

# Experimental Study on improving the bearing capacity of clay soil using lime and Bagasse ash

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**Abstract** – Clay has plastic property when mixed with water and becomes rigid when it is dried. Because of these properties, clay soil has posed challenges and troubles to the construction activities. To overcome this problem the soil is stabilized with bagasse ash and lime admixtures. The bagasse ash has high pozzolanic properties. Lime has good binding property and less plastic property. The admixtures (lime & bagasse ash) were added with clay soil sample in the range of 10% with different mix ratios. The various types of mixtures were added to the soil and tested after 4 different curing periods to study the effect of compressive strength of the soil. From the experimental study, the unconfined compressive strength of the soil with addition of admixtures in the range of 8% lime and 2% bagasse ash is found to increase when compared to other range of mixtures.

**Key Words:** Clay, Bagasse ash, Lime, Curing period & Compressive strength.

## 1. INTRODUCTION

Soil is the foundation materials which supports loads from the overlying structures. Soil is the most widely used materials in a highway system, either in its natural form or in a processed form. Also, all pavement structures eventually rest on soil foundation. Use of bagasse ash soil in road construction can prove efficient in increasing the strength of soil and in turn reduce the project cost (Prakash Chavan, et al., [11]). Rice husk ash is an important material to stabilize the black cotton soil and make suitable for construction purpose (Parimal jah, et al.,[10]). The UCS value at 28 days curing age showed by the strength development of lime bagasse ash is a slow process and a longer period is required to attain the specified strength (Ochepo., et al.,[9]). The variation of optimum moisture content with different percentage of bagasse ash and lime sludge, increasing the percentage of addition of bagasse ash the OMC of soil goes on increasing. With increasing percentage of addition of lime sludge to each expansive soil – bagasse ash mixes the OMC value further goes on increasing, increase to a value of 29.7%, when 20% lime sludge is added to expansive soil stabilized with bagasse ash (Akshaya kumar Sabat[1]).

In this project we study how “Lime” and “Bagasse ash” may be effectively utilized in combination with expansive soil to get an improved quantity of composite material which may be used in various soil structures. In our study

an attempt is made to stabilize clay soil with addition of bagasse ash and additive. The strength parameters like UCS are determined to know the suitability of material.

## 2. MATERIALS

### 2.1 Lime

Lime is calcium containing inorganic material in which carbonates, oxides and hydroxides predominate. In the strict sense of the term, lime is calcium oxide or calcium hydroxide. The word “lime” originates with its earliest use building mortar and has the sense of “sticking or adhering”. These materials are still used in large quantity as building and engineering materials as chemical feedstocks and for sugar refining among other uses. The lime was in increment of 2, 4, 6, 8 % by weight of the dry soil.



Fig -1: Lime

### 2.2 Bagasse Ash

The bagasse ash 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.



Fig -2: Bagasse Ash

3	Shrinkage Limit	16.85
4	Shrinkage Ratio	4.2
5	Flow Index	35.28
6	Plastic Limit	16.25
7	Toughness Index	0.39
8	Consistency Index	0.25
9	Maximum Dry Density	0.12
10	Optimum Moisture Content	20%

### 2.3 Clay Soil

Expansive clays are known to exhibit dual characteristics of excessive swelling and shrinkage under different moisture conditions. This swelling-shrinkage characteristic of expansive soils which depends on the stress and suction history of the soil causes deformations which are significantly greater than elastic deformations and cannot be predicted by the classical elastic or plastic theory, the movement is usually in an uneven pattern and of such magnitude as to cause extensive damage to the structures and pavements resting on them.



Fig -3: Clay Soil

Table -3: Engineering Properties of Clay Soil

S.NO.	INDEX PROPERTIES	EXPERIMENTAL VALUES
1	Specific Gravity	2.1
2	Liquid Limit	70.2

### 3. EXPERIMENTAL OBSERVATION

#### 3.1 Unconfined Compression Test

The unconfined compression test is conducted to determine the unconfined compressive strength of cohesive remolded soil. Unconfined compression test is a special case of tri axial compression test with no lateral pressure. The compressive load per unit area required to fail the soil cylinder is called “unconfined compressive strength” of the soil. The cylindrical specimen of soil is subjected to major principle stress  $\sigma_1$  till the specimen fails due to shearing along a critical plain of failure.

In this specimen form, the apparatus consists of a small load frame fitted with the proving ring to measure the vertical stress applied to the soil specimen. The deformation of the sample is measured with the help of a separate dial gauge. The ends of the cylinder specimen are hollowed in the form of cone. The cone setting reduces the tendency of the specimen to become barrel shaped by reducing end restraints.

During the test, load versus deformation reading are taken and a graph is plotted. When a brittle failure occurs, the proving ring dial indicates the definite maximum load which drops rapidly with the further increases of strength.

Table -1: Ratios adopted for UCS test

CLAY	LIME	BAGASSE ASH
100%	-	-
90%	2%	8%
90%	4%	6%
90%	6%	4%
90%	8%	2%

90%	5%	5%
90%	10%	-
90%	-	10%

Samples were tested for four different curing periods such as 0<sup>th</sup>, 7<sup>th</sup>, 14<sup>th</sup> & 21<sup>st</sup> days. The samples were wrapped in a polythene cover and kept in the laboratory at room temperature.

#### 4. RESULT & DISCUSSION

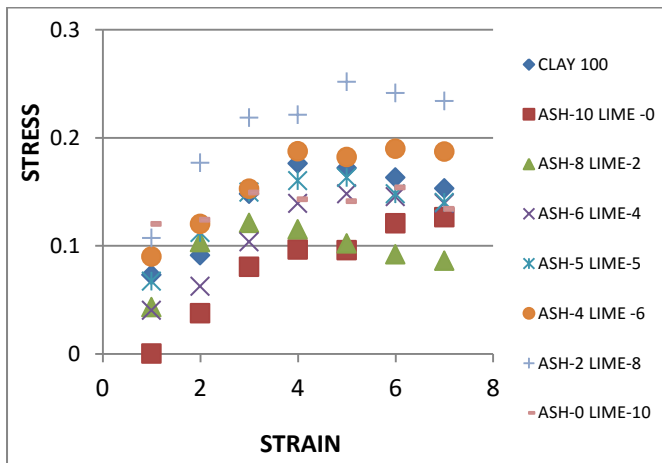


Chart -1: Compressive Strength of 0<sup>th</sup> day

0<sup>th</sup> day samples were tested in the laboratory and the obtained results are shown in chart -1. This chart shows that the peak value of compressive strength is obtained at 8% lime and 2% bagasse ash sample.

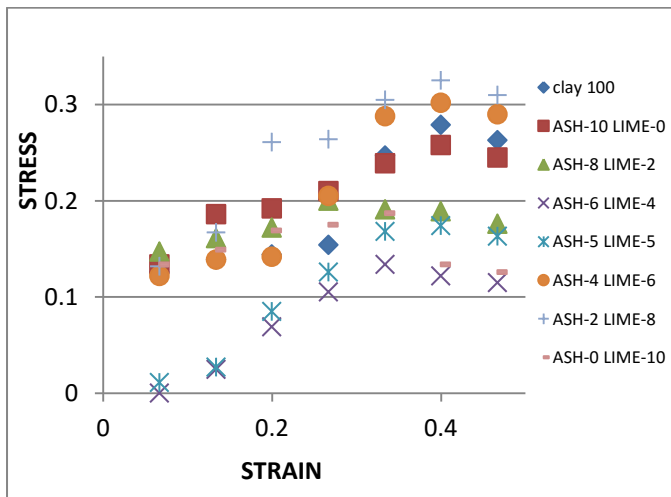


Chart -2: Compressive Strength of 7<sup>th</sup> day

7<sup>th</sup> day samples were tested in the laboratory and the obtained results are shown in chart -2. This chart shows

that the peak value of compressive strength is obtained at 8% lime and 2% bagasse ash sample.

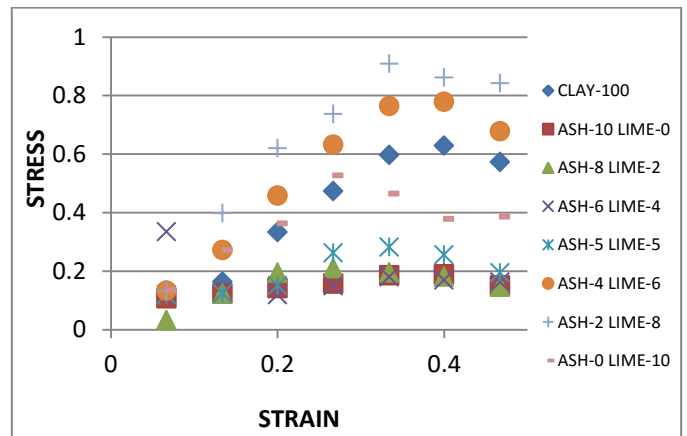


Chart -3: Compressive Strength of 14<sup>th</sup> day

14<sup>th</sup> day samples were tested in the laboratory and the obtained results are shown in chart -3. This chart shows that the peak value of compressive strength is obtained at 8% lime and 2% bagasse ash sample.

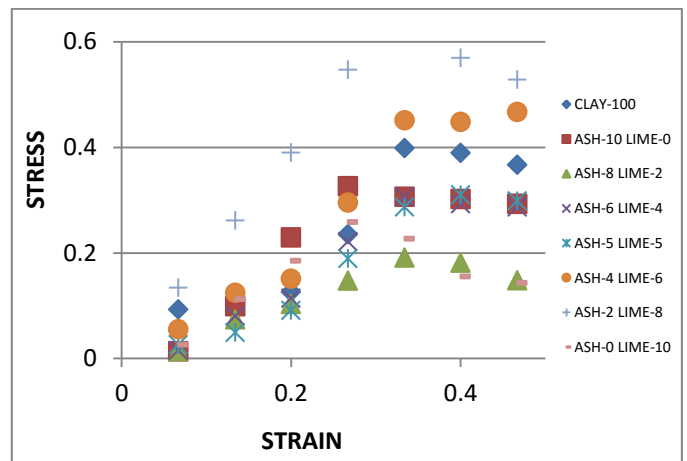


Chart -4: Compressive Strength of 21<sup>st</sup> day

21<sup>st</sup> day samples were tested in the laboratory and the obtained results are shown in chart -4. This chart shows that the peak value of compressive strength is obtained at 8% lime and 2% bagasse ash sample.

#### 3. CONCLUSIONS

This research was conducted to investigate the effect on the strength of clay soil-lime-bagasse ash. The clay soil was treated with lime and bagasse ash in stepped concentration of 0%, 2%, 4%, 6%, 8% and 10% by dry weight of the soil. The tests were done for 4 different curing periods such as 0th, 7th, 14th and 21st day.

- ❖ By the test results it is proved that 2 different ratios give best results compared to conventional clay.
- ❖ The recommended peak values of unconfined compression strength were obtained at 8% lime and 2% bagasse ash in each day of curing.
- ❖ The next higher strength is obtained at 6% lime and 4% bagasse ash.
- ❖ Unconfined compressive strength of specimens generally increased at higher curing.
- ❖ Next to these 2 ratios conventional sample (clay soil) shows better results, the other proportions give lesser strength values.
- ❖ Hence it is found that when increasing the bagasse ash beyond 4% strength will decrease.

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