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IMPROVEMENT OF ENGINEERING PROPERTIES OF BLACK COTTON SOIL BY 20% SUGARCANE BAGASSE ASH AND COIR FIBRE (AR – 80)

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ABSTRACT

Expansive soils have the tendency to undergo volume change behaviour and cause huge uplift pressures and upheaval of structures based on it due to presence of moisture. In most of cases, practically it is not possible to avoid expansive soil and replacement of soil by any material or soil, in large area of expansive soil. The black cotton soil is type of expansive soil. For the treatment of black cotton soil, various materials add in black cotton soil. These materials work as admixture in black cotton soil and stabilize the soil. In this research work, black cotton soil (expansive soil) is stabilized by using 20% sugarcane bagasse ash (SCBA) and different percentage of coir fibre aspect ratio (AR) 80 from 0.25% to 1.5% weight of black cotton soil mix specimen of 20% SCBA. The liquid limit, plastic limit, plasticity index, differential free swell index, standard proctor test and California bearing ratio tests were performed in laboratory to study the behaviour of black cotton soil.

Keywords *- **Black Cotton Soil, California Bearing Ratio, 20% Sugarcane Bagasse Ash, Coir Fibre, Standard Proctor Test***

I. INTRODUCTION

Soil was utilized as a building material since ancient time but it is found that it is poor in mechanical properties. It has pull out a challenge for civil engineers to enhance its properties depending upon requirement which varied from place to place. Various scientist and research tried to improve the properties of black cotton soil by using different admixtures and waste materials. **Noorahemd A. H. et. al.** studied the stabilization of black cotton soil using coir + pith and bagasse ash as stabilizer. The CBR test and other test were performed for study the behaviour of black cotton soil. From soaked CBR, it is observed that CBR value is increasing 1.90% to 4.04% and similarly, form unsoaked CBR value, it is observed that CBR value is increasing from 2.38% to 7.91% of soil mixed with varying percentage of coir fibre bagasse ash. **M. Bagra** performed experiment for stabilization of black cotton soil with reinforcement of jute fibre. From test results, it is observed that the fibre is increasing CBR and other properties of black cotton soil. **Amruta P. Kulkarni et. al.** performed experimental study on stabilization of black cotton soil using bagasse ash and

lime. The performed experiment on black cotton soil and they observed that plasticity index is decreasing and CBR value increasing when optimum ratio of bagasse ash to lime was used. Similarly, **Ashish Murari et. al.** studied that sugarcane bagasse ash helps in improving the engineering properties of black cotton soil. From experimental study they concluded that dry density and CBR value are increased with increasing the percentage of SCBA. Hence, this experimental study is done for black cotton soil which is locally available in **Bhopal** region.

II. Experimental Investigations

For determination and study the behaviour of black cotton soil with different percentage of sugarcane bagasse ash following tests were performed.

2.1 Engineering Properties of BCS, BCS + 20%SCBA

The following engineering properties are determined by laboratory experiments as shown in Table 1

Table 1 – Engineering Properties of Black Cotton Soil, BCS + 20% SCBA

Properties	Black Cotton Soil (BCS)	BCS + 20% SCBA
Liquid Limit (%)	73.00	51.50
Plastic Limit (%)	30.00	24.50
Plasticity Index (%)	43.00	27.00
Differential Free Swell (%)	58.00	47.20
MDD (gm/cc)	1.66	1.98
OMC (%)	19.10	16.36
IS Classification	CH	CI

2.2 Standard Proctor Test

This test is performed for determining the maximum dry density and optimum moisture content in soil sample. This test was performed according IS 2720 (Part – 9) – 1971. The test results are shown in Table 2.

Table 2 – Standard Proctor Test for BCS + 20%SCBA with Mix Specimen of Coir Fibre

Specimen Name	MDD (gm/cc)	OMC (%)
BCS	1.66	19.10
BCS + 20% SCBA	1.98	16.36
BCS + 20% SCBA + 0.25% Fibre	1.86	16.76
BCS + 20% SCBA + 0.50% Fibre	1.88	16.65
BCS + 20% SCBA + 0.75% Fibre	1.92	16.49
BCS + 20% SCBA + 1.0% Fibre	1.89	16.73
BCS + 20% SCBA + 1.25% Fibre	1.85	16.82

From Table 2, it has been observed that the black cotton soil (clay) + 20% SCBA mix specimen is having 1.98 gm/cc maximum dry density. With increasing the percentage of fibre in black cotton soil + 20% SCBA, the maximum dry density of mix specimen is increased with increasing the percentage of fibre till 0.75%. After 0.75% fibre, the value of maximum dry density is decreased by increasing the percentage of fibre and it is decreased up to 9.60%. The graphical presentation of percentage variation in MDD for BCS + 20% SCBA mix specimen of fibre is shown in fig. 1.

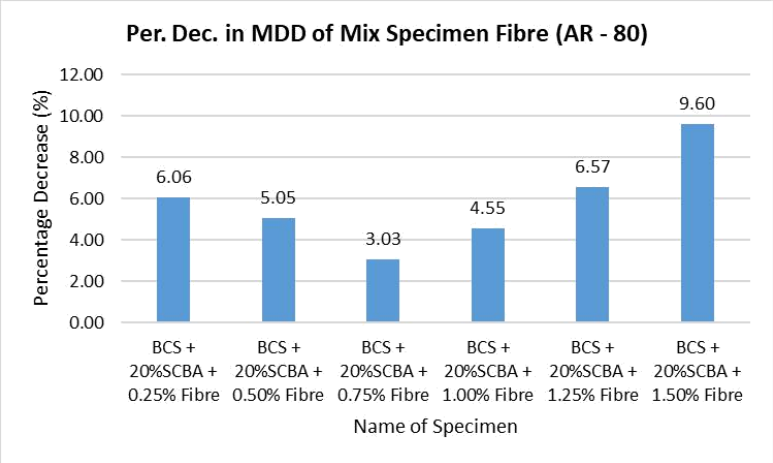

Fig. 1 – Percentage variation in MDD for BCS + 20% SCBA mix specimen of fibre

2.3 California Bearing Ratio Test

The California bearing ratio test (usually abbreviated as CBR test) is an adhoc penetration test developed by the California state highway department of USA for the evolution of subgrade strength of roads and pavements. This test was performed according IS 2702: (Part – 16) – 1979. The test results of unsoaked CBR are shown in Table 3.

Table 3 – CBR Test Results Obtained for BCS and Mix Specimen of SCBA

Specimen Name	CBR Value (%)	% Variation
BCS	1.87	-
BCS + 20% SCBA	3.87	-
BCS + 20% SCBA + 0.25% Fibre	6.59	70.28
BCS + 20% SCBA + 0.50% Fibre	6.65	71.83
BCS + 20% SCBA + 0.75% Fibre	6.72	73.64
BCS + 20% SCBA + 1.0% Fibre	6.59	70.28
BCS + 20% SCBA + 1.25% Fibre	6.35	64.08

From Table 3, it has been observed that the value of CBR for black cotton soil specimen is 1.87%. When 20% SCBA is mixed in black cotton soil, the value of CBR is increasing up to 3.87%. Further when adding fibre in mix specimen of BCS + 20% SCBA, by increasing the percentage of fibre up to 0.75%, the value of CBR increases by 6.72%. Hence, it is concluded that value of CBR increases with increasing percentage of fibre till 0.75% in black cotton soil + 20% SCBA mix specimen. The graphical presentation of percentage variation in CBR value of black cotton soil + 20% SCBA mix specimen of fibre is shown in fig. 2.

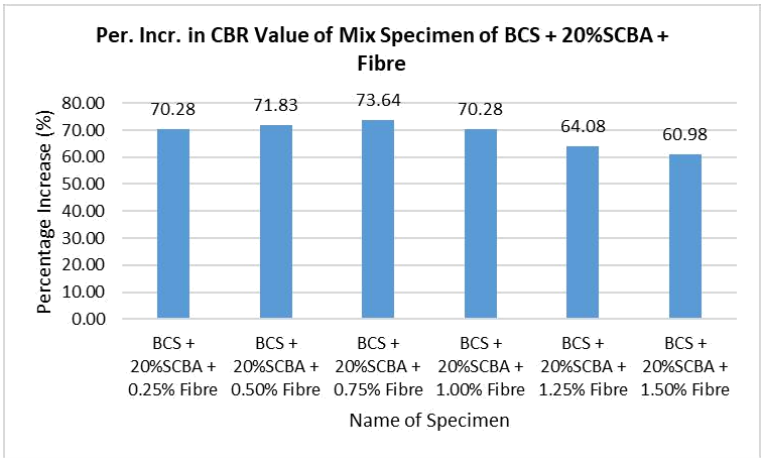

Fig. 2 – Percentage variation in CBR value of BCS + 20% SCBA mix specimen of fibre

III. Discussion on Test results

The black cotton soil changes it is behaviour due to sugarcane bagasse ash. The sugarcane bagasse ash is low plasticity material and black cotton soil inorganic clay of High plasticity. The plasticity of black cotton soil decreases with increasing the percentage of SCBA. The maximum dry density and optimum moisture content is 1.98 gm/cc and 16.36% determined for BCS + 20% SCBA but when more than 0.75% fibre is added in black cotton soil + 20% SCBA, the maximum dry density and optimum moisture content are decreased up to 1.92 gm/cc and 16.49% respectively. It is also observed that when up to 0.75% fibre is mixed in black cotton soil + 20% SCBA mix specimen, the CBR value is increasing.

IV. Conclusions

The black cotton soil is inorganic clay of high plasticity soil. with 20% percentage of SCBA, the black cotton soil changes its behaviour from inorganic clay of high plasticity soil to inorganic clay of medium plasticity (CH to CI) and the plasticity index of black cotton soil is decreased 42.09%. The maximum dry density of black cotton soil + 20%SCBA is 1.98 gm/cc determined but when 0.75% fibre is mixed in black cotton soil + 20% SCBA, the maximum dry density of black cotton soil + 20% SCBA mix specimen is decreasing up to 1.92 gm/cc. From CBR test, it is also observed that the 0.75% fibre mix specimen of black cotton soil + 20% SCBA, increasing CBR value by 73.67%.

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VI. REFERENCES

[1] Mr. Noorahmed A H., Mr. Basavaraj Kundur, Mr. Bhagyashree Chauhan, Mr. Sunil Bavihal, Ms. Sneha Bannur, "Stabilization of Black Cotton Soil Using Coir + Pith and Bagasse ash as Stabilizer", Project Reference No: 39S – BE – 1799.

[2] M. Bagra and H. P. Singh (2013), "Improvement in CBR Value of Soil Reinforced with Jute Fibre", International Journal of Innovative Research in Science, Engineering and Technology, Aug Vol.- 2, pp. 3447-3452.

[3] Dr. B. C. Punamia, Ashok Jain, Arun Jain, Soil Mechanics and Foundations, Laxmi Publications, New Delhi.

[4] Dr. K. R. Arora, Soil Mechanics and Foundation Engineering, Standard Publications, New Delhi.

[5] Indian Standard Code : IS 1498 – 1970, Classification and identification of soils for general engineering purposes (first revision).

[6] Indian Standard Code : IS 2720 (Part 5) – 1985, Determination of liquid limit and plastic limit (second revision).

[7] Indian Standard Code : IS 2720 (Part 7) – 1980, Determination of water content, dry density relation using light compaction (second revision).

[8] Indian Standard Code : IS 2720 (Part – 9) – 1971, Determination of dry density and moisture content relation by weight of soil method.

[9] Indian Standard Code : IS 2720 (Part – 16) – 1979, Methods of test for Soils, Part 16 – Laboratory determination of CBR.

[10] Indian Standard Code : IS 2720 (Part – 40) – 1977, Method for test for Soils, Part 40 – Determination of Free Swell Index of Soils.