

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 6, June 2019

Experimental Investigation on Expansive Soil Stabilized Using Bagasse Ash

Arpitha I.V.Gowda¹, Guruprasada M.D.¹, Manoj S.¹, Manu S.¹, Nagaraj K.¹, Goutham D.R.²

Under Graduate Students, Adichunchanagiri Institute of Technology, Chikkamagaluru, Karnataka, India.¹

Assistant Professor, Department of Civil Engineering, Adichunchanagiri Institute of Technology, Chikkamagaluru,
Karnataka, India.²

ABSTRACT: Soil is the foundation material which supports loads from the overlying structure. Stabilization of soils is an effective method for improvement of soil properties and the structural system performance, especially in expansive soils like black cotton soil where the degree of being susceptible to problems is high due to its nature of undergoing volume changes because of variations in moisture content. Generally expansive soils have poor bearing capacity and shear strength and therefore special attention is required for the stabilization of this soil to make it suitable for all construction purposes. This experimental study deals with the stabilization of black cotton soil using bagasse ash in varying percentages to the dry weight of the soil. Different dosages of blast furnace slag are 3%, 6%, 9% and 12% were used to stabilize the expansive soil. The performance of bagasse ash stabilized soil was evaluated using physical and strength performance tests namely; specific gravity, liquid limit, plastic limit, maximum dry density and unconfined compressive strength test (UCS). These tests were conducted in order to evaluate the improvement in strength characteristics of the black cotton soil and the change in properties such as liquid limit and plastic limit of the stabilized soil. Comparisons are drawn for change in maximum dry density (MDD), optimum moisture content (OMC) and unconfined compressive strength test values of both stabilized soil and untreated soil.

KEYWORDS: Black Cotton Soil, Bagasse Ash, MDD, OMC and Unconfined Compressive Strength.

I. INTRODUCTION

Black Cotton soils are highly clayey soils, greyish to blackish in colour. Black cotton soils have been formed from blast or trap. Black cotton soils contain the clay mineral montmorillonite, which is responsible for the excessive swelling and shrinkage characteristics of soil. Black cotton soil undergoes change in volume when it comes in contact with water. It expands during rainy season due to intake of water and shrinks during summer season. Sugarcane bagasse ash is a by-product of the sugar factories found after burning sugarcane bagasse which itself is found after the extraction of all economical sugar from sugarcane. The disposal of this material is already causing environmental problems around the sugar factories. The present work is undertaken to identify the potentiality of the bagasse ash as a stabilization material for black cotton soil. The stabilization is done using locally available bagasse ash. [1]Used bagasse ash admixture to improve the strength properties of black cotton soil, the soil was mixed with optimum dosage of bagasse ash for different proportions (3%, 6%, 9% and 12%) by dry weight of soil. Compaction properties and unconfined compressive strength (UCS) values were determined for soil mixtures compacted using British Standard Light (BSL). Test results indicated that the inclusion of bagasse ash in stabilized specimen resulted in increased maximum dry density and reduced optimum moisture content as well as increased UCS and therefore enhances load carrying capacity of the sub grade. [3] The percentage of bagasse ash by dry weight of soil is taken as 3%, 6%, 9% and 12% and corresponding to each bagasse ash content un-soaked and soaked UCS tests are conducted in the laboratory.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 6, June 2019

A. Objectives

The following are the objectives of the present project work.

1. To find the properties of black cotton soil for treated condition and untreated condition.
2. To find the shear strength parameters of black cotton soil using UCS test for treated and untreated soil.

II. METHODOLOGY

1. To conduct basic experiments to identify soil properties.
2. To find shear strength of virgin soil using UCS test.
3. Addition of bagasse ash to soil in varying percentage by weight of soil (3%, 6%, 9% & 12%).
4. To find shear strength of stabilized soil using UCS test.
5. To find change in properties of stabilized soil by conducting basic experiments.
6. Comparing the test results of stabilized soil with untreated black cotton soil.

B. Materials

1. Black Cotton Soil (B.C.)

The soil was collected from Beekanahalli village, Chikkamagaluru District (Karnataka) at a depth of 1m below from the ground level. The test results are given in the table-1.

Table 1: Physical Properties of Black cotton soil sample

Sl.No.	Parameters	Properties of BC
1.	Natural moisture content (%)	13
2.	Specific gravity	2.58
3.	Sieve analysis results Percentage gravel Percentage sand Percentage silt and clay	14.2 83.9 1.9
4.	Liquid limit (%)	48.5
5.	Plastic limit (%)	38.22
6.	Shrinkage limit (%)	12.39
7.	Soil classification	CH
8.	Max dry density (g/cc)	1.6
9.	Optimum moisture content (%)	27.74
10.	UCS (N/mm ²)	0.318

2. Bagasse ash

The bagasse ash was collected from Mugulavalli village, Chikkamagaluru District (Karnataka); the table-2 specifies some of the physical and chemical properties of the bagasse ash.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 6, June 2019

Table 2: Physical and Chemical Properties of bagasse ash

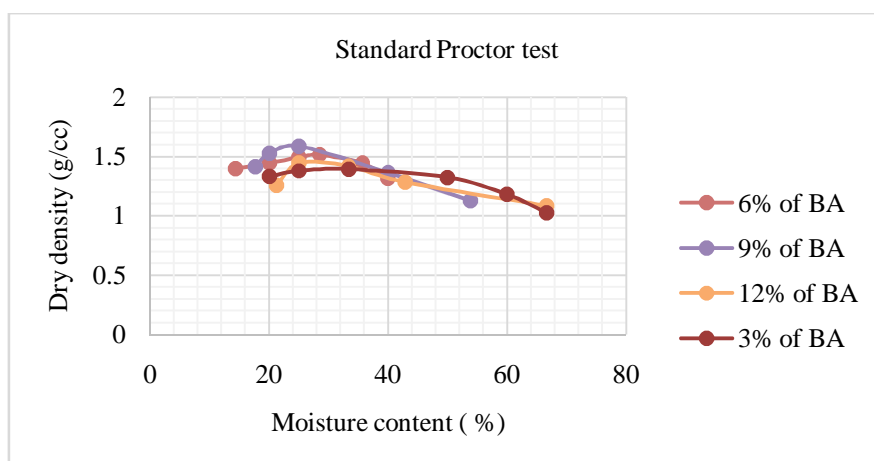
Physical properties		Chemical properties	
Property	Value	Components	Percentage by weight
Specific gravity	3.38	Ignition loss	2.11
Liquid limit (%)	41	SiO ₂	65.27
Plastic limit (%)	None	Al ₂ O ₃	3.11
Optimum moisture content (%)	48	Fe ₂ O ₃	2.10
Maximum dry density (g/cc)	1.27	CaO	11.16
Lime reactivity (kg/cc)	32	MgO	1.27

III. RESULTS AND DISCUSSIONS

The graph-1 shows the variation of MDD and OMC values against various dosage of bagasse ash added to black cotton soil. Numerical values of the same are also quoted in the table-3. Addition of bagasse ash to soil up to 9 % gives increase in the value of dry density of the soil. Soil with higher dry density tend to sustain better during the application of loading compared with the ones of low dry density soil.

Table 3: Comparison of OMC and MDD for 3%, 6%, 9% and 12% of bagasse ash to the soil

Materials	Dry Density (g/cc)	OMC (%)
BC Soil	1.44	33.33
BC Soil + 3% Bagasse ash	1.39	33.33
BC Soil + 6% Bagasse ash	1.51	28.5
BC Soil + 9% Bagasse ash	1.58	25
BC Soil + 12% Bagasse ash	1.44	25



Graph 1: Variation of OMC and MDD for 3%, 6%, 9% and 12% of bagasse ash to the soil

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

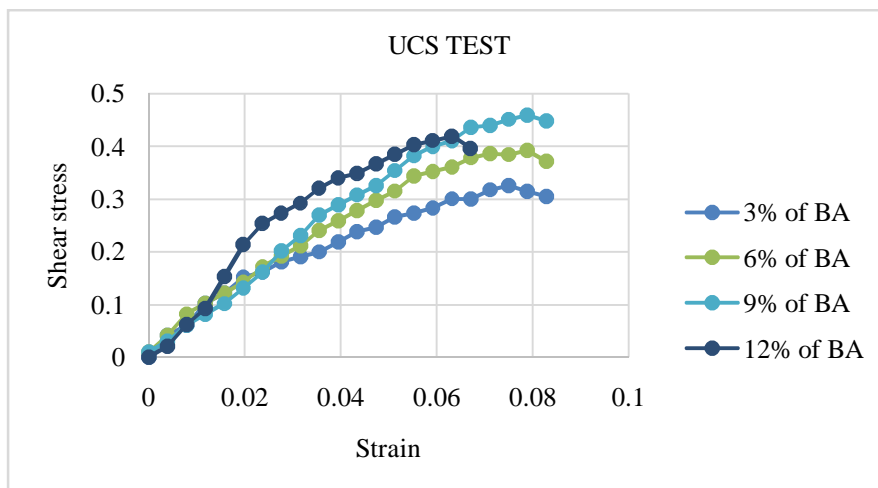
Visit: www.ijirset.com

Vol. 8, Issue 6, June 2019

The graph-2 shows the variation of shear stress to strain values against various dosage of bagasse ash added to black cotton soil. Numerical values of the same are also quoted in the table-4. Addition of bagasse ash results in increase in shear stress values there by reducing the strain parameter of the soil.

Table 4: UCS Values for untreated soil and treated soil with varying percentages of bagasse ash

Materials	Shear Stress (N/mm ²)
BC Soil	0.317
BC Soil + 3% Bagasse ash	0.325
BC Soil + 6% Bagasse ash	0.391
BC Soil + 9% Bagasse ash	0.456
BC Soil + 12% Bagasse ash	0.406



Graph 2: Variation of UCS values for untreated soil and treated soil with different percentages of bagasse ash

The values tabulated in the table-5 are for the virgin black cotton soil and black cotton soil with 9% addition of bagasse ash. Since the UCS value for 9% addition of bagasse ash to BC soil gives higher values among all the mix proportions, the change in behavior for liquid limit and plastic limit values are studied and tabulated.

Table 5: Liquid and Plastic limit values for BC Soil and with 9% of bagasse ash to BC soil

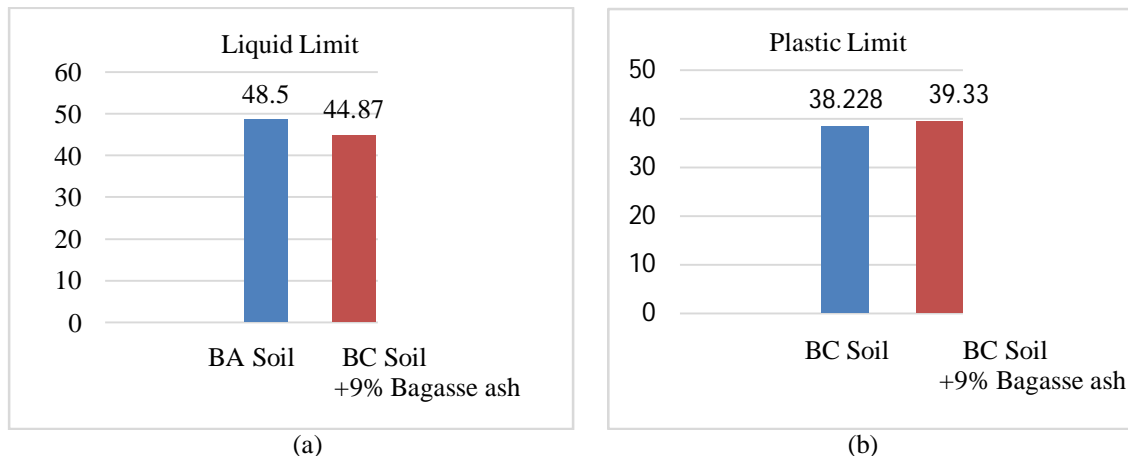
Liquid Limit		Plastic Limit	
Materials	Liquid limit (%)	Materials	Plastic limit (%)
BC Soil	48.5	BC Soil	38.228
BC Soil + 9% of bagasse ash	44.87	BC Soil + 9% of bagasse ash	39.33

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 6, June 2019



Graph 3: (a) Liquid limit comparison (b) Plastic limit comparison

IV. CONCLUSION

1. It is observed that there is an increase in plastic limit value for treated condition from 38.228% to 39.33%.
2. It is observed that, the addition of 9% of bagasse ash for the black cotton soil leads to increase in MDD values from 1.44 to 1.58 g/cc and OMC decreases from 33.33% to 25%. Further addition of bagasse ash decreases dry density and increases OMC. Hence optimum percentage of bagasse ash is considered to be 9%.
3. It is seen that, among all the percentage addition of bagasse Ash to black cotton soil from 3% to 12% at the interval of 3%, the addition of bagasse ash at 9% gives higher shearing strength capacity by UCS test results. Hence for this proportion, the MDD and OMC, Liquid Limit and Plastic Limit tests were conducted and they are compared with untreated soil condition.
4. The liquid limit for black cotton soil is 48.5% and for black cotton soil with 9% addition of bagasse ash is 44.87%. There is considerable decrease in the water content due to addition of bagasse ash. The impression of decrease in the water content is also reflected in MDD and OMC test, where OMC value of 25% corresponds to the same percentage addition of bagasse ash.
5. UCS values increased from 0.317 N/mm² to 0.456 N/mm² at 9% of bagasse ash content. Further addition of bagasse ash reduces the UCS value.

REFERENCES

- [1]. Prakash and Nagakumar, "Studies on soil stabilization by using bagasse ash". International Journal of Scientific Research Engineering & Technology, 30-31 August 2014, ISSN 2278-0882.
- [2]. Kiran and Kiran, "Analysis of strength characteristics of black cotton soil using bagasse ash and additives as stabilizer", International Journal of Engineering Research & Technology, Vol-2, ISSN 2278-0181, Issue 7, July-2013.
- [3]. Gandhi, "Expansive soil stabilization using bagasse ash", International Journal of Engineering Research & Technology, , Vol-1 Issue 5, ISSN: 2278-0181, July-2012.
- [4]. Hayder Hasan et al, "Remediation of expansive soils using agricultural waste bagasse ash". The 3rd International Conference on Transportation Geotechnics, 2016, Vol 143.
- [5]. Shukla Devdatt et.al (2015), "Soil stabilization using coir fibre", International Journal of Engineering Research, Volume 3, Issue 11, ISSN: 2321-9653.
- [6]. Priyank Goyal et.al (2015), "Improvement in properties of black cotton soil with an addition of natural fibre (coir) derived from coconut covering", Int. Journal of Engineering Research and Applications www.ijera.com ISSN: 2248-9622, Vol. 5, Issue 3, (Part -5) March 2015, pp: 36-37.
- [7]. Goutham D.R. et.al (2019), "Experimental Investigation on Expansive Soil Stabilized Using Coir Fibre", International Journal of Civil and Structural Engineering Research, Vol. 7, Issue 1, pp: (65-70), Month: April 2019 -September 2019



ISSN(Online): 2319-8753
ISSN (Print): 2347-6710

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 6, June 2019

- [8]. Parag M. Chaple et.al (2013), "Performance of coir fiber reinforced clayey soil", The International Journal Of Engineering and Science (IJES) ,Volume 2, Issue 4 ,Pages 54-64, ISSN (e): 2319 –1813, ISSN p: 2319 –1805.
- [9]. IS: 2720 (Part 4)-1985 "Grain Size Analysis" Bureau of Indian Standards.
- [10]. IS: 2720 (Part 5)-1985 "Determination of Liquid and Plastic Limit", Bureau of Indian Standards.
- [11]. IS: 2720 (PART 8)-1983 "Determination of Water Content - Dry Density Relation Using Heavy Compaction", Bureau of Indian Standards.
- [12]. IS: 9143-1979 "Determination of Unconfined Compressive Strength", Bureau of Indian Standards.