

# Stabilization of black cotton soil by using Sisal fiber

Sandyarani<sup>1</sup>, Dr.Vageesha S Mathada<sup>2</sup>, Sharanakumar<sup>3</sup>

<sup>1</sup>M.Tech student, Department of Geotechnical Engineering, BKIT, Bhalki, Dist. Bidar

<sup>2</sup> Associate Professor, Department of Geotechnical Engineering, BKIT, Bhalki, Dist. Bidar

<sup>3</sup> Assistant Professor, Department of Geotechnical Engineering, BKIT, Bhalki, Dist. Bidar, Karnataka, India

\*\*\*

**Abstract** – Black cotton soil was collected from Hulsoor, Dist. Bidar, Karnataka. Here in my research work used two materials they are black cotton soil and sisal fiber.

The sisal fiber was collected from Tokyo Engineering Corporation Private Limited, Coimbatore (Tamilnadu). Soil stabilization is done with the addition of sisal fiber with varying percentages of sisal fiber are 0.2%, 0.5%, 0.9% and 1.2% with varying lengths of sisal fiber are 3cm, 3.2cm and 3.4cm length at the interval of 0.2cm. For knowing the properties of soil laboratory tests are to be done. They are Atterberg's limits, Light compaction test, unconfined compressive strength test, Specific gravity test, California bearing ratio test, Moisture content test and Sieve analysis test. The addition of sisal fiber, the optimum moisture content decreases and maximum dry density is increased at 0.5%. Unconfined compressive strength and California bearing ratio (Unsoaked) are increased at 0.5% sisal fiber.

**Key Words:** Black cotton soil, Sisal fiber, OMC, MDD, UCS, Unsoaked CBR.

## 1. INTRODUCTION

Black cotton soil is available everywhere in India. These soils are looking dark in color. These soils are sticky and weak soil. For coming out from this problematic situation have chosen the sisal fiber. The sisal fiber gives good tensile strength and it is reusable material then easy to carry because it is light weight material. Sisal fiber is available in three types. Type1 lower type is used in paper industry, Type2 is medium type is used in cordage industry and Type3 is higher type is used in carpet industry. Brazil is producing high amount of sisal fiber in the world. Sisal fiber comes under natural fibers as geotextiles. Few factors are there for using sisal fiber. It is used for erosion control, reinforcement, filtration, agricultural use and reinforcement use. Many researchers done work on the stabilizing locally available materials. Black cotton soil is mixed with sisal fiber with varying percentages and varying lengths of sisal fiber then various laboratory tests have to be conducted.

### 1.1 SCOPE OF WORK

- \* To know the physical properties of the black cotton soil.
- \* To make stabilization process easy and economical by using naturally available materials.

\* To study the behavior of strength gain in sisal fiber stabilization.

\* Evaluation of index properties of black cotton soil, when stabilized with sisal fiber by varying percentages of sisal fiber from 0.2, 0.5, 0.9 and 1.2% with varying lengths from 3 to 3.4cm at the interval of 0.2cm.

## 2. MATERIALS AND METHODS

### 2.1 Materials

#### 2.1.1 Black cotton soil: -

Soil was collected from Hulsoor, Dist. Bidar (KA), at a depth of 1.0m from the ground level.

#### 2.1.2 Sisal fiber: -

Sisal fiber was collected from Tokyo Engineering Corporation Pvt. Ltd, Coimbatore. The fiber color is creamy white and average diameter of fiber is 0.2mm and average length of sisal fiber is 1000mm or 100cm.

### 2.2 Methods

#### 2.2.1 Sample Preparation:-

Soil sample were prepared as 0.2%SF+B.C. Soil, 0.5%SF+B.C. Soil, 0.9%SF+B.C. Soil and 1.2%SF+B.C. Soil (3cm length of sisal fiber) similarly, for 3.2cm and 3.4cm lengths of sisal fiber are also samples are to be prepared. After taking proportions, treated UCS specimens were prepared for each percentages and kept in desiccators for the curing periods of 1, 3 and 7 days respectively.

#### 2.2.2 Experimental work: -

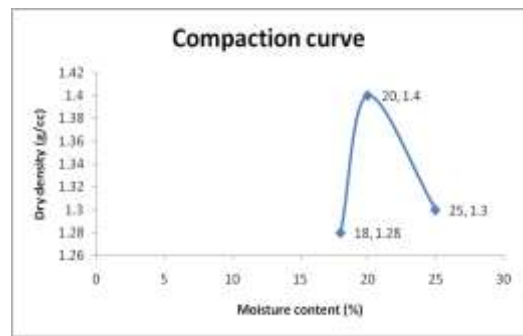
Tests were carried out to know the strength of the soil, specific gravity test, moisture content test, atterberg's limits, wet sieve analysis, free swell test, light compaction test, unconfined compressive test, California bearing ratio test.

## 2. RESULT AND DISCUSSIONS

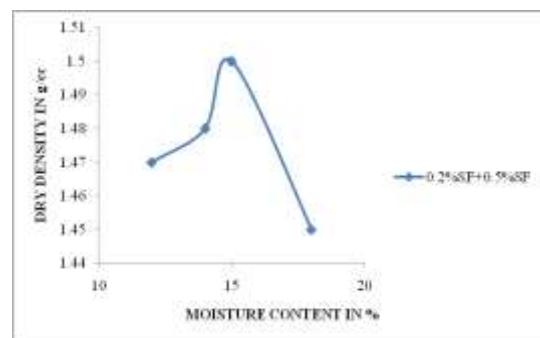
The following tests are to be done as shown in below. Table-1.

**Table -1: Physical properties of Black cotton soil sample**

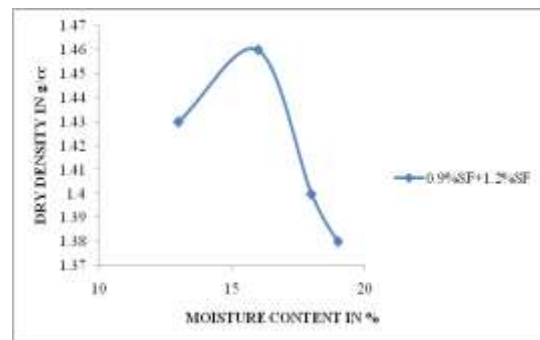
S.No.	Properties	B.C.Soil
1	Moisture content (%)	22.33
2	Specific gravity	2.68
3	Wet sieve analysis:- %gravel %sand %silt and %clay	0 28 38
4	Free swell index (%)	45
5	Liquid limit (%)	66
6	Plastic limit (%)	27.20
7	Plasticity index (%)	38.80
7	Classification	CH
8	Maximum dry density(g/cc)	1.40
9	Optimum moisture content (%)	20
10	Unsoaked CBR (%)	2.77
11	UCS(Kg/sq.cm)	0.55
12	Color	Dark color



**Fig -1:** Graphical representation of Compaction curve of Black cotton soil



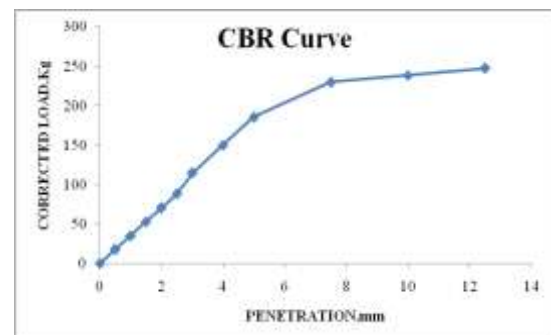
**Fig -2:** Graphical representation of Compaction curve of 0.2% and 0.5% sisal fiber



**Fig -3:** Graphical representation of Compaction curve of 0.9% and 1.2% sisal fiber

**Table -2: Combination results of Black cotton soil with 3cm length of sisal fiber**

Description	B.C.Soil+3Cm length of sisal fiber			
	0.2%S F	0.5%S F	0.9%S F	1.2%S F
OMC (%)	14	15	16	13
MDD(g/cc)	1.48	1.5	1.46	1.43
Unsoaked CBR (%)	5.68	6.94	6.42	6.28
UCS(Kg/sq.cm) 1 day curing	0.745	0.77	0.755	0.73
UCS(Kg/sq.cm) 3 days curing	1.2	1.245	1.225	1.215
UCS(Kg/sq.cm) 7 days curing	1.325	1.365	1.345	1.32



**Fig -4:** Graphical representation of CBR Curve of B.C. Soil

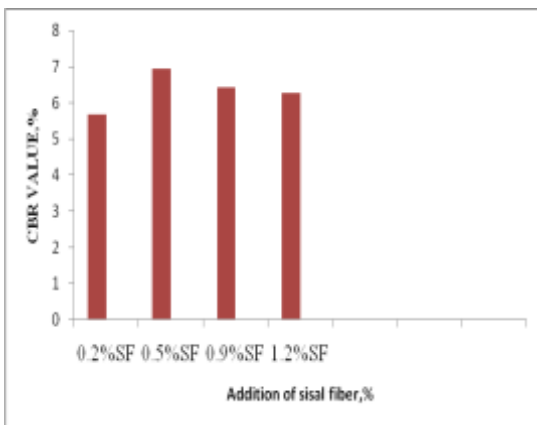


Fig -5: Graphical representation of CBR readings of 0.2%SF, 0.5%SF, 0.9%SF and 1.2%SF.

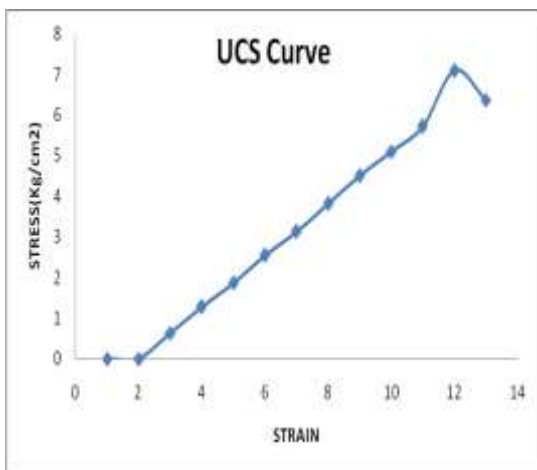


Fig -6: Graphical representation of UCS curve of Black cotton soil

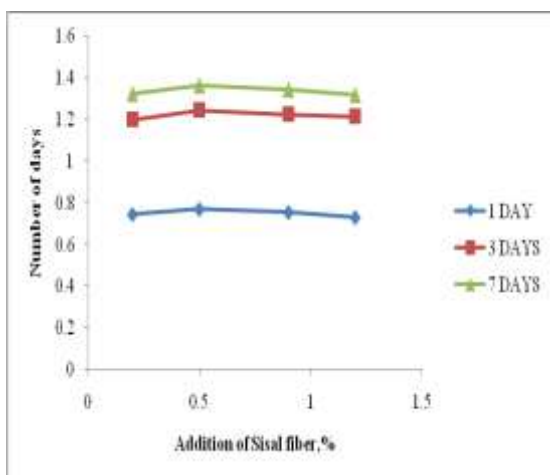


Fig -7: Graphical representation of UCS readings of 0.2%SF, 0.5%SF, 0.9%SF and 1.2%SF With 3cm length of sisal fiber at curing period of 1, 3 and 7 days.

Table -4: Combination results of Black cotton soil with 3.2cm length of sisal fiber

Description	B.C.Soil+3.2Cm length of sisal fiber			
	0.2%SF	0.5%SF	0.9%SF	1.2%SF
OMC (%)	13	15	16	17
MDD(g/cc)	1.44	1.47	1.455	1.44
Unsoaked CBR, %	6.25	9.42	8.08	7.07
UCS(Kg/sq.cm) 1 day curing	1.4	1.46	1.435	1.415
UCS(Kg/sq.cm) 3 days curing	1.465	1.535	1.52	1.505
UCS(Kg/sq.cm) 7 days curing	1.57	1.625	1.61	1.585

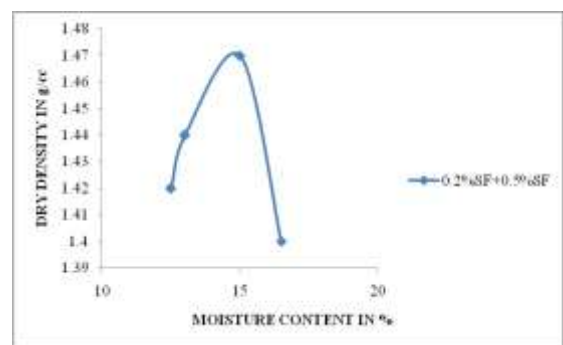


Fig -8: Graphical representation of Compaction curve of 0.2 and 0.5% sisal fiber

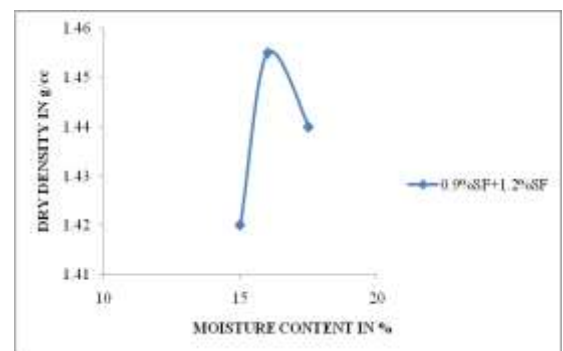


Fig -9: Graphical representation of Compaction curve of 0.9 and 1.2% sisal fiber

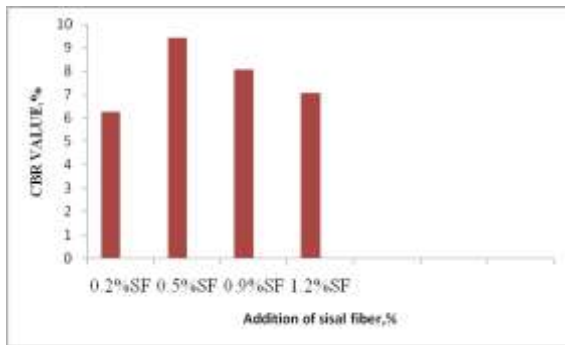


Fig -10: Graphical representation of CBR Readings of 0.2%, 0.5%, 0.9% and 1.2% sisal fiber

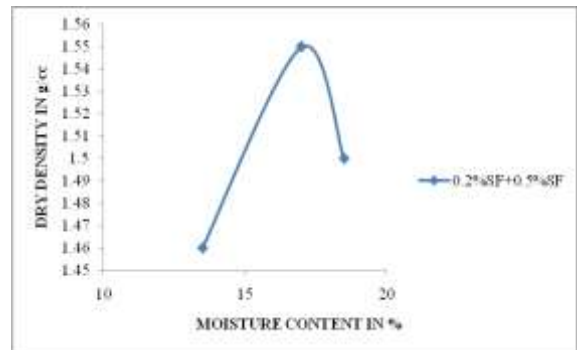


Fig -12: Graphical representation of Compaction curve of 0.2% and 0.5% sisal fiber

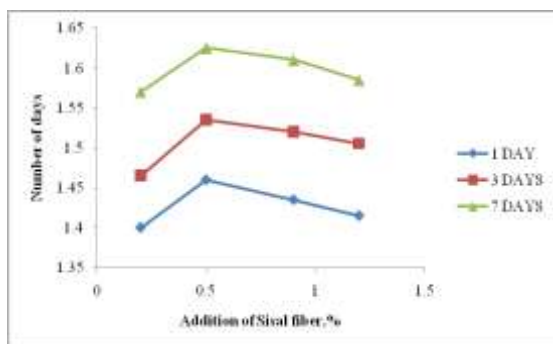


Fig -11: Graphical representation of UCS Readings of 0.2%, 0.5%, 0.9% and 1.2% sisal fiber With 3.2cm length of sisal fiber at curing period of 1, 3 and 7 days.

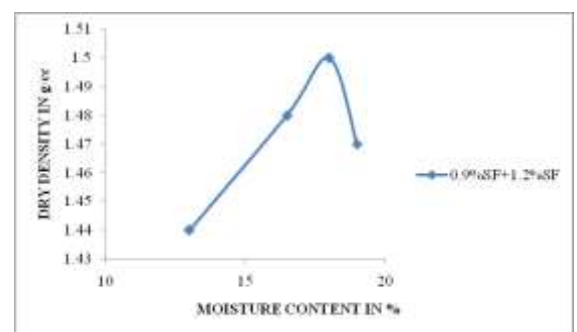


Fig -13: Graphical representation of Compaction curve of 0.9% and 1.2% sisal fiber

Table -5: Combination results of Black cotton soil with 3.4cm length of sisal fiber

Description	B.C.Soil+3.4Cm length of sisal fiber			
	0.2%S F	0.5%S F	0.9%S F	1.2%S F
OMC (%)	13.5	17	18	16.5
MDD(g/cc)	1.46	1.55	1.5	1.48
Unsoaked CBR, %	7.64	10.10	9.75	8.83
UCS(Kg/sq.cm) 1 day curing	1.66	1.695	1.675	1.6
UCS(Kg/sq.cm) 3 days curing	1.805	1.875	1.86	1.845
UCS(Kg/sq.cm) 7 days curing	1.965	2.03	2.02	2

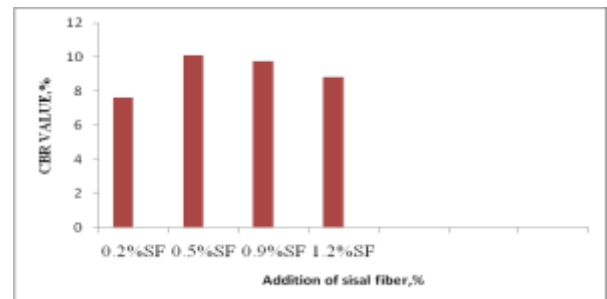


Fig -14: Graphical representation of CBR Readings of 0.2%, 0.5%, 0.9% and 1.2% sisal fiber

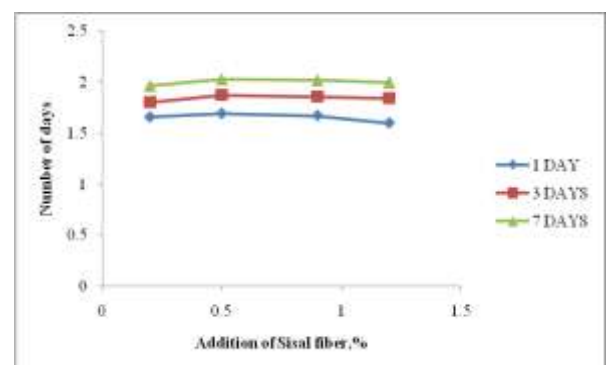


Fig -15: Graphical representation of UCS Readings of 0.2%, 0.5%, 0.9% and 1.2% sisal fiber With 3.4cm length of sisal fiber at curing period of 1, 3 and 7 days.

### 3. CONCLUSIONS

\* The Optimum moisture content is decreased at the percent of 0.5% of sisal fiber.

\* The Maximum dry density is increased at the percent of 0.5% of sisal fiber.

\* The Unconfined compressive strength of soil with sisal fiber is increases at the percent of 0.5% sisal fiber.

\* The California bearing ratio of soil with sisal fiber is increases at the percent of 0.5% sisal fiber.

\* The specific gravity of soil with sisal fiber is reduced as compared to black cotton soil.

\* The liquid limit of soil with sisal fiber is reduced as compared to black cotton soil.

### REFERENCES

- [1] Santhi Krishna k et.al (2009) – “Behavior of black cotton soil reinforced with sisal fiber”, 10th National Conference on Technological Trends (NCTT09)6-7Nov 2009.
- [2] Amrutha Mathew et.al – “Effect on strength characteristics of expansive soil using sisal fiber and waste materials”, - International Journal of Science and Research (IJSR) ISSN: 2319-7064(2015).
- [3] Shrithi S Badami – “ Stabilization of Black cotton soil by random inclusion of sisal fiber”,- International Journal of Innovative Research in Science,Engineering and Technology.Volume 6, Issue 2,Feb 2017.
- [4] Mr.Kilabanur promod et.al(2017) – “A Comparative study on Engineering properties of expansive soil treated with sisal fiber in addition to cement”,IJRTI,Volume 2,Issue 7,ISSN:2456-3315.