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Study of Bagasse ash and Cement stabilised Marshy Soil

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ABSTRACT: The present study provides an approach for the reuse of industrial waste in soil stabilization, which is used for improving the engineering properties of marshy soil. Due to rapid economic growth and industrialization, a huge quantity of waste materials generated creates a tremendous threat to public health and ecology. So considering this situation, an experimental program was undertaken to explore the possibility of utilization of the alternative material like bagasse ash by stabilizing it with marshy soil and adding small percentage of cement.
In this study behaviour of marshy soil is studied by stabilizing it with bagasse ash and additives such as cement and lime. The laboratory experiments are carried out for different percentages (4%, 8% & 12%) of bagasse ash with cement. The tests on atterburg limits of marshy soil were conducted with different percentages of bagasse ash, cement. The addition of bagasse ash, cement has a significant improvement in the properties of soil. From the experimental results it was observed that addition of cement gives better results. Hence, cement & bagasse ash acts as a better additive improving the index and engineering properties of marshy soil making it suitable for construction.

KEYWORDS: Marshy soil, Bagasse ash, California bearing ratio.

I. INTRODUCTION

The long-term performance of any construction project depends on the condition of the underlying soils. Unstable soils can create significant problems for structures. Marshy soil is one such an example. There are many infrastructure projects and coastal high-rise buildings whose foundations are often supported by such soils of low shear strength and high compressibility. The construction of these projects on soft soils can lead to a very expensive foundation system. Moreover, the installation of traditional foundation elements particularly driven piles or caissons, can destroy any naturally existing cohesion or cementation between the soil particles and disturb the structure of the soil in the close vicinity of the foundation, causing excessive settlement. Hence to meet the requirements of technical specifications of construction industry, studying soil stabilization is of great importance.
Researchers all over the world today are focusing on ways of utilizing either industrial or agricultural wastes as an alternative material for improving the engineering performance of soil along with other additives. The utilization of these wastes from the industry is economical, but also helps in preventing the utility of land as dumping yard.
In the present study, waste from sugarcane industry namely Bagasse Ash has been utilized to study the engineering performance along with the additives such as cement and study of cement treated with marshy soil and bagasse ash has been studied.

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

- **Mohammed Abdullah (2012)** studied the Evaluation of Plasticity and Particle Size Distribution Characteristics of Bagasse Ash on Cement Treated Lateritic Soil. The paper evaluated the plasticity and particle size distribution characteristic of bagasse ash on cement treated laterite. It was observed that liquid limit and plasticity index reduced while plastic limit increased. As regards the particle size distribution, the was reduction in the percentage of fines as a result of formation of heavier pseudo- and particle with percentage passing BS Sieve No. 200 reduced from 63% to almost zero. However the recommended percentage of bagasse ash should be between 4%-6%.

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- **Amu.O et.al (2011)** conducted research on the Geotechnical properties of lateritic soil stabilized with sugarcane strawash. Preliminary tests were performed on three samples, A, B and C for identification and classification purposes followed by the consistency limit tests. This research determined the geotechnical properties of lateritic soil modified with sugarcane straw ash with a view to obtain a cheaper and effective replacement for the conventional soil stabilizers. The addition of sugarcane straw ash in 2, 4, 6 and 8% to the samples caused changes in the liquid limits and plastic limits of all the samples. The results showed reduction in plasticity indices which indicates the soil improvement.
- **Mohammed Abdullah (2007)** studied the Influence of Compactive Effort on Bagasse Ash with Cement Treated Lateritic Soil The result of a laboratory study on the influence of British Standard Light (BSL), West African Standard (WAS) and British Standard Heavy (BSH) compactive effort on up to 8% bagasse ash content with up to 4% cement treated lateritic soil on compaction and shear strength characteristic of laterite. The result shows decreased in Maximum Dry Density with increased in bagasse ash content and in shear strength properties there was decreased in cohesion and an increased in angle internal friction. The decreased was greater with higher bagasse ash content. However, as However, as compactive effort increased from BSL, WAS and BSH, the value of MDD increased and OMC decreased. as a result of flocculation and agglomeration of clay particle occupying larger space with a corresponding drop in dry density and because of extra water required for the pozzolanic reaction of bagasse ash and hydration of cement respectively.

III. MATERIALS

Marshy soil: The soil used in this investigation is a Marshy soil. The samples are collected from the lake side area near IISc campus, Bangalore at the depth of 1.5m test pit dug below the natural level. The soil sample were kept dry in jute bags in the Geotechnical laboratory and was oven dried . The soil was oven dried to ensure uniformity were pulverized and sieved through 425µ sieve before using.

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. 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. For the present study, Bagasse ash is collected from sugarcane mill located in Mandhya district.

Table 1: Physical Properties of Bagasse ash

Properties	
Color	Grey
Density g/cm³	2.52
Surface Area (cm²/g)	5140
Particle size (μm)	28.9

Table 2: Chemical properties of Bagasse ash

Chemical composition	**Mass (%)**
Silica (SiO_2)	62.43

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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

Cement: Cement is a binder substance that sets and hardens independently, and can bind other materials together. The ordinary Portland cement (OPC) used for the study is purchased in the local market.

IV. METHODOLOGY

The Marshy soil used in this investigation is found on the edges of lakes and streams. These soils are formed by the accumulation of organic matter. Marshy soil is very soft having low shear strength and they are commonly called as soft soils so, there is a need for stabilization of this type of soil. Hence in the present investigation an attempt is made to improve the strength characteristics of soil by stabilizing it with bagasse Ash and additive like cement. Bagasse ash is obtained from the sugarcane industry has been utilized to study the engineering behaviour of marshy soil. Along with the bagasse ash and other additives such as cement is used to enhance the strength characteristics of soil. The detailed experimental programme has been planned for the determination of Specific Gravity, Atterburg limits, Compaction, Unconfined Compression strength test and California Bearing Ratio test

Table 3: Experimental programme

SL.NO	Mixture	Experiments conducted
1.	Soil	Specific Gravity,Grain Size distribution, Atterburg Limits,Compaction, UCC & CBR
2.	Soil+4% B.A	Liquid ,Plastic Limit, & CBR
3.	Soil + 8% B.A	Liquid Plastic Limit & CBR
4.	Soil + 12% B.A	Liquid , Plastic Limit & CBR
5.	Soil +4% B.A+4%cement	Liquid Plastic Limit & CBR
6.	Soil+4% B.A +8%cement	Liquid Plastic Limit & CBR
7.	Soil+4% B.A+12%cement	Liquid Plastic Limit & CBR
8.	Soil+8% B.A +4%cement	Liquid Plastic Limit & CBR
9.	Soil+8% B.A +8%cement	Liquid Plastic Limit & CBR
10.	Soil+8%B.A+12%cement	Liquid Plastic Limit & CBR
11.	Soil+12% B.A +4%cement	Liquid Plastic Limit & CBR
12.	Soil+12% B.A +8%cement	Liquid Plastic Limit & CBR
13.	Soil+12% B.A +12%cement	Liquid Plastic Limit & CBR

V. EXPERIMENTAL RESULTS

The Marshy soil was initially tested for basic properties as results are shown in table 4.

Table 4: Physical properties of Soil used in the present study

SL.NO	Properties	Values
1.	Colour	Grey
2.	Specific gravity(G)	2.69

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3. 4. 5.	Grain size distribution Sand (%) Fines Silt (%) Clay (%)	 16.2 17.5 66.3
6. 7. 8.	Atterburg Limits Liquid limit (w_L) (%) Plastic limit (w_P) (%) Plasticity Index (PI)	 64.00 26.06 37.94
9.	Shrinkage limit (w_S) (%)	12
10.	IS Classification	CH
11 12	Optimum moisture content (OMC)(%) Maximum Dry density (g/cc)	24 1.42
13.	Unconfined Compressive Strength (N/mm²)	32.06
14.	CBR Soaked (%)	1.06

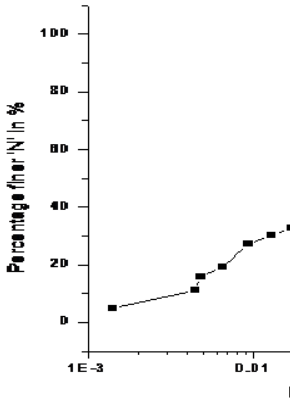

Fig1: Particla Size Distribution curve

Results of marshy soil stabilized with Bagasse Ash : Tests such as Liquid limit, plastic limit & CBR were conducted and results are as shown in the figures.

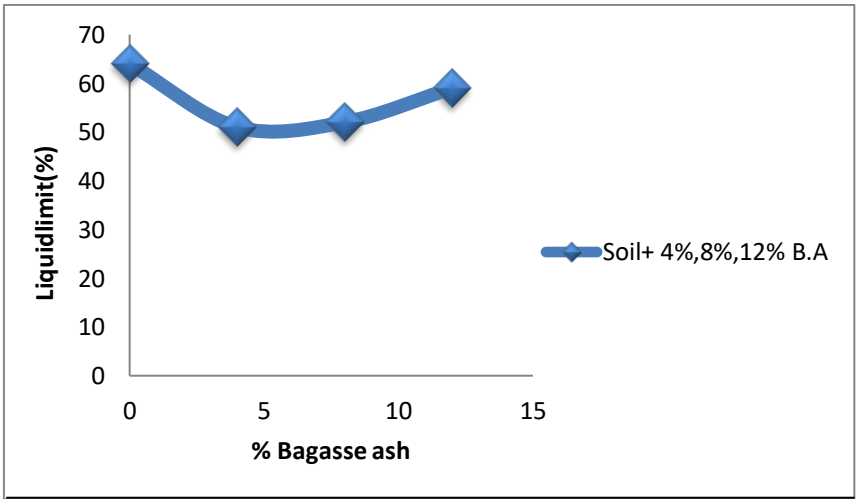

Fig 2: Liquid limit of Soil stabilized with different percentages of Bagasse ash

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The test results of bagasse ash on the liquid limit of soil is shown in the fig 2 .The liquid limit of the soil is found to be 64%.The result shows that there is an initial decrease in liquid limit for the addition of 4% bagasse ash and eventually increases to 59% with the addition of 12% bagasse ash.

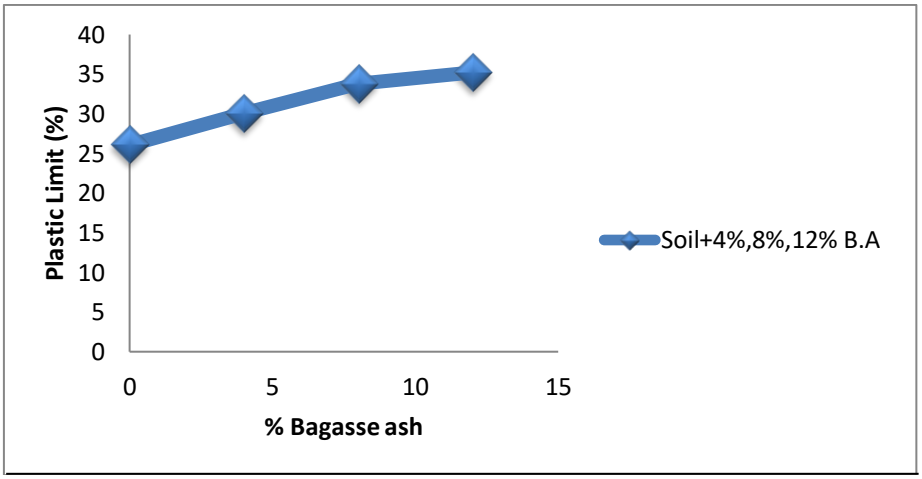

Fig 3: Plastic limit of Soil stabilized with different percentages of Bagasse ash

The experimental results of bagasse ash on the plastic limit of soil are shown in the fig 3. From the results it is observed that the plastic limit of the soil increases gradually with the increase in the percentage of bagasse ash. The Plastic limit of marshy soil is found to be 26.06% and it increased to 35.22% with the addition of 12% bagasse ash.

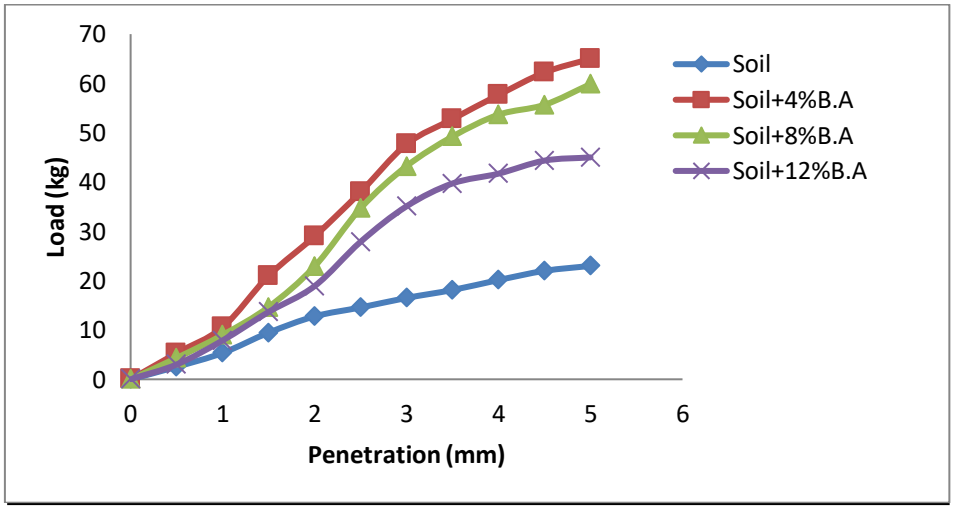

Fig 4:Soaked CBR curves of Soil stabilized with varying percentage of Bagasse ash

The test results of bagasse ash on the California bearing ratio of marshy soil is as shown in the fig 4.The addition of only bagasse ash has a beneficial effect on the CBR value of soil. The CBR value of the soil increases initially with the addition of 4%bagasse ash and reduces with the further addition of bagasse ash. The CBR value of soil is 1.06% respectively. On addition of 12% bagasse ash the CBR values decreases to 2.27%.

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Results of Marshy soil stabilized with Bagasse ash and Cement

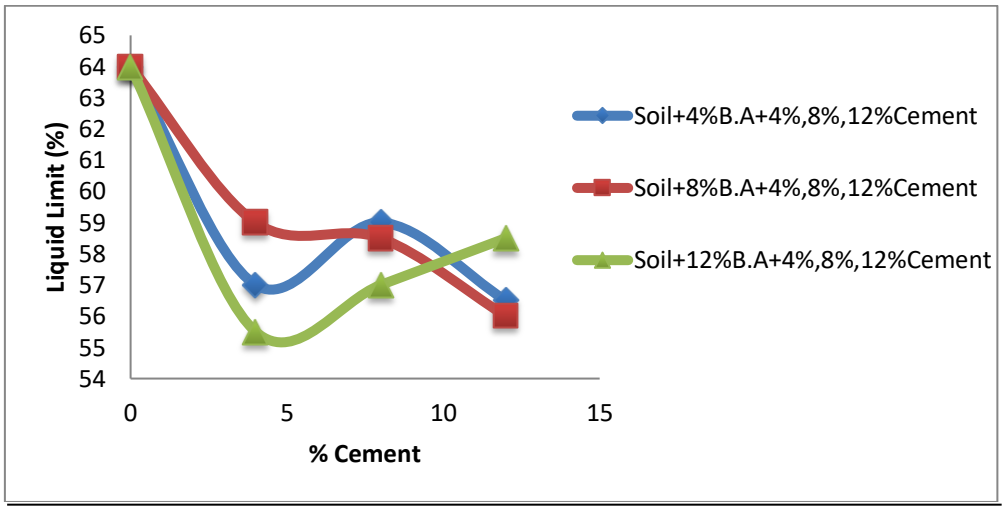

Fig 5: Liquid limit of Soil stabilized with different percentages of Bagasse ash and Cement

The test results of bagasse ash and cement on the liquid limit of soil is shown in the fig 5.

- The liquid limit of the soil is found to be 64% .On addition of 4% bagasse ash along with varying percentages of cement, it is observed that the liquid limit decreases to 56.5% for 4% bagasse ash and 12%cement.
- Similarly, by the addition of 8% bagasse ash along with varying percentages of cement, it was observed that liquid limit of the soil increased to 59% for 8% bagasse ash and 4% cement and gradually decreases to 56% for the addition of 8% bagasse ash and 12%cement.
- On the addition of 12% bagasse ash, liquid limit decreased further to 55.5% for 4%cement and it increased to 58.5% for 12% cement mix.

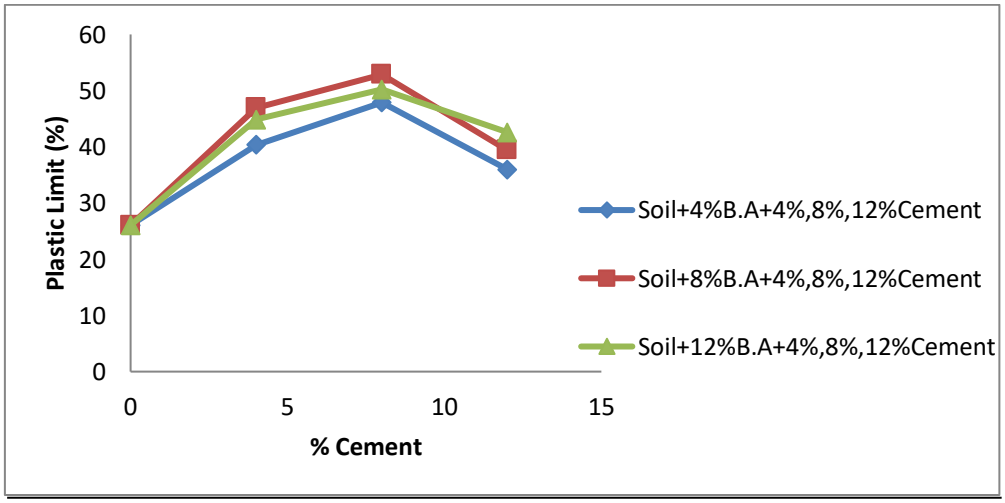

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Fig 6: Plastic limit of Soil stabilized with different percentages of Bagasse ash and Cement

The Experimental results of bagasse ash and cement on the plastic limit of soil is shown in the fig 6.

- The Plastic limit of the soil is found to be 26.06%. On addition of 4% bagasse ash along with varying percentages of cement the plastic limit increases to 47.88% for 4% bagasse ash and 12% cement and it decreases for 4% bagasse ash and 12% cement.
- With the addition of 8% bagasse ash and varying percentages of lime, it is noticed that plastic limit of soil increases to 50.22% for 8% bagasse ash and 8%cement and it reduces for 12% cement.
- On addition of 12% bagasse ash the plastic limit of the soil increases to 52.86% for 12% bagasse ash and 8% cement and decreases to 39.45% for 12% cement mix.

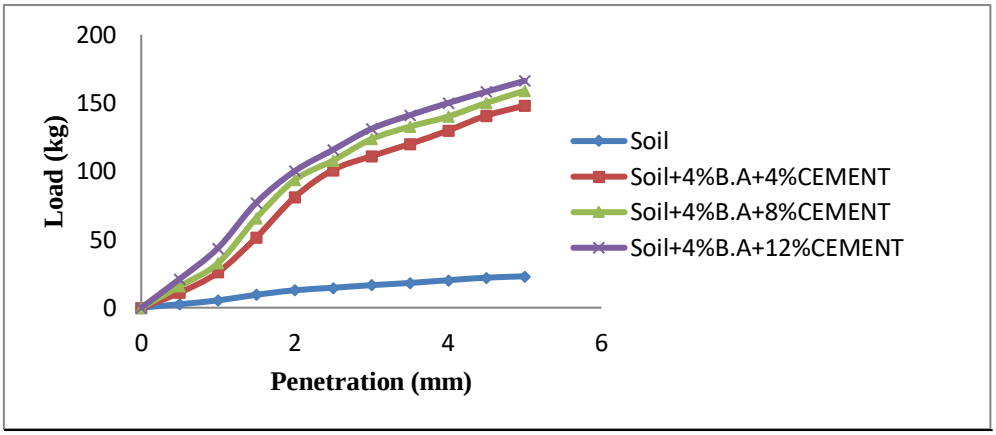

Fig 7: CBR curves of Soil stabilized with 4%ash and varying percentages of cement

The test results of 4%bagasse ash and varying percentages of cement on the California bearing ratio of marshy soil is shown in the fig 7. The CBR value of soil increases with the increase in the percentage of bagasse ash and cement. The CBR value of 8.44% is obtained with the addition of 4%bagasse ash and 12%cement mix.

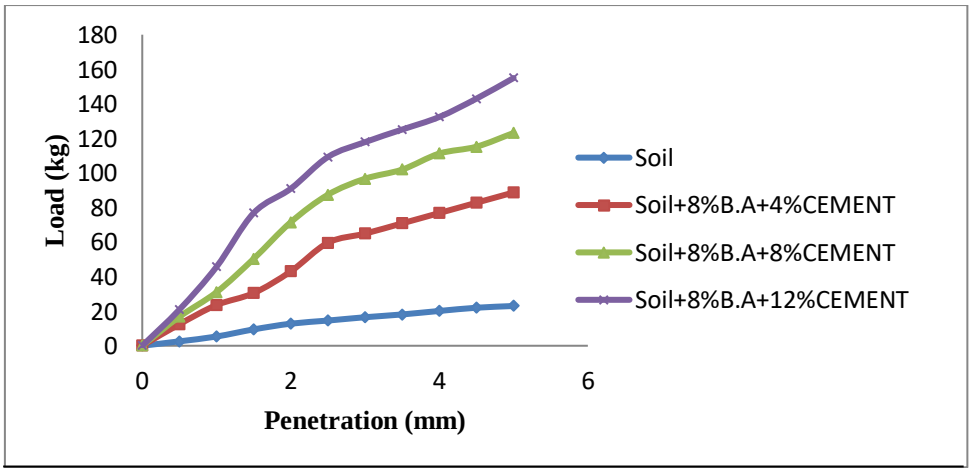

Fig 8: CBR curves of Soil stabilized with 8%ash and varying percentages of cement

The test results of 8% bagasse ash and varying percentages of cement on the california bearing ratio of marshy soil is as shown in the fig 8. The CBR value of soil increases with the increase in the percentage of bagasse ash and cement. The CBR value of 7.97% is obtained for 8%bagasse ash and 12%cement mix.

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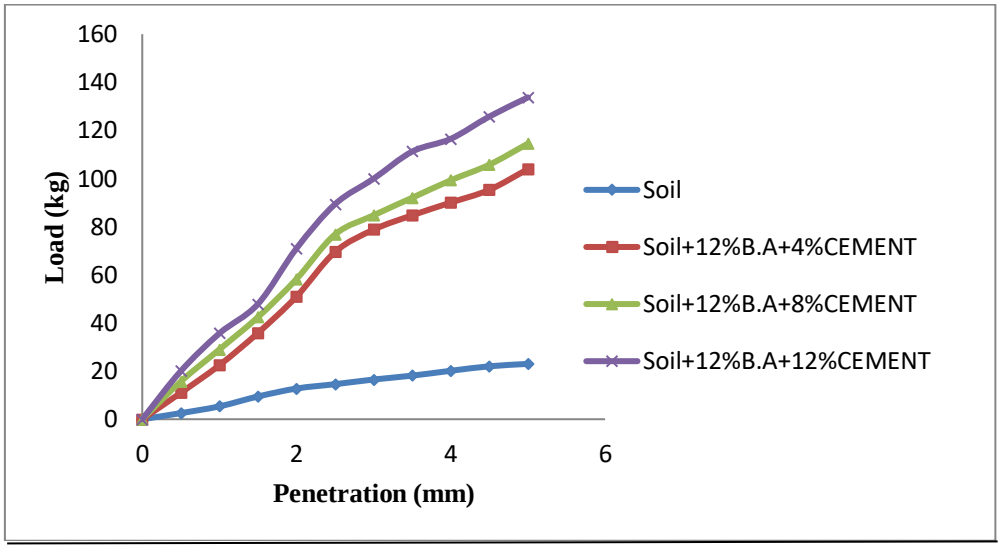

Fig 10: CBR curves of Soil stabilized with 12%ash and varying percentages of cement

The test results of 12%bagasse ash and varying percentages of cement on the California bearing ratio of marshy soil is as shown in the fig 9. The CBR value of soil increases with the increase in the percentage of bagasse ash and cement. The CBR value of 6.57% is obtained with the addition of 12%bagasse ash and 12%cement mix.

V. CONCLUSIONS

An Experimental study on Marshy soil was conducted to assess the effect of bagasse ash and cement on Marshy soil. The Marshy soil was stabilized with the additives in the stepped concentration of 4, 8, and 12%. The Marshy soil was initially tested for basic properties as results are shown in table 1.The following conclusions were drawn from the present study

- The Specific Gravity of soil and bagasse ash is found to be 2.69 and 1.94 respectively.
- The Liquid limit of the soil is 64%, when stabilized with bagasse ash it reduces to 59% on addition of 12% bagasse ash.
- The Liquid limit test was conducted on marshy soil stabilized with different percentages of bagasse ash and cement. It was noticed that the liquid limit of the soil reduced from 64% to 55.5% with the addition of 12% bagasse ash and 4% cement.
- The Plastic limit of the soil is 26.06%, when stabilized with bagasse ash plastic limit increases to 35.22% by the addition of 12% bagasse ash.
- The Plastic limit test was conducted on marshy soil stabilized with different percentages of bagasse ash and cement. It was observed that the plastic limit of the soil increases from 26.06% to 52.86% with the addition of 12% bagasse ash and 8% cement.
- The California Bearing ratio value of marshy soil for is found to be 1.06% .After stabilization with bagasse ash CBR values was increased to 2.27% by the addition of 12% bagasse ash.
- The California bearing ratio test was conducted on marshy soil stabilized with different percentages of bagasse ash and cement. It was observed that the CBR values of soil increased from 1.06% to and 8.44% with the addition of 4%bagasse ash and 12% cement.

Finally, from the experimental study we can concluded that bagasse ash can used as an replacement for marshy soil stabilize along with additives such as cement for improving its geotechnical properties.

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