EFFECT OF BITUMEN EMULSION AND SEA SHELL POWDER IN THE UNCONFINED COMPRESSIVE STRENGTH OF BLACK COTTON SOIL.

K.Jayaganesh[*], S.Yuvaraj[#], D.Yuvaraj[#], C.Nithesh[#] and G.Karthik[#]
[*]Assistant Professor and [#]B.E. Final year students, Department of Civil Engineering, Vel Tech High Tech Dr.Rangarajan Dr.Sakunthala Engineering College

ABSTRACT:
Black Cotton Soils which are a type of expansive soil are basically susceptible to volumetric changes, with the changes in moisture. This is due to the presence of mineral montmorillonite, which as an expansive lattice. In this paper an attempt has been made in finding the Unconfined Compressive Strength of black cotton soil by adding Bitumen Emulsion and Sea Shell powder as admixtures. The admixture bitumen emulsion is added at a proportion of 20% to 26% with an increment of 2% in the dry weight of the soil. Similarly sea shell powder is added at a proportion of 12% to 18% with an increment of 2%. It was concluded that the addition of admixtures had increased the unconfined compressive strength of the black cotton soil. For bitumen emulsion the maximum strength obtained at 24% was 559.67KN/m^2 and for sea shell powders it was 273KN/m^2 at 16% from 67.28KN/m^2 of the natural soil.

***KEY WORDS*:** bitumen emulsion, black cotton soil, sea shell powder, unconfined compressive strength.

1. INTRODUCTION

Expansive soils cover large area in several countries of the world and in India these deposits are known by the name "black cotton soil" and it occupies 20% of its area. They are predominant in the states of Gujarat, Maharashtra, Madhya Pradesh, Andhra Pradesh, Karnataka and Tamil Nadu. These soils undergo volumetric changes with the increase in moisture content. This is due to the presence of the mineral montmorillonate. They are of great challenge to civil engineers for the construction of building structures and roads over it.

Number of researchers worked in improving the strength of black cotton soil. They used many admixtures which are naturally available with the soil and showed best results. Laxmikant Yadu, Rajesh Kumar Tripathi and Dharamveer Singh (2011) have studied the effect of Fly Ash and Rice Husk in black cotton soil and showed that the soil attains its optimum strength at 12% and 9% of the admixtures. Oriola, Folagbade and Moses, George (2010) conducted experiments on black cotton soil by adding Ground Nut Shell Ash with them. Balasubramaniam et al., (1989), Locat et al., (1990) (1996), Narasimha Rao and Rajasekaran (1996) have found that the strength behaviour of soil greatly improved by adding Lime with it.

In this current investigation sea shell powder and bitumen emulsion were added with soil and its unconfined compressive strength characteristics were studied. Sea shells are naturally available materials on the sea shores. They are the hard exoskeleton of molluscs. They contain about 90% of calcium carbonate which is a major component in Lime. Bitumen emulsions which are easily available in our country act as a binder between the soil particles and prevent the entry of water within the soil (Elifas Bunga 2011).

2. EXPERIMENTAL PROGRAM

2.1 MATERIALS

2.1.1. BLACK COTTON SOIL

Black Cotton Soil samples were collected from Chennai Metro Rail Project at Shenoy Nagar. Samples were collected at 4m depth. The soil was air dried and pulverized to pass through IS425 Micron Sieve and then oven dried at 110^{o}C before testing. The properties of the Black Cotton Soil are as follows:

S.NO	PROPERTY	VALUE
1	Specific Gravity	2.46
2	Liquid Limit	63%
3	Plastic Limit	24%
4	Plasticity Index	39%
5	Optimum Moisture Content	14%
6	Dry Density	17.5 KN/m^3
7	Unconfined Compressive Strength	67.28 KN/m^2

Table 1: Properties of Black cotton soil

2.1.2 BITUMEN EMULSION

The cationic Bitumen Emulsion is obtained from VICHOOR BITUCHEMICALS. The type of Bitumen Emulsion used for this experiment is Cool tar-CE (Rapid Setting 1).

2.1.3 SEA SHELLS

The sea shells were finely grained and the sea shell powder retained on IS75 Micron Sieve was used for this experiment.

Fig.1 Sea Shell Powder and Bitumen Emulsion

2.2 TEST SPECIMEN

Initially specimen of size 8.9cm length and 3.8cm diameter was made with soil alone. Then the admixture Bitumen Emulsion were added in proportions 20%, 22%, 24% and 26% to the soil and specimen of same length and diameter was made. For Sea Shell Powder the proportions were 12%, 14%, 16% and18%.

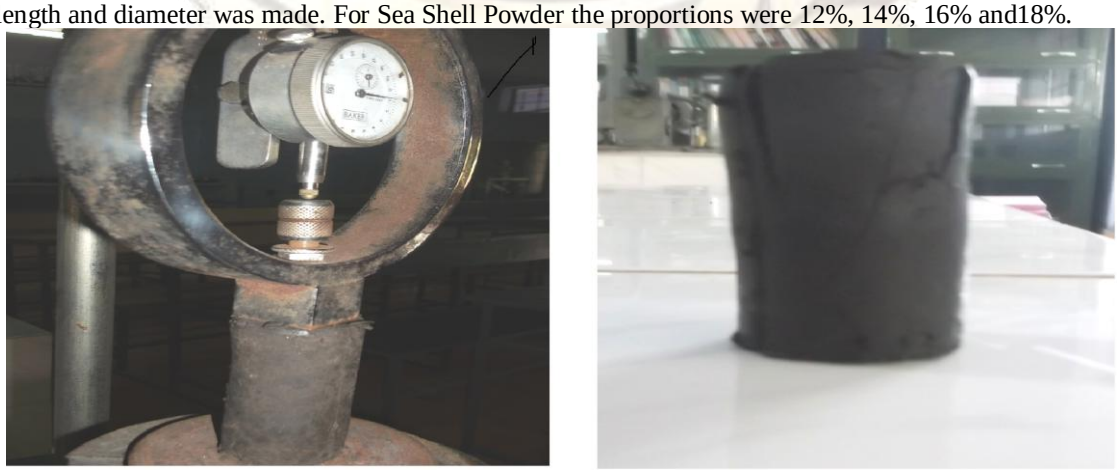

Fig. 2 Unconfined compressive strength test on Black Cotton Soil specimen

2.3 PROCEDURE

The initial length and diameter of the specimen was measured. The specimen is then placed in the apparatus. Care should be taken such that both the edges of the specimen are in complete contact with the apparatus. The dial gauge is adjusted to preferable value. Motor is then switched on. The specimen is allowed to compress until a crack occurs in the specimen. When initial crack appears in the specimen the motor is switched off and the corresponding value on the dial gauge is noted.

Fig.3 Unconfined Compressive Strength test on soil with Bitumen Emulsion and Sea Shell Powder

3. RESULT AND DISCUSSIONS:

After the detailed investigation on the unconfined compressive strength of black cotton soil has been done, the following results have been achieved.

1. The unconfined compressive strength of the black cotton soil showed significant results with the addition of bitumen emulsion. The UCS values increased from 67.88 KN/m^2 to 337 KN/m^2, 417.7 KN/m^2, and 559.6 KN/m^2 at 20%, 22% and 24%. At 26% there was a decrease in the of 539.26KN/m^2 as shown in fig.4.

2. Similarly addition of seashell powder also showed positive results on UCS of the soil. The strengths obtained were 134.8 KN/m^2, 213.9 KN/m^2 and 273 KN/m^2 at 12%, 14% and 16%. The value decreased to 258 KN/m^2 at 18% of the powder. The variation is shown in fig.5.

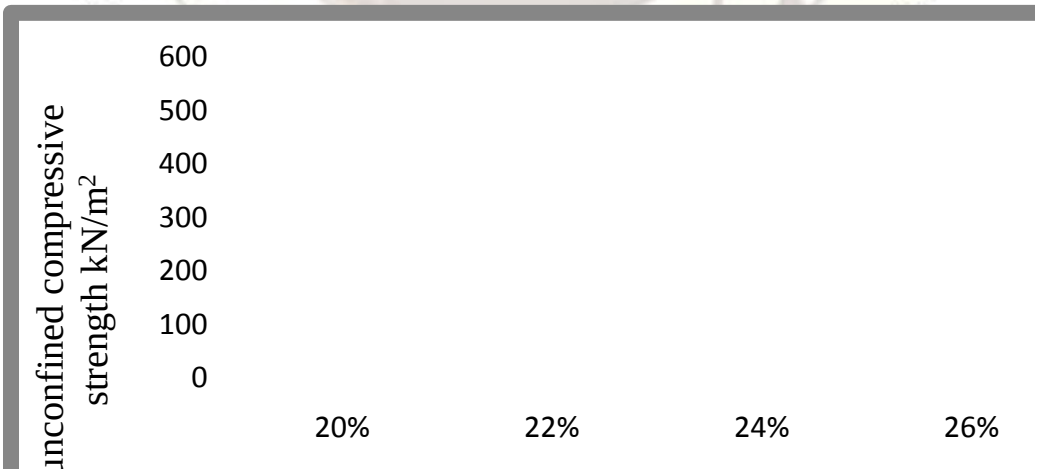

FIG.4. Unconfined Compressive Strength of black cotton soil at various proportions of Bitumen Emulsion

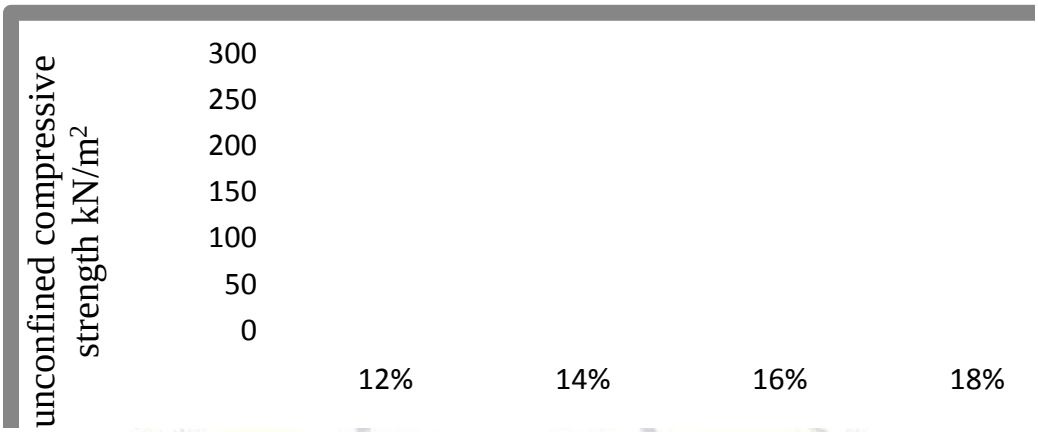

FIG.5. Unconfined Compressive Strength of black cotton soil at various proportions of Sea Shell Powder

4. CONCLUSION

The following conclusions have been made based on the results obtained from experimental investigations:

1. The unconfined compressive strength of the black cotton soil increases with the addition of admixtures bitumen emulsion and sea shell powder.
2. The optimum UCS value is obtained at 24% of addition of bitumen emulsion and at 16% for sea shell powder.
3. Further study can be done on the black cotton soil to obtain the effect of bitumen emulsion and sea shell powder by conducting the California Bearing Ratio of the soil.

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