Soil Stabilization of Clayey Soil using Bagasse Ash and Lime

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Abstract— *The objectives of this study are to improve the strength of the Clay soil by making soil-baggase ash-lime mixture. Nineteen specimens are prepared to investigate the properties of soil were prepared by adding 5%, 10%, 15%, 20%, 25% and 30% of Baggase Ash with the specimens are prepared by adding 0%, 5% and 10% lime of the above sample. Standard proctor test and unconfined compressive strength test are conducted to analyze the optimum moisture content (OMC), Maximum dry density (MDD) and compressive strength of soil mixture. In Standard Procter Test, the increase in Baggase Ash percentage the dry density increases upto 20% and after the MDD value has been decreasing trend. Though, a decrease in OMC has been observed with increase in Baggase Ash percentage and the increase in Lime percentage the MDD value having marginal increase. Though, a decrease in OMC has been observed with increase in percentage of lime content. In UCS, Due to increase in Baggase Ash percentage the UCS value having increasing trend with respect to the parent soil and due to increase in Lime percentage the UCS value has been observed increasing trend upto 5% after that having decreasing trend with increase in lime content.*

Keywords— OMC, MDD, UCS, Bagasse Ash and Lime

I. Introduction

The high cost of traditional soil stabilizers and industrial waste disposal problem has led to intense global research towards economical utilization of industrial and agricultural waste for engineering purposes. This research evaluated the effect of partial replacement of lime by Sugarcane bagasse ash in stabilization of problematic clay soil in construction works. Bagasse is the fibrous residue generated after the juice has been extracted from the sugar cane plant and normally deposited as waste and it litters the environment. Most of the bagasse produced, amounting to one-third of all the cane crushed in some cases supplies the fuel for the generation of steam which eventually results in bagasse ash

II. Objective of the Study

Need for soil stabilization:

1) Limited financial resources to provide a complete network road system to build in conventional method.
2) Effective utilization of locally available soils and other suitable stabilizing agents.
3) Encouraging the use of industrial wastages in building low cost construction of roads.
4) Many part around the globe facing problems in construction work due to clayey soil. Damage to the light structures and road pavement has been reported.

III. Material Collection

A. Collection of Clayey Soil

Soil used in the experiments has been collected from KAITHAL (HARYANA). Soil sample is collected from 0.3-0.5 m below the ground surface and remove impurities in soil lab.

S. No.	Parameters	Results
1.	I.S. Classification	CI
2.	Liquid Limit	44.48
3.	Plastic Limit	23.56
4.	Plastic Index	20.92
5.	Specific Gravity	2.65

Table 1: physical properties of soil

B. Bagasse Ash

Bagasse Ash was taken from Shahabad Markanda Sugar Mill. Sugarcane bagasse ash is a byproduct of sugar factories found after burning sugarcane bagasse which itself is found after the extraction of all economical sugar from sugarcane. The disposal of this material is already causing environmental problems around the sugar factories.

Component	Mass (%)
SiO_2	78.34
Al_2O_3	8.55
Fe_2O_3	3.61
CaO	2.15
K_2O	3.46

Table 2: Chemical properties of bagasse ash

C. Lime

Locally available Lime was used in the test. Lime is used as an excellent soil stabilizing materials for highly active soils which undergo through frequent expansion and shrinkage.

Description	Abbreviation	Lime (%)
Silica	Sio_2	0.00
Iron	Fe_2o_3	0.00
Magnesium	Mgo	0.04
Sodium	Na_2o	0.05
Potassium	K_2o	0.03
Calcium	Cao	95.03

Table 3: physical properties of Lime

IV. Methodology

A. Compaction Test

In this standard proctor test detailed investigation of the compaction of the parent soil with different samples on different percentages of ceramic dust and cement to find out or to obtain optimum moisture content and maximum dry density.

B. Unconfined compressive strength (UCS)

After the standard proctor test the compressive strength of soil is measured with the help of unconfined compressive strength test. Cylindrical specimen is compacted by static compaction in 3.8 cm diameter and 7.6 cm high mould. The inner surface of the mould is lubricated with mobile oil so as to extrude the sample from mould with minimum disturbance. The sample is placed inside the specimen

mould in seven layers using spoon, leveled and gently compacted. Pressure pad will be inserted into the mould and the whole assembly will be statically compacted in loading frame to the desired density. The sample is to be kept under static load for not less than 10 minutes in order to account for any subsequent increase in height of sample due to swelling. The sample will then be removed from the mould with the help of sample extruder.

V. TEST RESULT AND DISCUSSION

A. Effect of Bagasse ash and Lime on MDD and OMC

From the proctor test, it has been observed that the maximum dry density (MDD) increase by the addition of Bagasse ash in parent soil upto 20% after that it gradually decreases and the optimum moisture content decreasing trend with increase in percentage. Initially the OMC & MDD of the parent soil are 20.685%& 1.687gm/cc respectively according to proctor test conducted but further addition of Bagasse ash it is observe that the maximum dry density starts to increases when compared to parent soil.

Further if we add Bagasse ash with different material such as Lime the MDD and OMC of the clayey soil shows tremendous increases as compared to Bagasse ash. From the proctor test, it has been observed that the maximum dry density (MDD) increases by the addition of Lime in parent soil upto 5 percentage, after it gradually decreases and optimum moisture content varies at each percentage. The comparison of MDD and OMC for Bagasse ash and Lime are given.

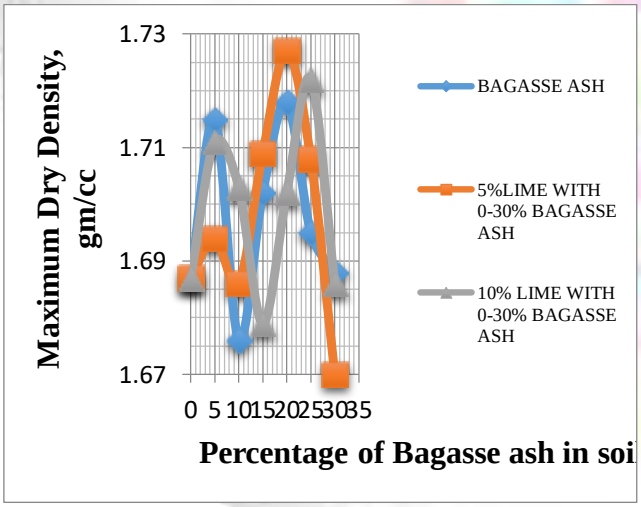

Fig. 1: Effect of Bagasse ash and Bagasse ash with Lime on MDD at different percentage

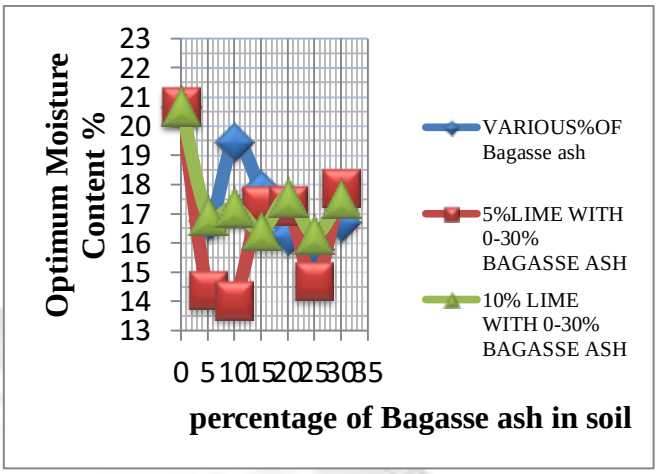

Fig. 2: Effect of Bagasse ash and Bagasse ash with Lime on OMC at different percentage

B. Effect of Bagasse ash and Lime on UCS

From UCS test conducted for the same sample as described in proctor test,the strength of samples shows increasing tendency for some samples with the increment of bagasse ash and lime percentage in the soil i.e; for parent soil strength obtained 0.8539kg/cm^2.for the bagasse ash –soil and lime mixture shows incremental results in the compressive strength as compared to the parent soil.

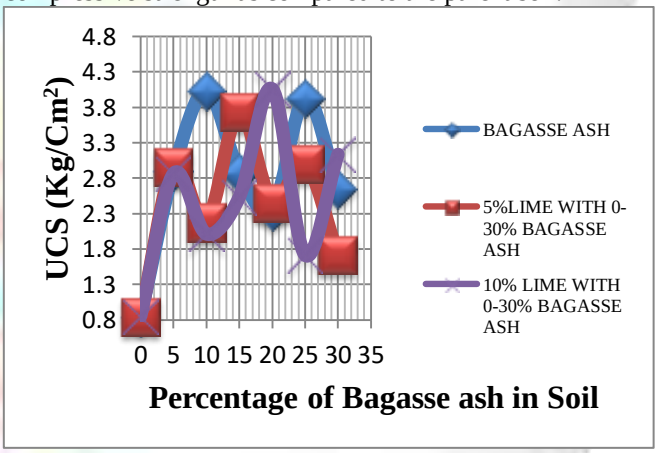

Fig. 3: Effect of bagasse ash and bagasse ash with lime on UCS at different percentage

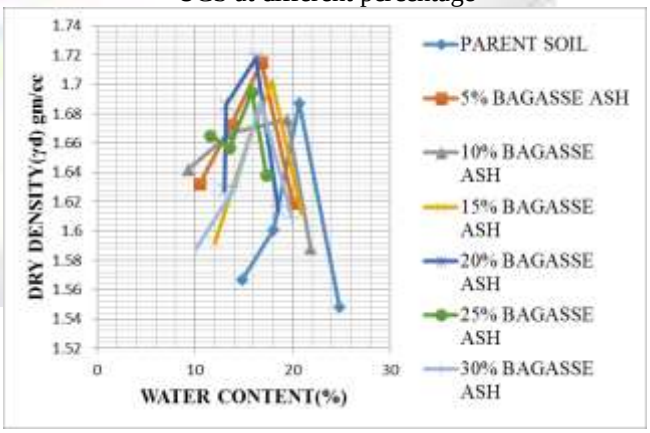

Fig. 4: Graph showing Moisture Density Relationship of parent soil mixed with various % of bagasse ash

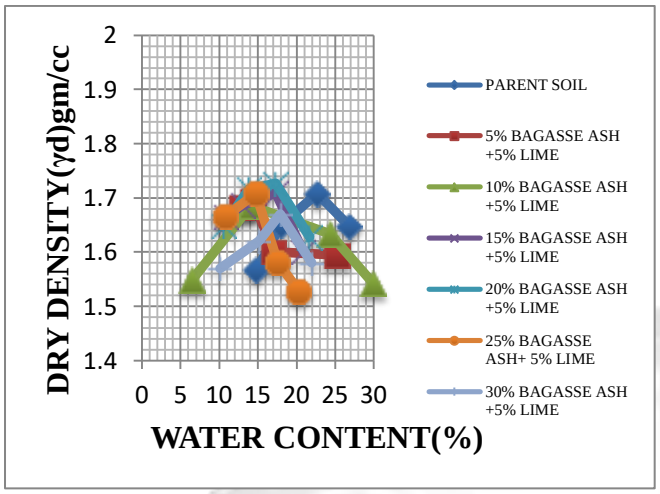

Fig. 5: Graph showing Moisture Density Relationship of parent soil mixed with various % of bagasse ash+5% lime

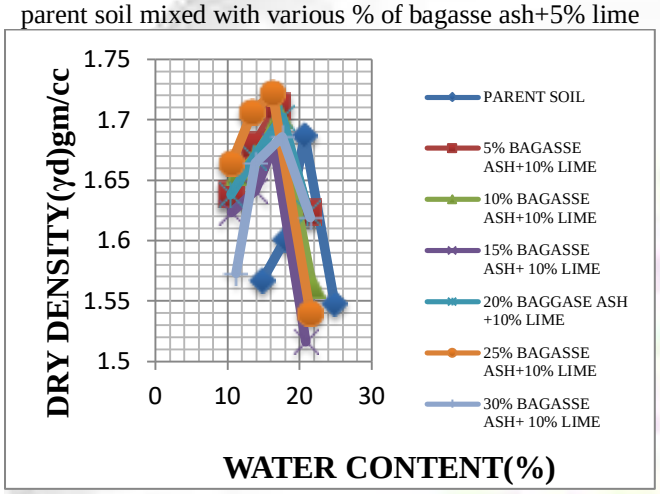

Fig. 6: Graph showing Moisture Density Relationship of parent soil mixed with various % of bagasse ash+10% lime

VI. Conclusion

Based on this experimental study on clay soil made some conclusion that are explained below. We find that this kind of treatment of clay soil should be very comfortable and economically suitable:

- In Standard Procter Test, the increase in Baggase Ash percentage the dry density increases upto 20% and after the MDD value has been decreasing trend. Though, a decrease in OMC has been observed with increase in Baggase Ash percentage.
- In Standard Procter Test, the increase in Lime percentage the MDD value having marginal increase. Though, a decrease in OMC has been observed with increase in percentage of lime content.
- In UCS, Due to increase in Baggase Ash percentage the UCS value having increasing trend with respect to the parent soil.
- In UCS, Due to increase in Lime percentage the UCS value has been observed increasing trend upto 5% after that having decreasing trend with increase in lime content.
- Lime not only acts as a activator in this case but also reduces the plasticity of the soil.
- Soil-Baggase-Lime specimen fails by formation of vertical cracks.

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