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SOIL STABILIZATION OF USING BAGASSE ASH

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Abstract: Enhancement of load carrying capacity and shear strength of soil has been improved by soil stabilization. The largely used soil stabilizing agent is fly ash, the waste from coal fired power plant, which is produced over 100 trillion each year creating thoughtful dumping as well as ecological complications in India. The wastes of industries and agriculture adversely affect the environment as high land area will be required for their disposal and when they disintegrate, results in the production of harmful gases causing, soil contamination, land fill space and many other hazardous effects. Soil stabilization is a process that improves the engineering properties of soil such as strength, volume stability and durability. Sugar Cane Bagasse Ash (S.C.B.A.), a waste material from the sugar industry is used as a stabilizer in modifying the properties of the soil. Bagasse is a fibrous residue of sugarcane stalks that remains after extraction of sugar and when incinerated gives the ash. The chemical analysis on bagasse ash was found to contain mainly silica, and potassium, iron, calcium, aluminum, magnesium as minor components and exhibit pozzolanic properties.

Keywords: Soil Stabilization, Sugar cane bagasse ash, fly ash

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INTRODUCTION

Importance of ground improvement technique is increasing now a day. At some construction sites, the soil properties may not meet to the necessitate provision; hence it is required to improve the characteristics of soil. Soil stabilization may be grouped under two main type's i.e. Modification of soil without adding any stabilizing agent and ii. Improving the properties by means of admixtures. Fly ash as additive have great influence as it is industrial by product, thus inexpensive to cement or lime e and increases the strength of soil as pointed out by Bose3. Fly ash admixed with organic soil and its outcome was the dry density of admixed so reduced to 15% to 20% due to low specific gravity of fly ash given by Prabhakar4.

In sugar industry sugar cane straw is produced as major by product during manufacturing off sugar. Bagasse ash is an agricultural by product of sugar cane bagasse incineration to generate electricity and its improper deposit poses a serious environmental problem.

2. BAGASSE ASH AND FLY ASH

A. BAGASSE 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. The major sugar producing States in India are Maharashtra, Uttar Pradesh, Tamil Nadu, Karnataka, Gujarat and Andhra Pradesh considering total sugar production. Bagasse is a by-product from sugar industries which is burnt to generate power required for different activities in the factory. The burning of bagasse leaves bagasse ash as a waste, which has a pozzolanic property that would potentially be used as a cement replacement material. The sugarcane bagasse consists of approximately 50% of cellulose, 25% of hemicellulose and 25% of lignin. Each ton of sugarcane generates approximately 26% of bagasse and 0.62% of residual ash.

TABLE 1: Chemical composition of bagasse ash

Chemical Composition	Mass(%)
Silica (sio_2)	62.43
Aluminum oxide (Al_2O_3)	4.38
Ferric oxide (Fe_2O_3)	6.98
Calcium oxide (CaO)	11.8
Magnesium oxide (Mgo)	2.51
Sulphur trioxide (So_3)	1.48
Potassium oxide (K_2O)	3.53
Loss of ignition	4.73

TABEL 2: Physical Properties of Bagasse ash

Color	Grey
Density g/cm3	2.52
Surface area (cm2/g)	5140
Particle size	28.9

B. FLY ASH

In recent time, the importance and use of fly ash has grown so much that it has almost become a common ingredient in concrete and soil, particularly in making high strength and high-performance concrete and soil.

There are two ways that the fly ash can be used: one way is to integrand certain percentage of fly ash with cement clinker at the factory to produce Portland pozzolona cement (PPC) and the second way is to use the fly ash as an admixture at the time of mixing the concrete at the site of work. But the main problem is that the fly ash produced in the 75 thermal power plants in India is not of the similar characteristics. The quality of fly ash should be of the standard of *IS: 3812-1981.* For better utilization of fly ash, it becomes important to know the hydration reactions, pozzolanic activity evaluation, effect of fly ash on fresh and hardened concrete, durability etc.

Table 3: Properties of fly ash

Properties	Value
Type	Class C
Specific Gravity	2.08
Coefficient of uniformity	3.14
Coefficient of curvature	2.344
Liquid limit & Plastic limit	Non-plastic
Silica	60.85%
Alumina	29.14%
Iron Oxide	3.01%
Titanium Oxide	0.68%
Lime	1.88%
Magnesia	0.35%
Potash	0.53%
Soda	0.48%

3. DIFFERENT COMPOSTION OF MATERIALS TO IMPROVE SOIL PROPERTY

A. Stabilization of Local Soil with Bagasse Ash

The proportions of Bagasse ash used along with the soil in the study are 2% 5%, 7% and 10% respectively. In order to determine maximum dry density (MDD) and optimum moisture content (OMC) of soil and soil-bagasse mix, standard proctor tests were conducted as per IS: 2720 (Part VII)-1980. The liquid limit and plastic limit were done according to IS: 2720 :(Part V) 1985. A series of laboratory tests (liquid limit, plastic limit, specific gravity and optimum moisture content) have been performed with soil and by Adding different percentages of bagasse ash

TABLE 4: Properties of soil

S.No.	Sample	L.L.	P.L.	P.I	OMC	MDD
1	Soil + 0% B.A.	35	22	13	15.30	1.793
2	Soil + 2% B.A.	33	22	11	16	1.769
3	Soil + 5% B.A.	30	20	10	16.70	1.722
4	Soil + 7% B.A.	28	19	9	17	1.701
5	Soil +10% B.A.	26	17	9	18	1.692

B. Analysis of Strength Properties of Sandy Soil stabilized with Sugarcane Bagasse Ash

Compaction curves were plotted for samples with different percentage of bagasse ash which is illustrated in Fig.2. Variation of maximum dry density with different percentages of bagasse ash is shown graphically in Fig.3. Variation of OMC with different percentages of bagasse ash is shown graphically in Fig.4. Fig.5 shows variation of CBR value with different percentages of bagasse ash.

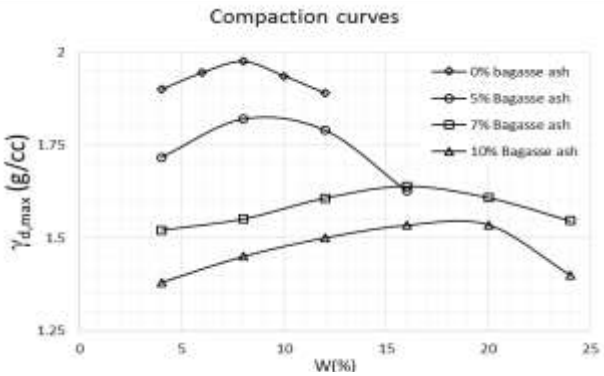

Fig 1: Compaction curve

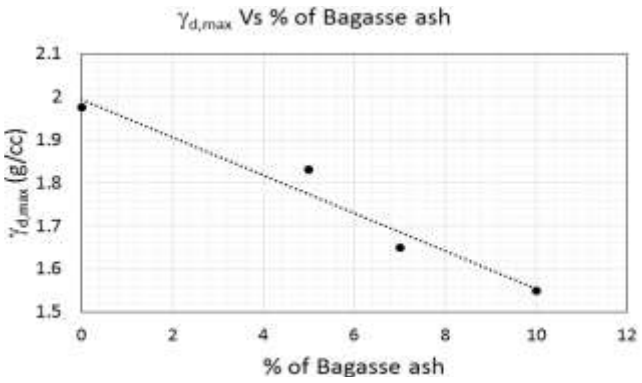

Fig. 2: Variation of maximum dry density with % of bagasse ash

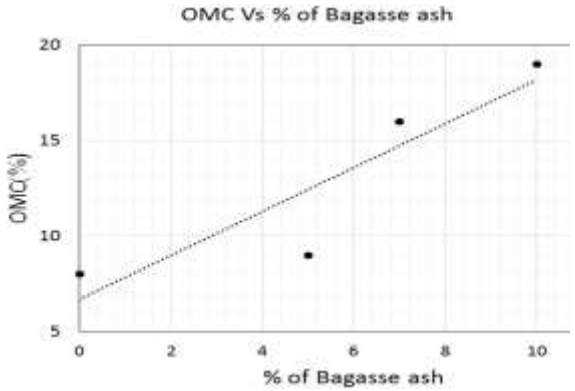

Fig. 3: Variation of optimum moisture content with % of bagasse ash

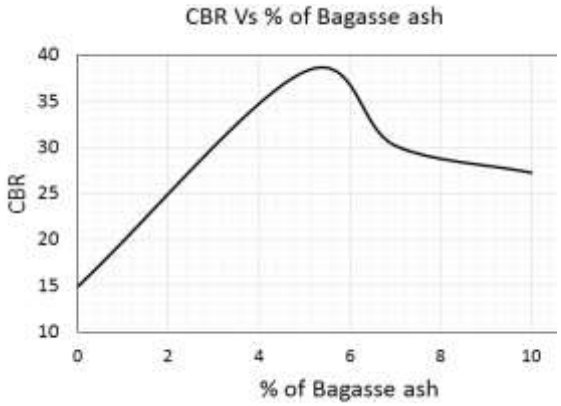

Fig. 4: Variation of CBR value with % of bagasse ash

C. Strength behavior of soil stabilized with fly ASH and sugarcane bagasse ASH

The soil at natural state has liquid limit 33.5%, plastic limit 28.169% and plasticity index 5.331. From these parameters, the soil is considered as silty sand (SM) with low plasticity according to ASTM C136. Aggregate weight of treated soil samples was decreased after adding fly ash in an incremental order from 5% to 20% because the particles are hollow and low weight. Thus, specific gravity decreased as shown in

Compaction Behavior: The Optimum Moisture Content and maximum Dry Density of soil found to be 15.50% and 2.04 respectively. With inclusion of fly ash, it is observed that the optimum moisture content increased to 26.62% whereas maximum dry density decreased to 1.798 gm/cc.

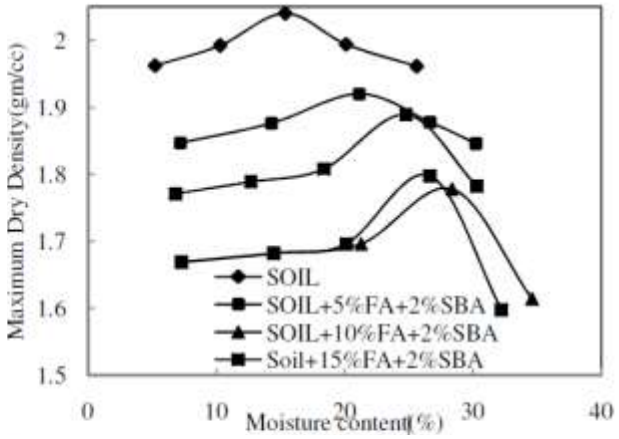

Fig 5: Compaction curve of untreated soil and treated soil With FA and SBA.

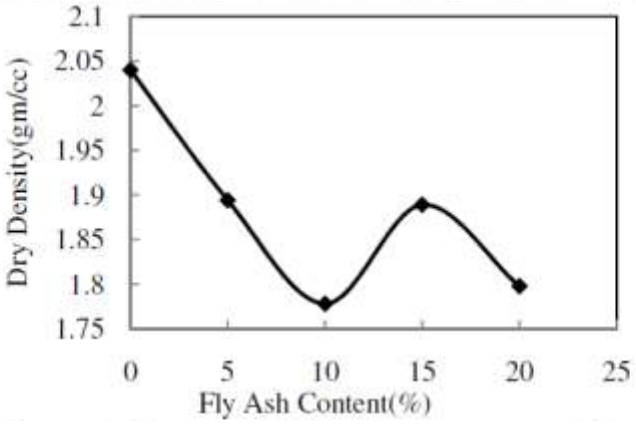

Fig 6: Variation of MDD at varying content of FA.

D. BLACK COTTON SOIL STABILIZATION USING BAGASSE ASH AND LIME

Standard Proctor Compaction Test

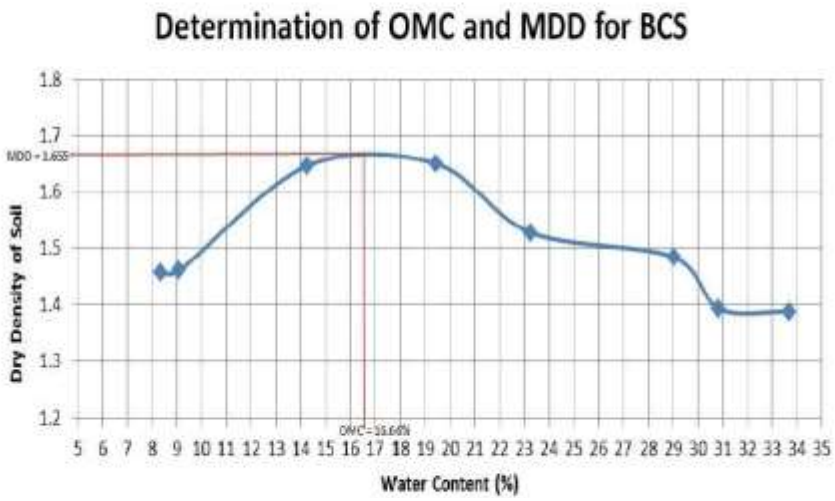

Fig 7: Determinations of OMC and MDD for BCS

4. CONCLUSION

When bagasse ash is mixed with the soil, the plastic limit and the liquid limit decreases. The optimum moisture content of soil increases with increase in Bagasse Ash because these admix was finer than the soil. [2] It was observed that Optimum moisture content increases with increase in % Bagasse ash due to the increase in specific surface, whereas, maximum dry density of soil decreases with increase in % of Bagasse ash. The experimental results show considerable improvement in CBR value by replacing 6-7% soil by Bagasse ash. It was observed that further increase in ash content reduce the bearing capacity of soil. [3] The fly ash was found to be uniformly graded, keeping the quantity of sugarcane bagasse ash constant, on increasing the fly ash content, the specific gravity decreased and the optimum moisture content increased and the maximum dry density decreased. The additions of these admixtures are akin to increased compactive effort. Hence soil is rendered more stable [4] as per this project, taking into account all the results and observations, the best proportion for Stabilization for Black Cotton Soil is recommended to be 2:3 of Bagasse Ash: Lime. [5]

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