INFLUENCE OF SEA SHELLS POWDER ON BLACK COTTON SOIL DURING STABILIZATION

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ABSTRACT
Black Cotton Soils are a type of expansive soil which 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. There are various materials that may be used as stabilizers but now in our research work we has made an attempt in finding the Unconfined Compressive Strength and CBR test of black cotton soil by adding Sea Shell powder as admixture. The admixture sea shell powder is added at a proportion of 12% to 18% with an increment of 2%. It was concluded that with the addition of admixtures, the unconfined compressive strength of the black cotton soil has been increased. For sea shell powders it was 273KN/m2 at 16%, when compared to natural black cotton soil it was 38.63KN/m2. The CBR values has also been increased by adding the sea shells powder as admixture at a proportion of 5% to 45% with an increment of 5% with the black cotton soil. It attains a maximum CBR value of 7.8% at 20%, as for black cotton soil without adding the admixture attains a value of 1.0%. Thus sea shells powder can be used as a stabilizing agent.

KEYWORDS: *Black cotton soil, California bearing ratio, sea shell powder, unconfined compressive strength*

I. 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 montmorillonite. 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 is 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.

II. AREA OF STUDY

Sample is collected from EGUPALLE near KADAPA. The soil sample is collected from a vast area of black cotton soil. The experiments are conducted in Geotechnical laboratory of KSRM College of Engineering, which is located near Krishnapuram village, KADAPA.

III. EXPERIMENTAL PROGRAM

2.1 materials:

2.1.1 black cotton soil:

Black Cotton Soil samples were collected from EGUPALLE near KADAPA. The soil was air dried and pulverized to pass through IS425 Micron Sieve and then oven dried at 110^0C before testing.

Fig.1: Black cotton soil

The properties of the Black Cotton Soil are as follows:

Table.1: Properties of Black cotton soil

S.NO	PROPERTY	VALUE
1	Specific Gravity	2.5
2	Liquid Limit	69.05%
3	Plastic Limit	23.2%
4	Plasticity Index	45.85%
5	Shrinkage Limit	14.11%
6	Shrinkage Ratio	1.91
7	Volumetric Shrinkage	0.63%
8	Uniformity coefficient(C_u)	2.5
9	Coefficient of Curvature(C_c)	1.02
10	Free swell index	88.89%
11	Optimum Moisture Content	24.21%
12	Dry Density	1.50 g/cm^3
13	Unconfined Compressive Strength	38.63 KN/m2
14	California Bearing Ratio	1.0%

Sea shells:

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

Fig.2: Sea shells powder

2.2 test specimen:

Initially specimen of size 8.9cm length and 3.8cm diameter was made with soil alone. Then the admixture sea shell Powder were added in the proportions 12%, 14%, 16% and18% to the soil and specimen of same length and diameter was made.

Fig.3: Unconfined compressive strength test on Black Cotton Soil specimen

2.3 procedure of unconfined compression test:

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.4: Unconfined Compressive Strength test on soil with Sea Shell Powder

2.4 procedure of cbr test:

Place the mould assembly with the surcharge weights on the penetration test machine. Seat the penetration piston at the center of the specimen with the smallest possible load, but in no case in excess of 4 kg so that full contact of the piston on the sample is established. Set the stress and strain dial gauge to read zero. Apply the load on the piston so that the penetration rate is about 1.25 mm/min. Record the load readings at penetrations of 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 4.0, 5.0, 7.5, 10 and 12.5 mm. Note the maximum load and corresponding penetration if it occurs for a penetration less than 12.5 mm. Detach the mould from the loading equipment. Take about 20 to 50 g of soil from the top 3 cm layer and determine the moisture content.

CBR definition:

It is the ratio of force per unit area required to penetrate a soil mass with standard circular piston at the rate of 1.25 mm/min. to that required for the corresponding penetration of a standard material.

C.B.R. = Test load/Standard load * 100.

The following table gives the standard loads adopted for different penetrations for the standard material with a C.B.R. value of 100%.

Table.2: Standard loads for different penetrations

Penetration of plunger (mm)	Standard load (kg)
2.5	1370
5.0	2055
7.5	2630
10.0	3180
12.5	3600

The test may be performed on undisturbed specimens and on remoulded specimens which may be compacted either statically or dynamically. CBR values are calculated at 2.5mm and 5mm penetration and final its average is considered.

Fig.5: CBR test on soil with Sea shell powder

IV. 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.

- At different percentages of Sea shell powder added with soil mass, UCS test as per IS 2720 part 10 -1991 were performed and results are shown in table.3 and fig.6

Table.3

Sea shells powder (%)	UCC Strength KN/m^2
12	130.6
14	207.4
16	261
18	237

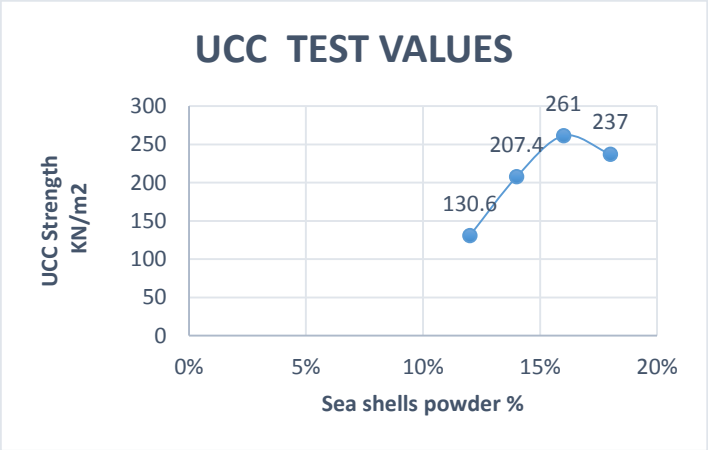

Fig.6: Graph representing variation of strength with sea shell powder

From the above graph we can clearly state that unconfined compression strength values are increasing up to 16% and decreasing beyond 16%. During this stage sea shell powder took additional moisture contents and attain better bonding between sea shells powder and black cotton soil particles.

- At different percentages of Sea shell powder added with soil mass, California bearing test as per IS:2720 part 16-1987, were performed and results are shown in table.4 and fig.7.

Table.4

Sea shells powder (%)	CBR (%)
0	1
5	2.5
10	4.5
15	6
20	7.8
25	6
30	5.5
35	5
40	5
45	4.5

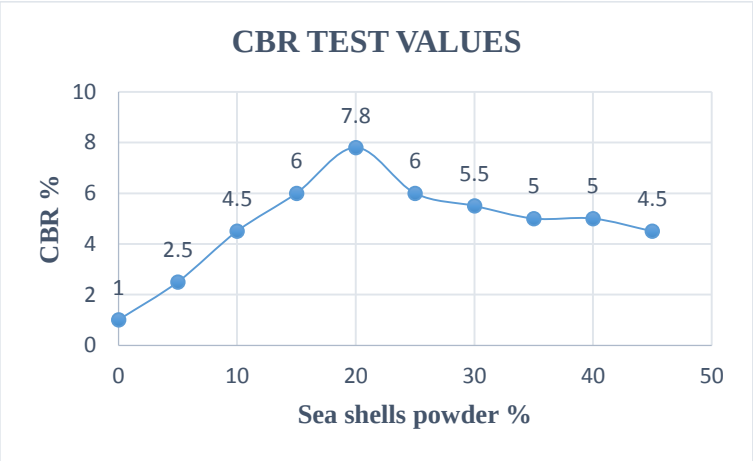

Fig.7: Graph representing variation of CBR values with sea shell powder

As the percentage of Sea shell powder increases, CBR values are steadily increased up to 10% and a rapid increase was observed in between 10% to 20%. Beyond 20% of Sea shell powder a steady decrease in CBR values can be attained. The increase in CBR values are due to the development of frictional resistance between soil and sea shells powder. Attainment of lower values is due to the reason that the mix represents the behavior sea shell powder.

V. CONCLUSION

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

The unconfined compressive strength and the California bearing ratio of the black cotton soil increases by stabilizing the soil with sea shells powder. It is one of admixture out of remaining admixture like stone dust, fly ash, rice husk, polymers, Portland cement, lime and ionic stabilizers. We can say it is a little bit of effective in using sea shells powder as admixtures when compared with other stabilizing agents.

Further study is conducted by mixing sea shells powder with bitumen emulsion and use as a stabilizer

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