STUDIES ON SOIL STABILIZATION BY USING BAGASSE ASH

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ABSTRACT
Soil is the foundation material which supports loads from the overlying structure. Soil is the most widely used material in a highway system, either in its natural form or in a processed form. Also, all pavement structures eventually rest on soil foundation. The construction cost can be considerably decreased by selecting local materials including local soils for the construction of the lower layers of the pavement such as the sub-base course. The formation of undulations, corrugations, up heaving and rutting are generally attributed to the poor sub grade conditions. In the present study the soil sampling was done on Kavadimatti village Bagalkote district as per IRC recommendations. This soil was classified as CH as per Indian Standard Classification System (ISCS). Different dosages of blast furnace slag i.e. 3%, 6%, 9% and 12% were used to stabilize the expansive soil. The performance of Bagasse Ash stabilized soil was evaluated using physical and strength performance tests namely; plasticity index, specific gravity, compaction, California bearing ratio (CBR) and Unconfined compressive strength Test (UCS). These tests were conducted in order to evaluate the improvement in strength characteristics of the subgrade soil. Hence use of such advanced materials in road construction can prove efficient in increasing the strength of soil and in turn reduce the project cost. From the results, it was observed that the basic tests carried out proved significant after the addition of Bagasse Ash. Furthermore California bearing ratio (CBR) value improved from 1.16% to 6.8 %. And the unconfined compressive strength of specimens increased from 93KN/m^2 to 429 KN/m^2.

Keywords: Bagasse Ash, Black cotton Soil, Stabilization etc

1 Introduction
The Stabilization of naturally occurring of soils has been performed over a several years. It was recognized before the Christian area begin that certain Geographical regions were plagued with surface materials and ambient conditions that made movement of men and materials are difficult, if not impossible over the path between village and towns. Lack of adequate road network caters to increased demand and increased distress in roads leading to frequent maintenance has always been a big problem in our country and the world. Evolving new constructions materials to suit various traffic and site conditions for economic and safe design is challenging task in road constructions. Effective utilization of Local weak soils by imparting additional strength using stabilizations enables reduction in construction and improved performances for roads. Obliviously, through history, there have been a number of improvements in the equipment and technology employed for the material stabization application. Swelling and shrinkage of expansive soil cause differential settlements resulting in severe damage to the foundations, building, roads, retaining structures, canal lining etc. the construction of foundation for structure on expansive soils poses a challenge to civil engineers.

2. Literature review
“Soil Stabilization by Calcium Carbide Residue and Fly Ash” Calcium carbide residue (CCR) and fly ash (FA) are both waste products from acetylene gas factories and power plants. 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. Next is the deterioration zone in which strength decreases with the CCR content. [1]

“Soil Stabilization with Calcined Paper Sludge: Laboratory and Field Tests” This paper examines the use of calcined paper sludge (CPS). The soils were stabilized with mixtures of CPS and cement (C). The mixture of CPS and Portland cement leads to mechanical improvements in the stabilization of soils. It is estimated that the greatest strength gain under compression may be obtained for mixtures of CPS:cement with ratios (in weight) of approximately 25:75.[2]

2.1 Objective of the study

1. To study the change in properties of untreated and treated soil.
2. To study the compaction characteristics of untreated and Bagasse Ash treated soil.
3. To evaluate the changes in strength characteristics of treated and untreated soil specimens by California bearing ratio test (CBR) under moist curing periods of 4 days.
4. To evaluate the changes in Unconfined compressive strength test for 0, 3,7,14 and 28 days. (UCS) with varied dosages of Bagasse Ash.

2.2 Scope of the present study

In remote rural villages, the development of road network is of vital importance in the socioeconomic development. Especially the rural villages having black cotton soil as subgrade is very difficult to lay the pavement. As the bagasse Ash is an industrial waste from cane mills, the optimum usage of this material in subgrade soil stabilization will bring down the construction cost of the pavements. In our study an attempt is made to stabilize black cotton soil with addition of bagasse ash and additive. The strength parameters like CBR, UCS are determined to know the suitability of material.

3 Material used for study

3.1 Bagasse Ash

The Bagasse is the fibrous waste produced after the extraction of the sugar juice from cane mills. Bagasse ash is the residue obtained from the incineration of bagasse in sugar producing factories. This material usually poses a disposal problem in sugar factories particularly in tropical countries. In many tropical countries there are substantial quantities of Bagasse is rich in amorphous silica indicated that it has pozzolanic properties. Utilization of industrial and agricultural waste products in the construction of roads has been the focus of research for economical and environmental reasons. To stabilize expansive soil, the waste product bagasse ash is collected from Mysore sugar factory located in Mandya district. 20 -32 MT of a Mysore sugar factory Bagasse ash was produced.

Figure 1: Bagasse ash used in present investigation

3.2 Black cotton soil

The materials used for the tests include the black cotton soil and Bagasse Ash. The black cotton soil obtained from a Soil was procured from Kavadimatti, Bagalkot District at a depth of 20cm. Manual labour method was used for the procurement of soil. Top vegetation and dry soil crust was removed for the depth of 20cm with crow bars. Bigger size lumps were broken down with pick axes and rammers. The soil was pulverized with wooden mallet to break the lumps and then sun dried. Then it was oven dried for 24 hours at 105°c to 110°c.

4 Methodology

All the laboratory tests conducted on native and stabilized soil. The California bearing ratio and unconfined compressive strength tests were conducted for different curing periods. Basic laboratory tests (Attenberg's limit, compaction, CBR, UCC) were carried out on black cotton soil sample to determine the basic properties of soil sample in order to evaluate the improvement in strength characteristics of sub grade soil.

Table 1 Properties of Black Cotton Soil

PROPERTIES	VALUE
1. Specific Gravity (IS 2720: Part 3)	2.52
2. Grain Size Distribution (IS 2720: Part 4) a) Gravel b) Sand c) Fines	 0.32 41.8 57.88
3. Liquid limit (%) (IS 2720: Part 5)	65
4. Plastic limit (%)(IS 2720: Part 5)	41
5. Plasticity Index (%)(IS 2720: Part 5)	24
6. Free Swell index (%)	60
7. IS classification of soil	CH
8. HRB classification	A-7-6
9. Proctor Compaction test (IS 2720: Part8) a) Maximum Dry Density (g/cc) b) Optimum Moisture content (%)	 1.570 17.20
10. California Bearing Ratio Test a) soaked b) unsoaked	 1.20 5.59

5 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.

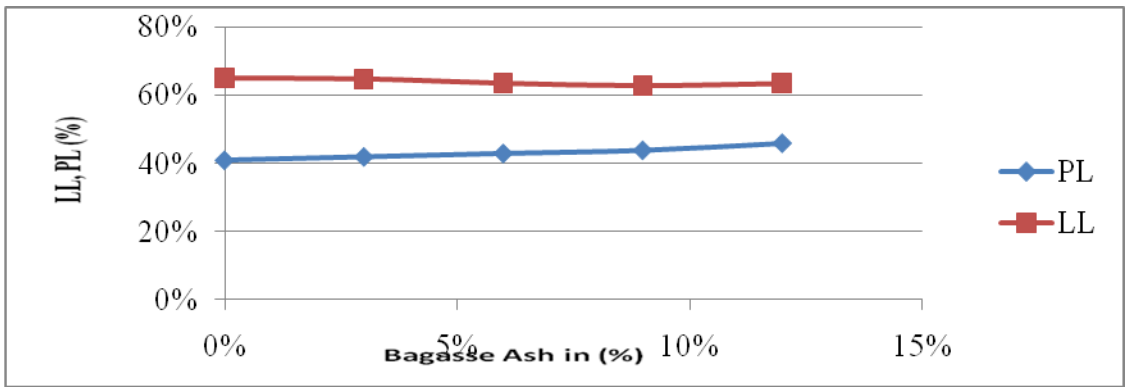

Fig. 1: Variation in LL and PL with increase in Bagasse Ash content

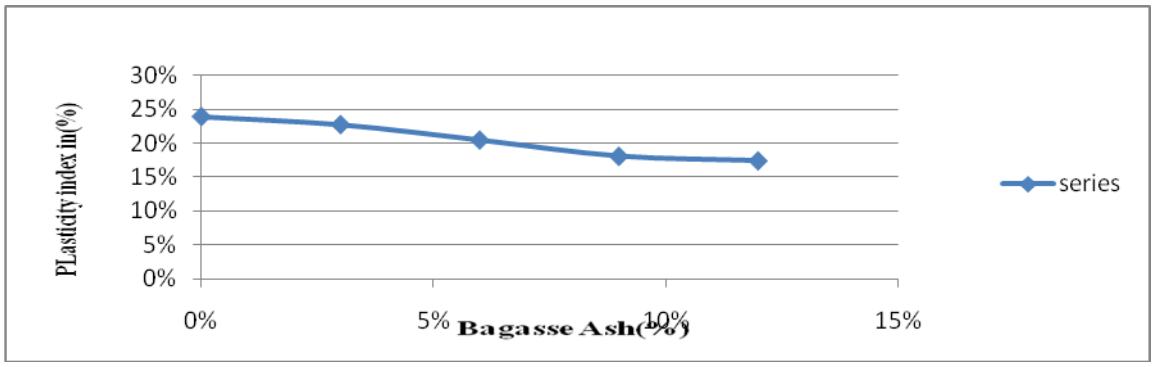

Fig. 2: Variation in PI with increase in Bagasse Ash content.

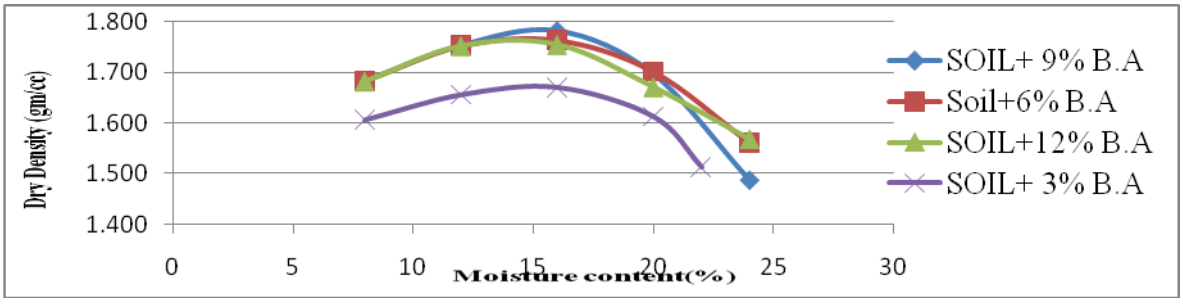

Fig. 3: Variations in compaction curves with Addition of Bagasse Ash.

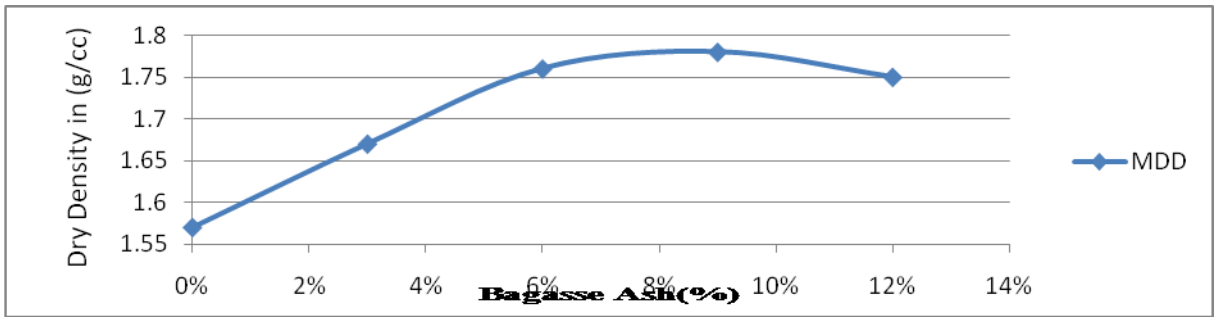

Fig. 4: Variation of maximum dry density with addition of B.A.

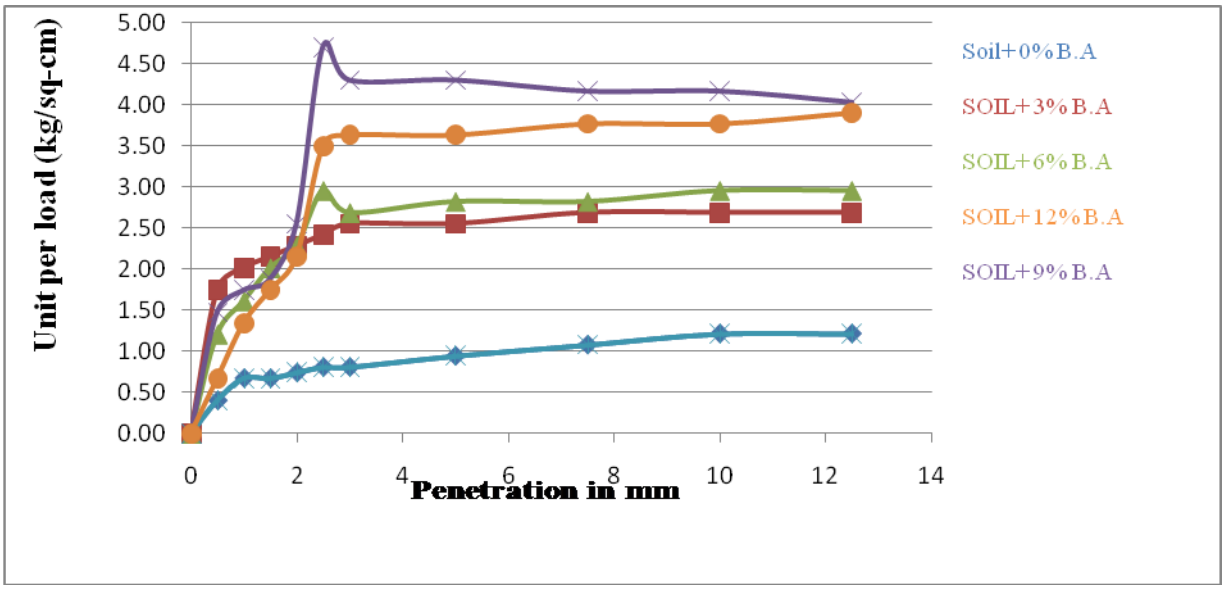

Fig. 5: Variation in soaked CBR for 4 day moist curing with Different percentage of B.A.

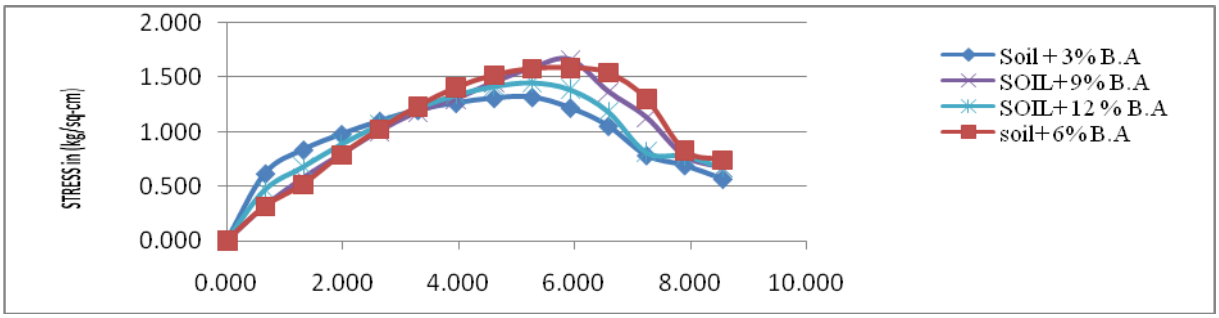

Fig. 6 : UCS Variations For Zero Days with different percentage of Bagasse Ash.

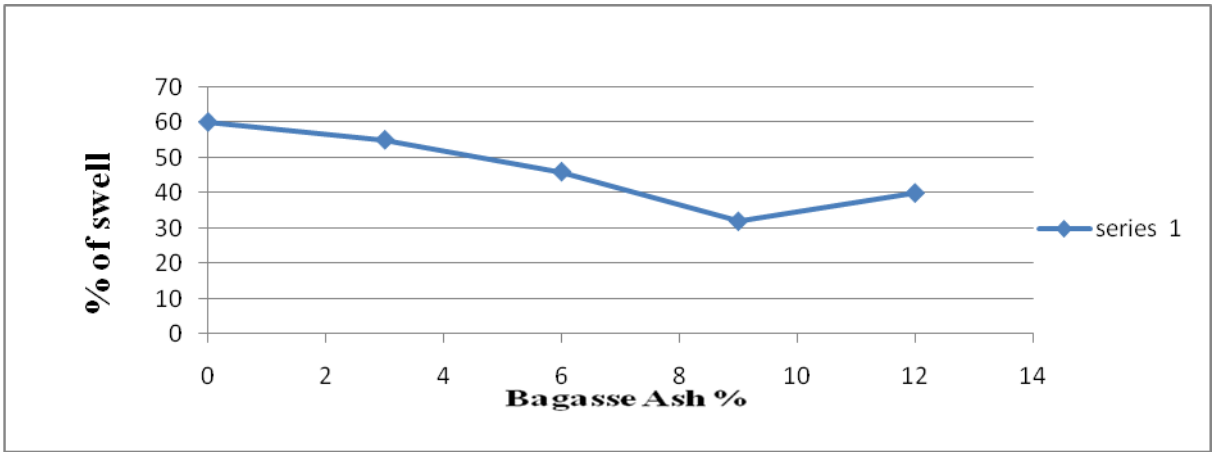

Fig. 7: Variation of free swell index with different Percentages Bagasse Ash.

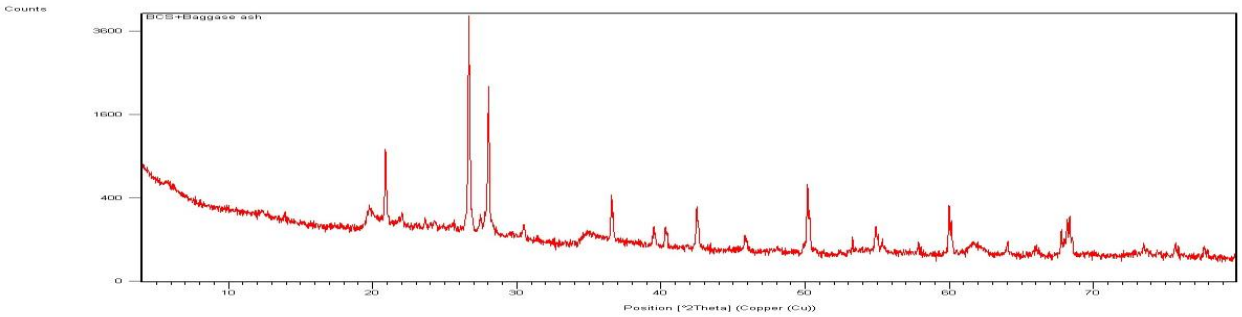

Fig. 8: XRD On Black cotton soil+ Bagasse Ash.

6 CONCLUSIONS

1. It was observed that there is reduction in Plasticity Index of Bagasse Ash treated soil from 24.00% to 17.40%.
2. It was observed that by the addition of 9% 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.
3. The increase in California bearing ratio value at 9% dosage had better effect compared to the other dosage. Increase in California bearing ratio indicates reduction in settlement.
4. CBR values got increased from 1.16 to 6.8% for addition of 9% Bagasse Ash. Further addition of Bagasse ash CBR values decreases.
5. UCS values got increases from 93.00KN/m^2 to 429.00 KN/m^2 at 9% bagasse ash content. Further addition of Bagasse ash UCS values decreases.

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