SOIL STABILIZATION USING BONE ASH AND SILICA FUME

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Abstract - *Increasing amount of waste fibres have raised a serious concern among the environmental authorities, these are not only non - bio degradable but are also environmental hazard and disposal of the waste fiber has emerged as a major problem.*

These waste fibers are synthetic or semi synthetic in nature. Although these have some good properties but are potentially harmful for the environment and may cause plastic pollution which adversely effects the land and the environment. In recent years some serious steps have been taken to employ these waste fibers in enhancing the properties of the soil. The purpose of this work is to study the effect of waste fibers along the brick kiln dust as an additive on the engineering properties of the soil through experimentation and observation. The engineering properties that were studied include basic Atterberg limits viz specific gravity, liquid limit, plastic limit, shrinkage limit, moisture content , optimum moisture content , dry density and maximum dry density, and direct shear strength . Percentages of polypropylene and BKD were varied by weight and by percentage and improvement in engineering properties of soil was observed with the addition of polypropylene and BKD. Further the properties of the reinforced soil were compared with those of the naturally virgin soil and the difference in the parameters was noted.

It was observed that PPF and BKD together have influenced the engineering properties of the soil.

Key Words: polypropylene, brick kiln dust, plastic limit, shear strength, unconfined compressive strength.

1. INTRODUCTION

The process for increasing soil geotechnical features, such as subgrade characteristics, shear strength, expanding and shrinking properties, and bearing limit, is mostly used. More than a quarter of the area in India's Madhya Pradesh and Andhra Pradesh provinces is covered by the extensive soil, which is also known as black cotton soil. Montmorillonite, a mineral found in the soil, causes the soil to expand when it comes into contact with water, making it dangerous.

1.1 materials

1.1.2 Clayey Soil

Clay is a finely-grained normal stone or soil material that consolidates at least one mud minerals with potential hints of quartz (SiO_2), metal oxides (Al_2O_3 , MgO and so on) and natural matter. Geologic mud stores are generally made out of phyllosilicate minerals containing variable measures of water caught in the mineral design. Muds are plastic because of molecule size and calculation just as water content, and become hard, fragile and non–plastic after drying or firing. Depending on the soil's substance in which it is found, earth can show up in different shadings from white to dull dim or brown to profound orange-red

1.1.3 Chicken bone ash

The calcination of bones results in the production of a white substance known as bone ash. An average sample of bone ash will have a composition of around 55.82 percent calcium oxide, 42.39 percent phosphorus pentoxide, and 1.79 percent water. Although the precise composition of these compounds may change depending on the sort of bones that are being utilised, the formula for bone ash is often written as follows: $Ca_5(OH)(PO_4)_3$. The average density of bone ash is around 3.10 g/mL, and its melting point is 1670 degrees Celsius (3038 degrees Fahrenheit). Calcification allows the majority of bones to maintain their cellular structure. At the sampling spot, the soil sample was retrieved from a depth of about one metre. The sample of dirt was dried with the assistance of an oven set at 1100 degrees Celsius. The grain size of soil samples was evaluated, together with Atterberg's limit, so that the soil could be categorised using the Indian Soil Classification System (ISC). The CBA used in the study was derived from various chicken byproducts. The chicken bones that were acquired were burned at an unregulated temperature in an open air environment. In order to get CBA, the CBA was first allowed to cool, then milled, and then sieved using a sieve with an aperture of 425 micron.

1.1.4 silica fume

The addition of silica fume (SF) to the concrete mix enhances the mix's workability and makes it more mobile while yet maintaining its cohesiveness. This is the result of the soil particles being more evenly dispersed, which is also related to the surface properties of the silica fume particles, which are smooth and absorb very little water as they are being mixed together.

The recent study demonstrates that an efficient application of micro silica fume may enhance the subgrade features of expansive soil. The results of a number of tests carried out in the laboratory indicate that the application of micro silica fume is a viable choice for the enhancement of the sub grade features of expansive soil.

1. 2 Mixing Proportions

Table -1: Mix proportions of Soil(S), Chicken Bone Ash (CBA) and Silica Fume (SF)

S.NO	DESIGNATION (S:CBA:SF)
1	100:0:0
2	98:2:0
3	96:4:0
4	94:6:0
5	92:8:0
6	95:0:5
7	90.0:10
8	85.0:15
9	80:0:20
10	93:2:5
11	86:4:10
12	79:6:15
13	72:8:20

1.3 objectives

To determine soil index properties (Atterberg's Limits)

- Liquid Limit
- Plastic Limit

To study the chicken bone ash and silica fume on CBR value of the clayey soil.

To find the optimum quantity of Bone ash and Silica Fume used for the stabilisation of soil.

To determine the effect chicken bone ash and silica fume on UCS.

To determine the maximum dry density and corresponding optimum moisture content

2. RESULTS AND DISCUSSIONS

2.1 ATTERBERGS LIMITS

Table -2 index properties of virgin and reinforced soil

Table -1 index properties of virgin and reinforced soil

Parameters	Soil sample
liquid limit of clay	32.5%
Liquid limit of the soil reinforced with CBA and SF	31.8%
Plastic limit of clay	23.2%
Plastic limit of the soil reinforced with CBA and SF	25.1%
Shrinkage limit of clay	4.2%
Shrinkage limit of the soil reinforced with CBA and SF	5.12%

2.2 MDD AND OMC CONTENT

Table -3 MDD and OMC for soil–CBA– SF mix

S. No.	Proportion Soil : CBA : SF	MDD G/CC)	OMC (%)
1	65 : 0 : 0	19.75	16
2	93:2:5	20.91	14
3	86:4:10	21.14	14.45
4	79:6:15	22.14	13.87
5	72:8:20	21.44	13.5

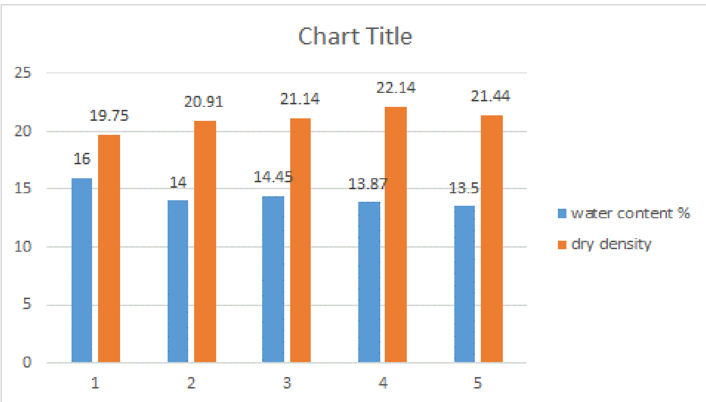

Fig. 1 Variation in the dry density with moisture content for soils with varying contents of CBA AND SF

2.3 UCS

The UCS test result shows that the UCS value of Clay soil is 142.5kN/m² and with addition of 2%upto 4% of CBA its increased 10kN/m² then decreased with the addition of 8% CBA. UCS test is performed with curing period of 3 days

Table -4: Values of UCS mixed with CBA SF.

S.NO	PROPORTION OF SOIL:CBA:SF	CURING PERIOD (DAYS)	UNCONFINED COMPRESSIVE STRENGTH (kN/M²)
1	100:0:0	3	142.25
2	93:2:5	3	215
3	86:4:10	3	221
4	79:6:15	3	229
5	72:8:20	3	224

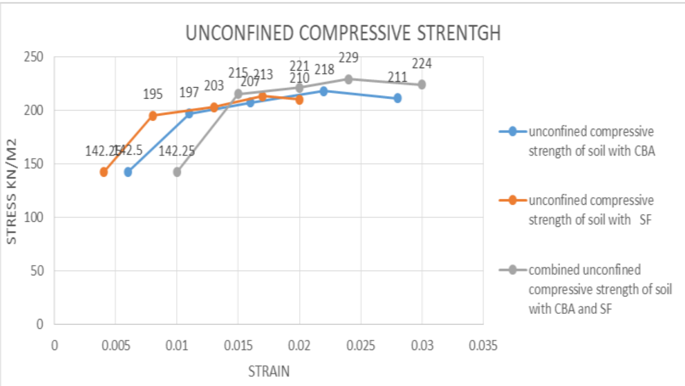

Fig .2 combined unconfined compressive strength of soil with CBA and SF

2.4 CBR

For soaked conditions, filter paper were placed on base plate. Surcharge plate of the weight is 5 kg were placed over plate, whole mould were placed in water tank for soaking of sample for 168 hours. After 168 hours mould was taken out of water tank.

Table -4: Values of CBR with CBA and SF

S. No.	Proportion Soil : CBA : SF	CBR VALUE (2.5 mm)	CBR VALUE (5 mm)
1	65 : 0 : 0	6.32	6.45
2	93:2:5	11.60	10.55
3	86:4:10	13.45	12.80
4	79:6:15	15.60	15.54
5	72:8:20	14.10	14.45

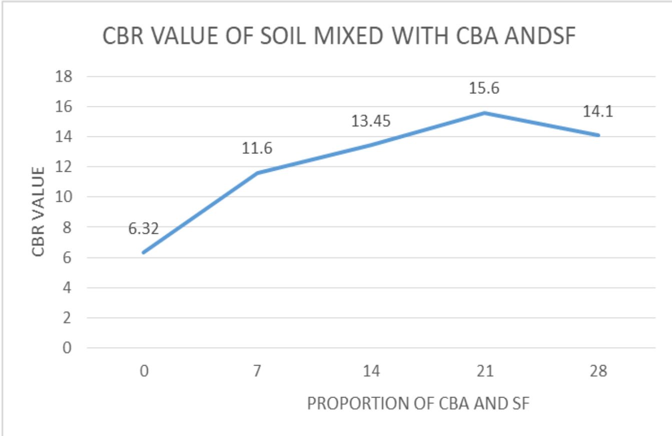

Fig.3 CBR VALUES OF SOIL WITH CBA AND SF AT 2.5MM

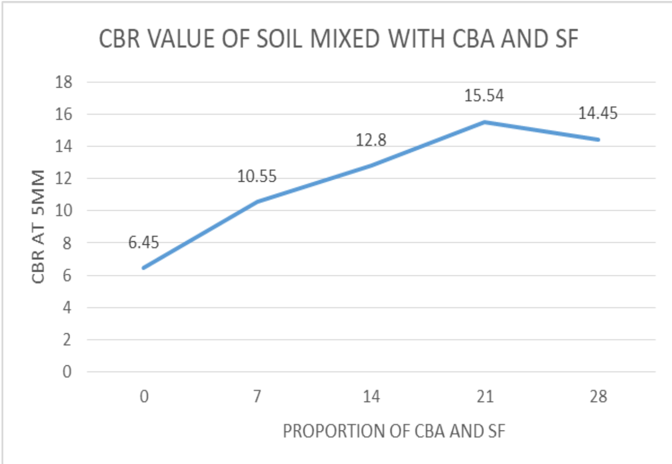

Fig.4 CBR VALUES OF SOIL WITH CBA AND SF AT 5M

3. CONCLUSION AND FUTURE SCOPE

3.1 conclusions

On the basis of the lab tests, outcomes obtained from the tests showed promising results and keeping in view these experimental investigations the following deductions can be drawn.

1. It has been found that the engineering properties of the soil sample were greatly enhanced by the use of CBA and SF

2. The individual use of CBA and SF also showed promising results.

3. Index properties of the soil were greatly influenced by the addition of CBA and SF. It was observed that that liquid limit dropped to 31.8% from 32.5%, the plastic limit was increaded to 25.1% from 23.2%.

4. The investigation of the geotechnical properties of the soil used in this research has enabled us to

establish the effect of CBA on the soil California bearing ratio. The maximum amount of CBA that would allow for an increase for CBR value is 6% and also by adding the percentage of Silica Fume the values of CBR again rises at 20% of silica fume.

5. According to this research to achieve the maximum shear strength of soil with the help of 6% of CBA mixed into soil by using the unconfined compressive strength test. After the test we found the shear strength was increased.

3.2 future scope

1. In the present study only up to 8 percent replacement of CBA by soil has been considered. The other percentages percent need to be investigated in the future

2. From the results obtained from the tests it can be predicted that CBA and SF have ability to enhance the engineering properties of the soil.

3. Extensive research should be conducted in order to explore more and more effective use of CBA and SF in engineering purposes.

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