Experimental Evaluation of Clayey Soil Stabilized with Bagasse Ash and Randomly Distributed Core Fibres

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Abstract –

Soil is very basic and important element in civil engineering field. Usually, each structure depends on the type and characteristics of foundation which depends on type of soil. Basically, the black cotton soil is rather a difficult one to use in foundation because of its shrinkage and swelling properties. There are many methods to make black cotton soil stable for various constructions. Black cotton soil is comfortable for road work, compared to other types of soil. Today, the amount of wastes has increased year by year and the disposal becomes a world faces a serious problem in disposing the large quantity of agricultural waste like Sugarcane Bagasse Ash, rice husk ash and coconut shell etc. This paper presents the effects of Sugarcane Bagasse Ash and Core Fibre on, liquid limit, plastic limit, compaction characteristics and California Bearing Ratio on the black cotton soil.
In this research, Coir Fibre and Bagasse Ash were employed in stabilizing CF, BA was fixed at 20% in CF respectively using index properties tests and then Coir Fibre was varied (2, 2.5, 3.0 and 3.5%). Design and construction of civil engineering structures on and with expansive soils is a challenging task for engineers. The present work is aimed to assess the improvement in the strength and stability characteristics in soft Subgrade soil by using the Sugarcane Bagasse Ash for the stabilization and then Core fibre as reinforcing material. Randomly distributed fibre reinforced soil (RDFRS) technique is used to prepare the reinforced soil samples.

Keywords: Black cotton soil, coir fibre, Bagasse ash, Sieve Analysis, Specific gravity, Compaction test, Liquid limit device, CBR test, UCS test.

I. INTRODUCTION

Soil stabilization is the process adopted for improvement of the engineering properties of the soil and then making it in more stable. It is required when the soil available at site location during the site location during the construction is not suitable for the intended purpose.

For growth of the country along with the technological advancements, development in infrastructure field is also required and with the rapid rate of urban growth in our country it is becoming difficult to find the proper quality of soil for engineering applications. Hence, it has become a challenge for a geotechnical engineer to come up with some new ideas which would allow us to work on the even poor quality of soil without any risk of Failure of the structure. With a diversification of many types of soil in our country a major category of soil which is of many problems to engineers is expansive soil which creates a lot of problems to structure formed on them. This study focuses on the expansive soils and how various geotechnical parameters can be enhanced by the use of coir fiber and Bagasse Ash. The major goal of soil stabilization is to enhance the strength properties and reduce the settlement. Soil stabilization is an efficient and unfailing technique for enhancing soil strength and firmness. The material which is use to mix with soil for the soil stabilization is known as the soil stabilizer. It is illustrious that the mechanism of soil stabilization by coir fiber and Bagasse Ash is a worthy method of ground improvement, which leads to increase in UCS, CBR value of clay soil, hence it increases the stability of structures, i.e. sub grade and foundation

II. MATERIALS

A. Soil:

Sample of soil used in the mix was collected from the fields of RS PURA (JAMMU DISTRICT), J&K. It will be combined with soil and fibre in different proportions for further analysis.

The soil collected from the site was pulverized to break the lumps with wooden hammer and then dried in air under covered area. Then it was sieved through 2.35 mm IS sieve and mixed thoroughly. For each test required quantity of soil was taken from polythene bags and dried in an oven at 105˚ C ± 5˚C for 24 hours. The soil was allowed to cool at room temperature.

S No.	*Soil properties*	*Values*
1	*Specific Gravity*	*2.86%*
2	*Liquid Limit*	*39%*
3	*Plastic Limit*	*23.5%*
4	*Plastic Index*	*15.5%*
5	*Optimum Moisture*	*13.9%*
6	*Maximum dry density (kn/m³)*	*18.61*
7	*CBR*	*3.3%*
8	*UCS kN/M2*	*86.57*
9	*Indian soil classification*	*CI*

Table1 Basic properties of the natural untreated soil used in experiment work are presented.

B.Sugar Cane Bagasse Ash:

Sugar cane bagasse ash (SCBA) is an abundant byproduct of the sugar and ethanol industry. SCBA is generally used as a fertilizer or is disposed of in landfills, which has led to intensified environmental concerns. In recent years, SCBA research has mainly been focused on utilization in construction materials due to the abundance and pozzolanic characteristics of SCBA. In this paper, a comprehensive review of the state-of-the-art morphology, physical properties, chemical composition, and mineralogical composition of SCBA is presented. Studies indicate that SCBA is a potentially promising construction material.

C.Coir Fibre

Coir fibre or Coconut coir is a natural Fibre extracted from the skin of coconut. It is the fibrous material found between the hard, internal shell and outer coat of a coconut. The main advantage of using coconut coir in improving the strength of soil sub grade is they are cheap, locally available and eco-friendly. In this study the coconut coir is extracted mainly from green nut.

III. SOIL PREPARE & EXPERIMENT

The clayey soil will be mixing with four different contents of Coir Fibres and Bagasse Ash in order to prepare various samples.

In order to investigate the various geotechnical properties of soil tests were conducting in soil and soil mixed with the various percentages of coir fibre, the various tests conducting are listed as:

- Standard proctor's test
- Unconfined compression test
- California bearing ratio test
- Liquid limit
- Plastic limit
- Specific Gravity test

RESULT AND DISCUSSION

A.Liquid Limit:

The value of liquid limit of soil was observed as 39%

B. Plastic Limit:

Plastic limit of the soil sample was 23.5%

C. Specific Gravity Test:

The Specific Gravity of Soil can be determined in Laboratory using Pycnometer. Specific Gravity is the ratio of the mass/weight in air of a given volume of dry soil solids to the mass/weight of equal volume of water.

G = W2-W1/ (W2-W1) -(W3-W4)

W1 = Empty weight of Bottle

W2 = Empty weight of Bottle + Soil

W3 = Empty weight of Bottle + Soil + Water W4 = Empty weight of Bottle + Water

V. RESULTS OF SPECIFIC GRAVITY TEST

W1=weight of empty pycnometer bottle	*187.4*
W2=weight of pycnometer bottle half filled with soil sample	*212.36*
W3 =weight of pycnometer bottle half filled with sample and rest with water	*303.61*
W4=weight of pycnometer bottle filled with water	*287.37*

Table-2 Result of Specific Gravity Test

A. Standard Proctor Test

SOIL: BAGASSE ASH: COIR FIBRE MIX

SOIL:BA:CF	MDD (kN/m^3)	OMC (%)
78:20:2	17.27	14.71
77.5:20:2.5	16.87	14.98
77:20:3	16.59	15.32
76.5:20:3.5	16.33	15.51

Table 3: Results of MDD and OMC of SOIL: BAGASSE ASH: COIR FIBRE Mix

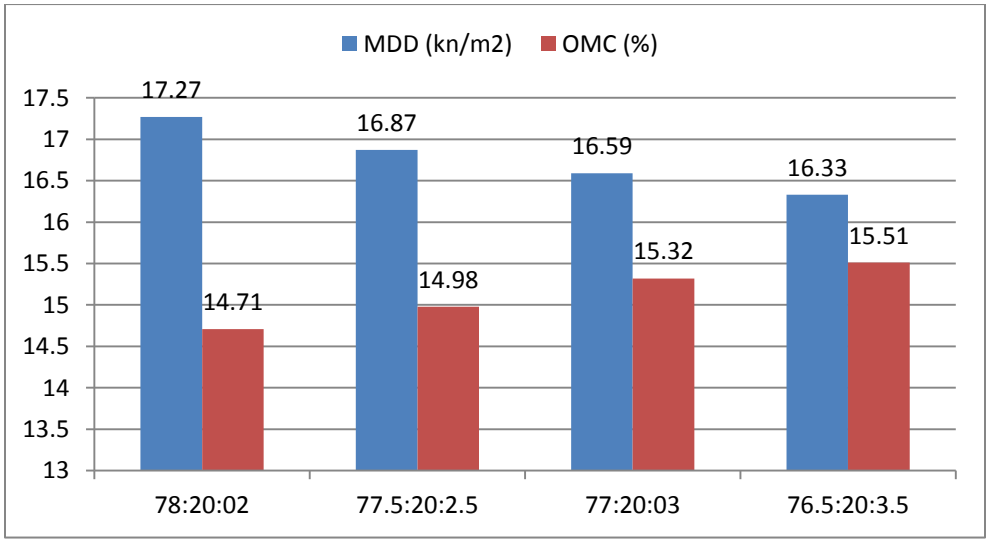

Fig: -1 Graph b/w MDD and OMC of Soil, Coir Fibre & Bagasse Ash with different proportions

B. California Bearing Ratio Test

SOIL: COIR FIBRE: BAGASSE ASH MIX

SOIL: COIR FIBRE: BA	CBR (%)
78: 2: 20	5.65
77.5: 2.5: 20	5.81
77:3: 20	6.15
76.5: 3.5: 20	5.96

Table 4: CBR RESULTS OF SOIL: COIR FIBRE: BAGASSE ASH MIX

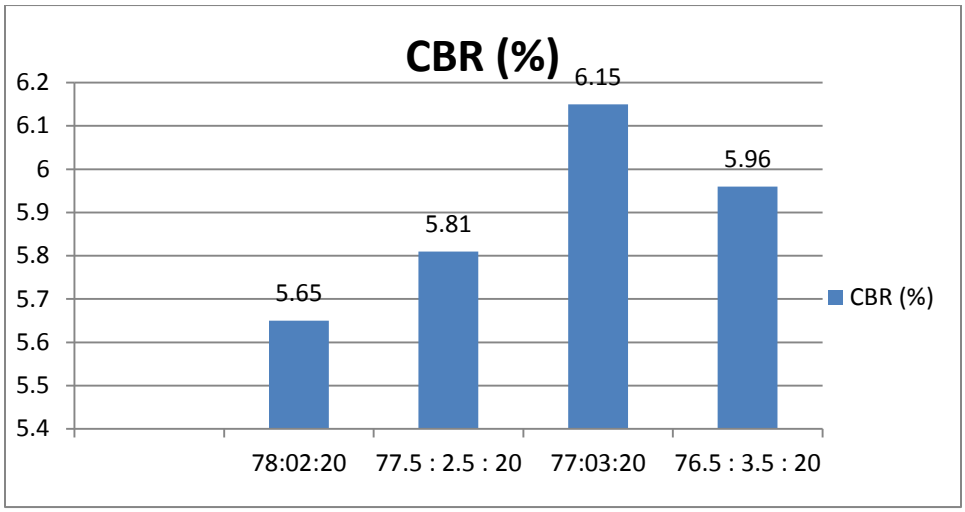

Fig: -2 Graph of CBR Test of Soil, Coir Fibre & Bagasse Ash with different proportions

c. UCS RESULTS

SOIL: COIR FIBRE: BAGASSE ASH MIX

SOIL: COIR FIBRE : BAGASSE ASH	CURING PERIOD	UCS (kN/m^2)
78: 2: 20	7	195.57
77.5: 2.5: 20	7	230.18
77: 3: 20	7	256.09
76.5: 3.5: 20	7	238.01

Table 5: UCS RESULTS OF SOIL: COIR FIBRE: BAGASSE ASH MIX

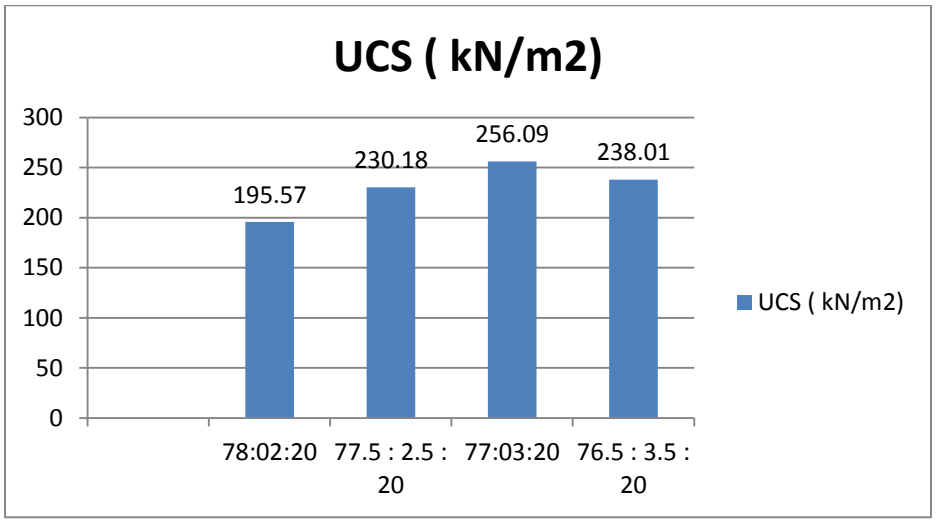

Fig: -3 Graph of UCS Test of Soil, Coir Fibre & Bagasse Ash with different proportions

IV. CONCLUSIONS

1) There is also increase in OMC from 14.35 to 15.95% and decrease in MDD from 17.80 kN/m^3 to 16.10 kN/m^3 when the percentages of Bagasse Ash are used as 10, 15, 20 and 25% respectively.

2) With Bagasse Ash kept constant at 20% MDD decreases with an addition of Coir Fibre content in soil and Bagasse Ash a mix. The reason behind of such behavior is Coir Fibre is lighter in weight and it has high water absorption properties and hence OMC increases with increase of Coir Fibre content.

3) There is an also little increase of CBR value was observed when Bagasse Ash is added to soil.
After increase in the amount of Bagasse Ash beyond 20% the CBR value starts decreasing.

4) The optimum value of Bagasse Ash and Coir Fibre for maximum percentage was found at 20% of Bagasse Ash and 3.0% of Coir Fibre which is 6.15% thus the Value of CBR is increased from 3.31% to 6.15% by using Soil is mixed with Bagasse Ash and Coir Fibre.

5) The optimum value of Bagasse Ash and Coir Fibre for maximum percentage was found at 20% of Bagasse Ash and 3.0% of Coir Fibre which is 256.09% thus the Value of UCS is increased from 86.57% to 256.09% by using Soil is mixed with Bagasse Ash and Coir Fibre. Which is nearly three times

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