silica (SiO<sub>2</sub>) and can be used to improve the existing properties of black cotton soil. In this study laboratory experiments were conducted on black cotton soil with partial replacement by Bagasse Ash (3.2%, 6.4%, 9.6% and 12.8%). This paper highlights significant increase in properties of black cotton soil obtained at 6% replacement of Bagasse Ash without any chemical or cementing material.

**Keywords** - Soil stabilization, black cotton soil, Bagasse Ash, CBR, unconfined compressive strength

## 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. Black cotton soil has tendency to heave during wet condition. In summer season reduction in water content it shrinks and produces cracks.

Thus as a result of this roads on black cotton soil suffer from early failures in pavement with heavy traffic excessive unevenness, ruts, waves and corrugations are formed. It is proposed to study causes of roads failure on black cotton soil. Typical behaviour of these soils under different climatic conditions has made the construction and maintenance of road not only expensive but also difficult. The failure occurs after every monsoon season, resulting in heavy cost of maintenance demand every year.

The black cotton soils are very poor and undependable subgrade material. Hence the main problem is to treat the subgrade soil itself such that the undesirable characteristics are modified by stabilization. Stabilization is the process of improving the engineering properties of soil and making it more stable. In this study, industrial wastes from sugarcane industry “Bagasse Ash” is used to stabilize the soil.

## REQUIREMENT OF SOIL STABILIZATION

The main requirement of soil stabilization is adequate strength and it depends on character of soil. In case of

cohesion less soils the strength could be improved by providing confinement or by adding cohesion with a cementing or binding agent. In case of cohesive soil the strength could be increased by drying, making soil moisture resistant, altering the clay electrolyte concentration, increasing cohesion with acementing agent and adding frictional properties. Black cotton soil swells during rainy season and shrinks during summer season. This alternate swelling and shrinkage creates cracks in the black cotton soil. These shrinkage cracks are 100 mm to 150 mm wide and 0.5 to 2 m deep. Swelling creates upward pressure on structure and shrinkage creates downward pull.

It results into cracks or damage in the foundations.

## II. LITERATURE REVIEW

This chapter presents a review of the most relevant literature in the area of soil stabilization using industrial and agricultural wastes as an admixture. In the recent years, several researchers are trying to develop solutions for the soil stabilization by using different types of waste generated which has become one of the major challenges for the environmental issues. Several researchers presented technique of using wastes such as bagasse ash, rice husk ash etc to be mixed with soil to enhance the properties of soil.

The input of CCR reduces the maximum dry unit weight of the soil because the specific gravity of the CCR is lower than that of the soil. In the active zone, strength significantly increases with the CCR content up to the CCR fixation point. Beyond this point, the strength gradually increases. This zone is designated as the inert zone. An easy way to comply with

### Publication History

Manuscript Received : 5 January 2018  
Manuscript Accepted : 10 February 2018  
Revision Received : 11 February 2018  
Manuscript Published : 14 February 2018

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### III. MATERIALS

#### BLACK COTTON SOIL

Black cotton soil is the Indian name given to the expansive soil deposit in the central part of the country. Black cotton Soil is a residual soil, which have been formed from basalt or trap and contain the clay mineral montmorillonite that causes excessive swelling and shrinkage characteristics of the soil. The swelling behavior of the soil would depend largely on the type of clay minerals that are present in these soils and proportions in which they are present. The swelling and shrinkage of the black cotton soil can lead to damage the foundations of the buildings and road pavements. This results in difficulty of construct of foundation on such soil, so this soil needs special care. This soil produces excessive settlement of the foundation due to high compressibility. So it is important to improve the geotechnical properties of the blacksoil.

#### BAGGASE ASH

Bagasse is the matted cellulose fiber residue from sugarcane that has been processed in a sugar mill, used as a source of cellulose for some paper products. Previously, Bagasse was burned as a means of solid waste disposal. The major sugar producing States in India are Maharashtra, Uttar Pradesh, Tamil Nadu, Karnataka, Gujarat and Andhra Pradesh considering total sugar production. Brazil is the largest producer of sugar cane worldwide and the residues from this product are generated in equal proportions, moreover reutilization of the components of this vegetal biomass is extremely important environmentally and economically.

**TABLE I  
PROPERTIES OF BAGASSE ASH**

S.No	Description of Properties	Results obtained in The laboratory
1	Colour	Black – grey
2	Specific Gravity	2.57
3	Liquid Limit	65
4	Plastic Limit	41
5	Shrinkage Limit	19.25
6	Plasticity index	44.42
7	Consistency Index	1.05
8	Liquidity Index	-0.05
9	Maximum Dry Density	1.58
10	OMC	1.58
11	Unconfined Compression Strength	102.56
12	California Bearing Ratio	1.20

#### SAMPLE PREPARATION

Collected soil sample is first dried in direct sunlight; the clods are broken to get a uniform sample. The organic matters, small aggregates, broken wooden material, pieces of glasses are removed carefully from soil sample. Sample is kept in oven for drying to use in test at temperature 105 C for 24 hrs. The prepared sample is then used for the test specified in 3.2.

The weight of soil sample taken for test is replaced by percentage of weight of bagasse ash. Four different blends are prepared for replacement of soil in varying proportion of (3.2%, 6.4%, 9.6% and 12.8%)

### IV. RESULTS AND DISCUSSIONS

After the determination of basic properties of black cotton soil, soil stabilized with bagasse ash and the strength parameters like MDD, CBR and UCC were determined by conducting compaction, CBR (California bearing ratio) and UCCS (unconfined compressive stress) tests.

**TABLE III  
RESULTS OF MMD AND OMC FOR BLACK COTTON SOIL  
STABILIZED WITH BAGASSE ASH**

% Replacement	Black Cotton Soil + % Bagasse Ash	
	MDD (g/cc)	OMC (%)
3.2	1.56	40%
6.4	1.59	44%
9.6	1.50	35%
12.8	1.47	29%

**TABLE IIIII  
RESULTS OF UNCONFINED COMPRESSION TEST FOR BLACK  
COTTON SOIL STABILIZED WITH BAGASSE ASH**

% Replacement	Black Cotton Soil + Bagasse Ash
3.2	144.32
6.4	211.90
9.6	176.74
12.8	140.52

**TABLE IVV  
RESULTS OF CBR TEST FOR BLACK COTTON SOIL  
STABILIZED WITH BAGASSE ASH**

% Replacement	Black Cotton Soil + Bagasse Ash
3.2	1.60
6.4	2.33
9.6	1.20
12.8	0.80

### V. CONCLUSIONS

It was observed that there is reduction in Plasticity Index of Bagasse Ash treated soil from 24.00% to 17.40%.

It was observed that by the addition of 6% bagasse ash for black cotton soils, the density has significant increases from 1.57 to 1.78 g/cc. But OMC decreases from 17.20 to 15.00%. Further addition of Bagasse Ash density decreases and OMC increases.

UCS values got increases from 93.00KN/m<sup>2</sup> to 429.00 KN/m<sup>2</sup> at 6% bagasse ash content. Further addition of Bagasse ash UCS values decreases.

The increase in California bearing ratio value at 6% dosage had better effect compared to the other dosage.

Increase in California bearing ratio indicates reduction in settlement.

CBR values got increased from 1.16 to 6.8% for addition of 6% Bagasse Ash. Further addition of Bagasse ash CBR values decreases.

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