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EFFECTS OF BRICK POWDER AND CORN COB ASH ON BLACK COTTON SOIL

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Abstract - Civil Engineering construction works on expansive soil demands great deal of attention. It is more important to concentrate on strength of soil layers underlying the surface course, because the strength, thickness and design life of pavement are mainly depends upon the sub grade strength. Soil stabilization is an effective method of improving soil properties. Sub grade using geo grid, geo textiles and geo membrane are most widely used in soil reinforcement. In the present study to strengthen soft sub grade soil by using brick powder and corn cob ash. Several tests were carried on black cotton soil and replacing with brick powder and corn cob ash at various mixing proportion i.e., 25%, 35% and 45% of brick powder keeping 5% of corn cob ash as constant.

***Key Words*: Black Cotton Soil (BCS), Brick Powder (BP), Corn Cob Ash (CCA), Maximum Dry Density (MDD), Optimum Moisture Content (OMC), Unconfined Compressive Strength (UCS), California Bearing Ratio (CBR)**

1. INTRODUCTION

The 20% of Indian land is covered with expansive soils. Black cotton soil falls under expansive soils. Black Cotton Soil is observed in broad part of Deccan Plateau (Western and Southern India) in India. Land surface having Black Cotton soil is fertile and extreme profitable for cultivation activities. The economical progress of any nation is measured on the infrastructure facility. But when it comes to the construction such as roadways and railways the black cotton soil fails due to its expansion and contraction when soil get in touch with water.

The black cotton soil named so because of its black color appearance and suitable for cotton crop cultivation. Swelling and shrinkage are major issues of the black cotton soil. The soil swells due to existence of access water and get shrinks on dehydration. Black Cotton Soil often swell and shrink that could develop cracks that leads to increase in permeability. This permeability guides to severe destructions like building cracking or structure disturbance and distraction in pavements. Therefore it is significant to enhance the geo-technical quality of black cotton soil.

Many years ago soil stabilization technique was started to develop the soil properties as per the engineering project requirements by adding cementing agents, agricultural waste or unwanted industrial waste. Utilization of unwanted waste materials obtained from industries solves the industrial disposal problems and prevents dangerous effects on earth and human beings.

2. LITERATURE REVIEW

2.1 Sugarcane Bagasse Ash

DR. K. SHIMOLA, Associate Prof., Civil Engineering Department from Malla Reddy Engineering College, Secunderabad, Telangana, India in december-2018 has carried out experimental studies on BCS using sugarcane bagasse ash as agent for stabilization at various percentages. From this study she concluded that plasticity index decreases from 16.87% to 7.8% at 16% mix of bagasse ash that is preferable for construction. At 16% of bagasse mix, the maximum dry density, shear strength and unconfined compressive strength raised.

2.2 Groundnut Shell Ash, Polypropylene

T. MURLI KRISHNAA, Associate Prof. and Head of Civil Engineering and SHEKOON BIBI, B.Tech. Student from PACE College has conducted study and found results 24.60%, 44.26% and 59.01% for unconfined compressive strength by varying groundnut shell ash mixing. Overall they concluded that groundnut shell ash and polypropylene can be preferable as soil stabilizing material to develop engineering quality of soil.

2.3 Rice Husk Ash, Lime and Gypsum

KOTESHWAR RAO, ANUSHA M., Civil Engg. Dept. from JNTUK, Kakinada (AP). The result proved that 20% of rice husk, 5% lime and 5% gypsum mixture with soil shows positive results for liquid limit, free swell index, CBR and UCS tests

2.4 Corn Cob Ash

P. MADAN MOHAN REDDY, Assistant Professor, and P. THANMAI, N. TRILOK KUMAR, Student from K. O. R. M. College of Engineering, Andhra Pradesh, India, has stabilized BCS treating with corn cob ash at different percentages. The

work has proven that the mixing of corn cob ash suppress the swelling and also enhance the strength of BCS.

3. MATERIALS AND MIX PROPORTION

3.1 Materials

Black Cotton Soil:
Obtained from Jawalga village, Bhalki Taluka, Bidar District (Karnataka) at a depth more than 2 to 3 meters from the ground level surface.

Table -1: Basic Properties of Black Cotton Soil

S. No.	Properties	Value
1	Colour	Black
2	Specific Gravity	2.43
3	Liquid Limit	44.00%
4	Plastic Limit	17.94%
5	Plasticity Index	26.06%
6	Maximum Dry Density	1.69 gm/cm^3
7	Optimum Moisture Content	18.01%
8	Unconfined Compressive Strength	0.89 kg/cm^2
9	California Bearing Ratio	1.51%
10	Free Swell Index	46.67%

Brick Powder:
Bricks are the important part of all civil engineering activities hence brick production units are most necessary in India and other countries. As per the trusted survey sources it is calculated that 1 lac kilns in India and manufacture 150 to 200 billion bricks per year. Brick dust powdery waste is obtained from the bricks due to improper burning during manufacturing process and one more source is demolition waste. Brick Powder has a good tendency to decrease the swelling and shrinkage properties of BCS.

Corn Cob Ash:
Corncob ash powder derived from corncob by flaming under prescribed temperature. Approximately around 180 to 200 kg of corn cob is obtained from the production of 1000 kg of corn.

3.2 Mix Proportion

The following mix proportion samples are used

a. Parental Black Cotton Soil
b. BCS + 25% Brick Powder + 5% Corn Cob Ash
c. BCS + 35% Brick Powder + 5% Corn Cob Ash
d. BCS + 45% Brick Powder + 5% Corn Cob Ash

4. RESULTS AND DISCUSSIONS

4.1 Specific Gravity - IS 2720 (PART 3) 1964

Table -2: Specific Gravity Test Values

Sample Proportion	Values
Parental BCS	2.43
BCS + 25% BP + 5% CCA	2.54
BCS + 35% BP + 5% CCA	2.59
BCS + 45% BP + 5% CCA	2.71

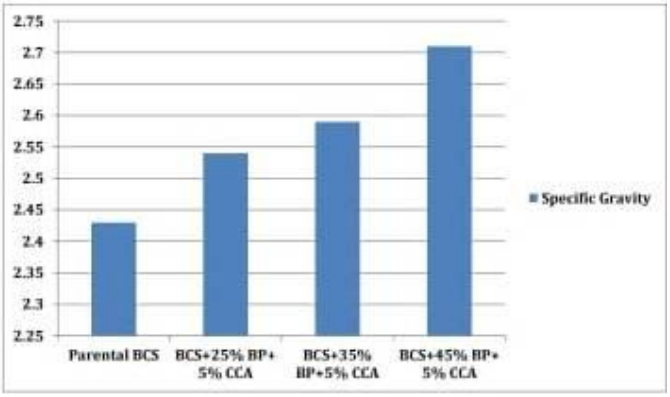

Chart -1: Graph for Specific Gravity Test Values

4.2 Atterbergs Limit - IS 2720 (PART 5) l985

Table -3: Atterbergs Limit Test Values

Sample Proportion	Liquid Limit %	Plastic Limit %	Plasticity Index %
Parental BCS	44.00	17.94	26.06
BCS + 25% BP + 5% CCA	33.60	12.98	20.62
BCS + 35% BP + 5% CCA	32.60	12.82	19.78
BCS + 45% BP + 5% CCA	29.50	11.51	17.99

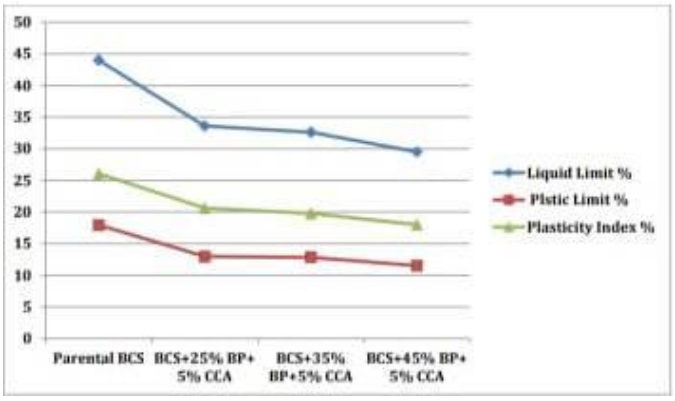

Chart -2: Graph for Atterbergs Limit Test Values

4.3 Modified Proctor Test - IS 2720 (PART 8) 1983

Table -4: Modified Proctor Test Values

Sample Proportion	MDD (gm/cm³)	OMC (%)
Parental BCS	1.69	18.01
BCS + 25% BP + 5% CCA	1.80	15.51
BCS + 35% BP + 5% CCA	1.85	14.20
BCS + 45% BP + 5% CCA	1.94	11.54

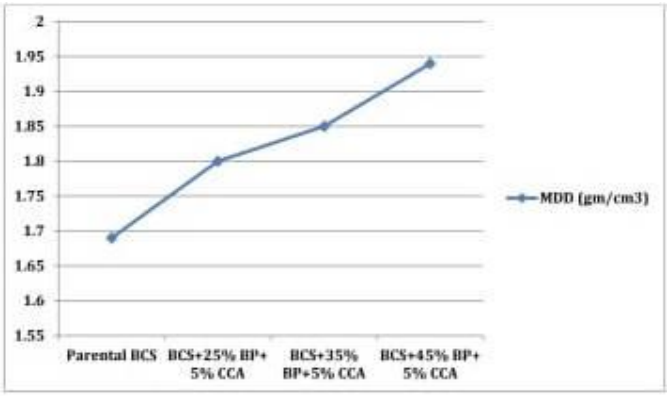

Chart - 3: Graph for Maximum Dry Density

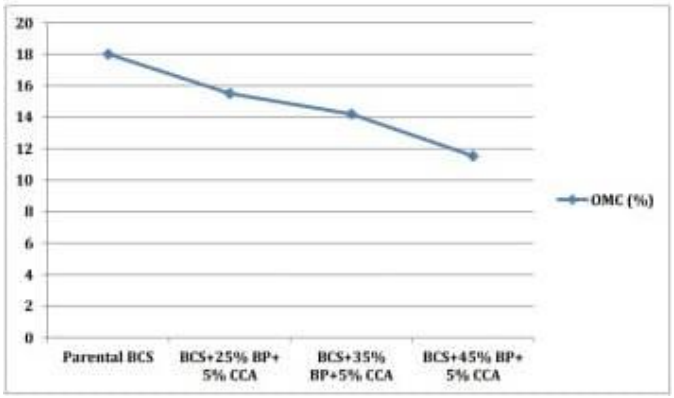

Chart -4: Graph for Optimum Moisture Content

4.4 Unconfined Compressive Strength - IS 2720 (PART 10) 1991

Table -5: Unconfined Compressive Strength Test Values

Sample Proportion	UCS Values in kg/cm²
Parental BCS	0.89
BCS + 25% BP + 5% CCA	1.23
BCS + 35% BP + 5% CCA	1.67
BCS + 45% BP + 5% CCA	1.92

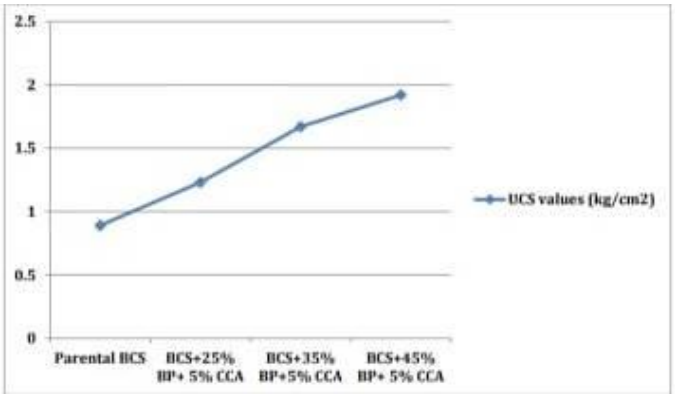

Chart - 5: Graph for Unconfined Compressive Strength Test Values

4.5 California Bearing Ratio - IS 2720 (PART 7) 1992

Table -6: California Bearing Ratio Test Values

Sample Proportion	CBR Values in %	
	For 2.5 mm	For 5.0 mm
Parental BCS	1.51	1.18
BCS + 25% BP + 5% CCA	2.40	2.08
BCS + 35% BP + 5% CCA	2.85	2.42
BCS + 45% BP + 5% CCA	3.16	2.72

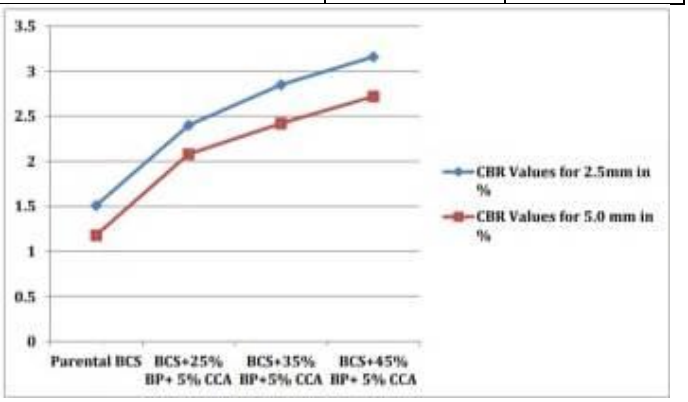

Chart - 6: Graph for California Bearing Ratio Test Values

4. 6 Free Swell Index - IS 2720 (PART 20) 1977

Table -7: Free Swell Index Test Values

Sample Proportion	Free Swell Index Values in %
Parental BCS	46.67
BCS + 25% BP + 5% CCA	35.71
BCS + 35% BP + 5% CCA	23.08
BCS + 45% BP + 5% CCA	16.67

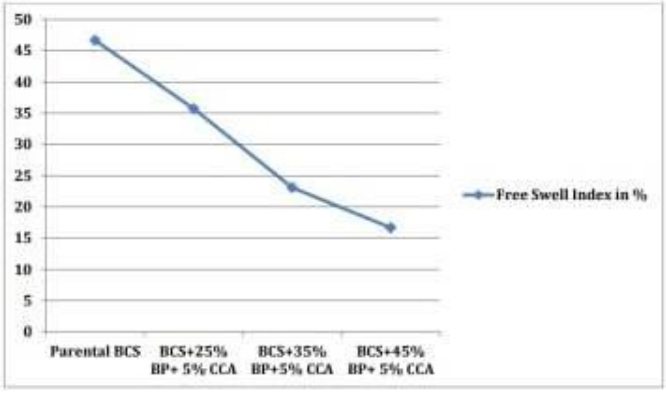

Chart - 7: Graph for Free Swell Index Test Values

5. CONCLUSIONS

The conclusions are summarized as below:

- The specific gravity of parental BCS is 2.43. On mixing of brick powder and corncob ash powder to BCS with various proportions, the BCS shown the increase in specific gravity to 2.54, 2.59 and 2.71.
- Initially liquid limit of parental BCS is 44.00%. Later on mixing of brick powder and corncob ash powder to BCS with various proportions, the BCS starts reducing to 33.60, 32.60 and 29.50.
- The BCS subjected to modified proctor test obtained MDD value as 1.69 g/cm3 and OMC value as 18.01%. On the mixing of brick powder and corncob ash powder to BCS with various proportions, the MDD value increases to 1.80, 1.85 and 1.94 and OMC value decreases to 15.51, 14.20 and 11.54.
- The soil for any construction activities should posses great load bearing capacity. With the help of UCS test the load bearing determined. The strength of BCS obtained is 0.89 kg/cm2. On the mixing of brick powder and corncob ash powder to BCS with various proportions, the strength increases to 1.23, 1.67 and 1.92.
- There is rise in CBR value on the mixing of brick powder and corncob ash powder to BCS with various proportions.
- From Free Swell Index test, BCS soil having 46.67% of swelling index. Swell potential reduces further on the mixing of brick powder and corncob ash powder to BCS with various proportions.

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