Stabilization Of Black Cotton Soil Using Coir Pith

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ABSTRACT: Black cotton soil is typical expansive soil have inherent property of shrinking when they are dried and swelling when water is absorbed. For any structure, the foundation is very important and it has to be strong to support the entire structure. In order for the foundation to be strong, the soil around it plays a very critical role. To work on soils, we need to have proper knowledge about their properties and factors which affect their behavior. Expansive soils always create problems more for lightly loaded structures than moderately loaded structures. In this paper the experimental results obtained in the laboratory on expansive soils treated with industrial waste Coir Pith (CP) as a stabilizer are presented. A study is carried out to check the improvements in the properties of expansive soil with Coir Pith in varying percentages. The test results such as liquid limit, Modified proctor compaction, and Unconfined Compression strength test obtained on expansive clays mixed at different proportions of Coir Pith as a admixture ranging from 0.1%, 0.2%, 0.3% and 0.4%. The plasticity index (PI) of 0.1 &0.2% addition of coir pith is less compared to untreated BC Soil. The max dry density (MDD) of 0.1 &0.2% addition of coir pith is more compare to untreated BC Soil, optimum moisture content (OMC) is reduced compare to BC Soil. The unconfined compressive strength (UCS) for BC Soil treated with 0.1 &0.2% of 0,7,14 days curing is more compared to untreated BC Soil.

Keywords : BC soil, Coir pith

1. INTRODUCTION

ENGINEERS are often faced with the problem of constructing facilities on or with soils, which do not possess sufficient strength to support the loads imposed upon them either during construction or during the service life of the structure. Many areas of India consist of soils with high silt contents, low strengths and poor bearing capacities. These negative soil performance characteristics are quite often attributed to the nature and quantity of the fines present in the material. For better performance of structures built on such soils, the performance characteristics of such soils need to be improved. The poor engineering performance of such soils has forced Engineers to attempt to improve the engineering properties of poor quality soils. There are various methods that could be used to improve the performance of poor quality soils. These methods range from replacing with a good quality soil to methods that involve complex chemical processes. The choice of a particular method depends mainly on the type of soil to be improved, its characteristics and the type and degree of improvement desired in a particular application. Stabilization of soils is an effective method for improving the properties of soil and pavement system performance. The objectives of any stabilization technique used are to increase the strength and stiffness of soil, improve workability and constructability of the soil and reduce the Plasticity Index. For any given soil many stabilization methods, using different stabilizing agents, may be effective to improve the soil properties in-place rather than removing and replacing the material. Availability or financial considerations may also be the determining factor on which a stabilizing agent is selected. The addition of coir pith reduces the volume change behavior of expansive soils. The coefficient of consolidation of coir pith stabilized soil was increased by 5.5 times with the addition of coir pith. The swell and compression indices were decreased by 95% and 68% respectively. The shrinkage index for coir pith stabilization was decreasing. The usage of coir pith is not found to be effective for reducing the plasticity characteristics and shrinkage strains below the non–problematic soil criteria. Hence an additional reinforcing material such as coir fiber can be used to reduce the problematic soil conditions [8]. Coir fibers are added ranging from 0.5 – 5% and having different aspect ratio (l/d=40, 80, 120, 60).Coir fiber increases the UCS value in soils, suggests that 4% of coir fiber with l/d =80 and 3% of coir fiber with l/d = 40, appeared to be optimum [2]. Plate load tests were carried out .Two varieties of coir products, namely geotextile and braided rope. Coir geotextile as well as braided coir rope are appropriate materials for subsoil improvement. Strength improvement as high as about three to four-fold and the reduction in settlement of about 80 percent is achievable through the use of these coir products [4].from the above literature survey, it is observed that coir fibre coir pith is can be used as stabilizer for BC Soil stabilization.so an attempt is done to study the stabilization of black cotton soil using coir pith.

2. MATERIALS

2.1 Black Cotton Soil

Black cotton soil was collected from Madenahalli Village, Gubbi Taluk, Tumkur District at a depth of 1m from the Natural Ground Level. The physical properties of collected BC Soil are shown in table 1.

2.2 Coir Pith

Coir pith, a part of waste by – product of coir manufacturing industry, was collected from pathre matthighatta coir industries, near CIT Gubbi. The coir waste collected was sun dried and sieved through 1.18mm IS sieve.

3. TEST METHODS

3.1 Specific Gravity Test

Standard test equipment and procedure available for specific gravity test was used in the present work (IS: 2720 (part 3/sec 1)-1980.

3.2 Grain Size Distribution Test

Sieve analysis test is conducted for grain size distribution. The tests were conducted as per IS: 2720 (part4) 1985.

3.3 Atterberg's Limit

Standard test equipment and procedure available for LL and PL test was used in the present work (IS: 2720 (part 5)-1985). The tests were conducted immediately after mixing water.

3.4 Modified Compaction

Determination of water content and Dry density Relation using Heavy compaction. (IS: 2720 (part7)-1980

3.5 Unconfined Compression Test

The unconfined compression strength (UCS) test was carried out on Black Cotton soil treated for 0, 7 and 14 days. (IS: 2720 (part 10)-1973).

4. TEST RESULTS AND DISCUSSION

4.1. RESULTS

TABLE 1: *Properties Of Black Cotton Soil*

Sl no.	Properties	Results Obtained
1.	Specific gravity	2.60
2.	Grain size distribution	
	% Gravel	0.70
	% Sand	20.60
	% Silt + clay	66.95
	Consistency limits	
	Liquid limit %	62.40
	Plastic limit %	31.00
	Plasticity index %	31.40
3.	IS soil classification	CH
4.	Compaction test	
	Maximum dry density (g/cc)	1.72
	Optimum moisture content (%)	20.40
5.	Unconfined compression strength (kn/m2)	
	0 days	30.50
	7 days	16.29
	14 days	14.43

TABLE 2 : *SIEVE ANALYSIS FOR BC SOIL*

IS Sieve Size (mm)	Wt. of Material Retained (gm)	Percent Retained (%)	Cumulative Percent Retained (%)	Percent Passing or Finer (%)
4.75	0	0	0	100
2.36	7	0.7	0.7	99.3
1.18	53.5	5.35	6.05	93.95
0.6	72.5	7.25	13.3	86.7
0.3	98	9.8	23.1	76.9
0.15	35.5	3.55	26.65	73.35
0.075	64	6.4	33.05	66.95

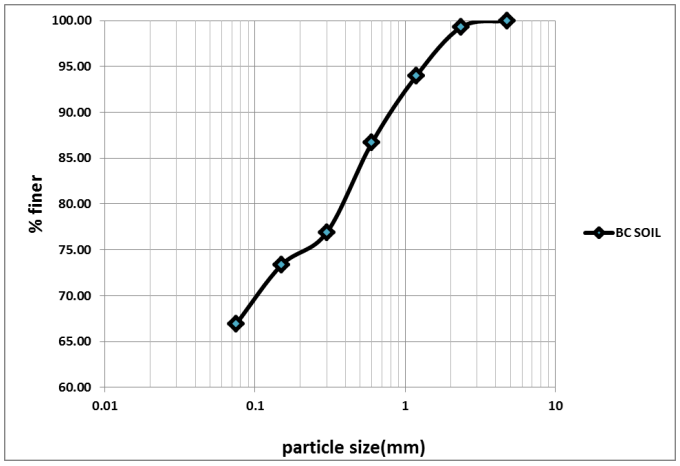

Fig 1: *Sieve Analysis Curve*

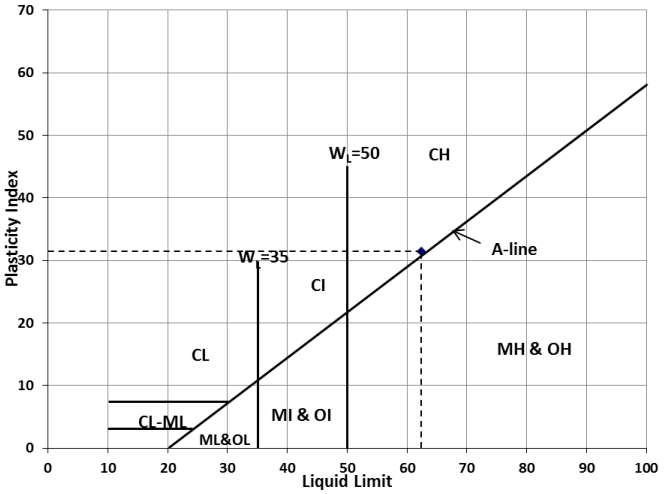

Fig 2: *Plasticity Chart*

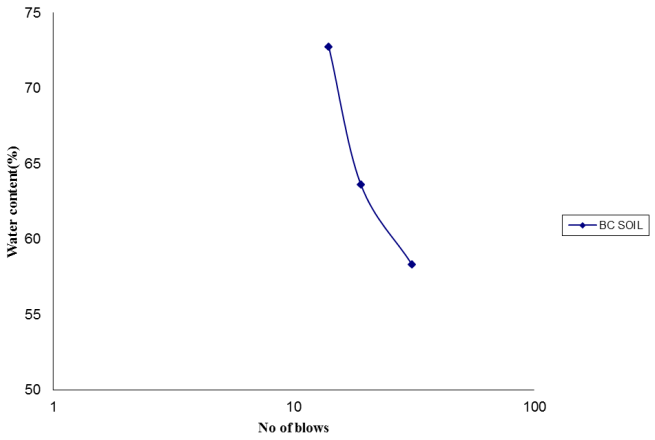

Fig 3: *Water Content V/S No. of blows for Liquid Limit Test*

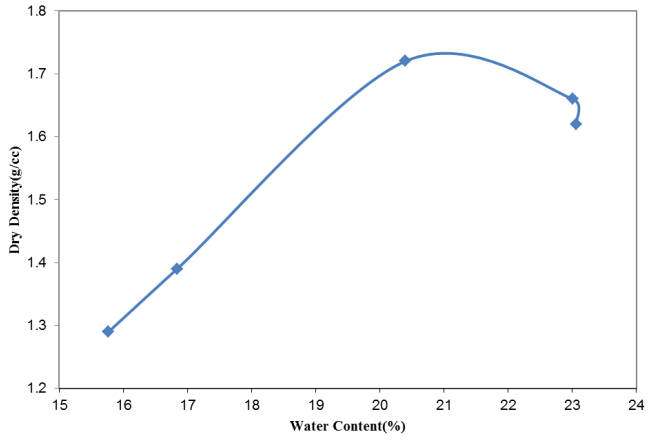

Fig 4: *Dry Density V/S Water Content for Compaction test*

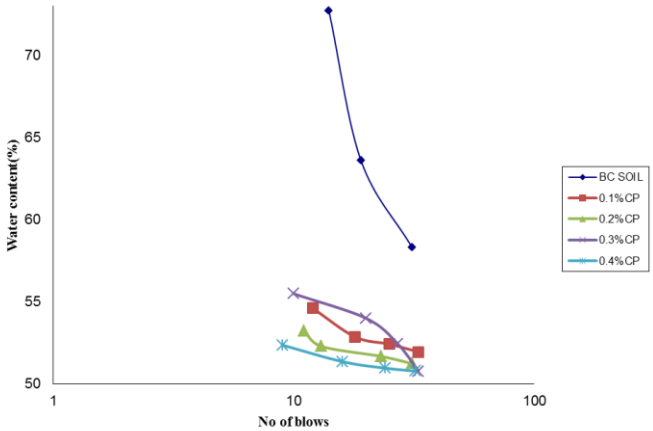

Fig 6: *Water Content V/S No. of Blows for Various % of CP*

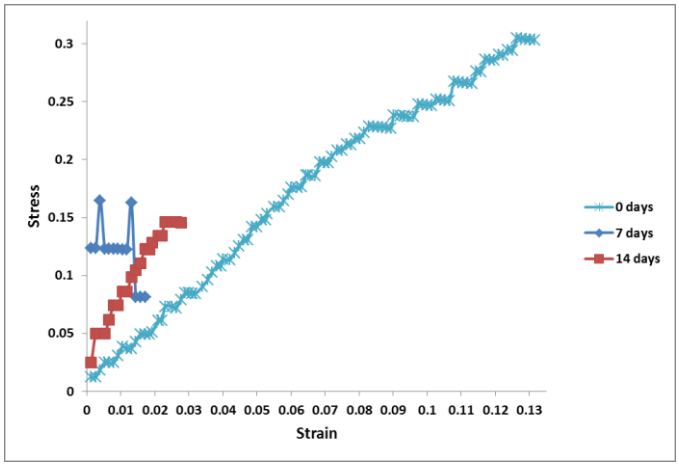

Fig 5: *Stress V/S Strain for UCS test*

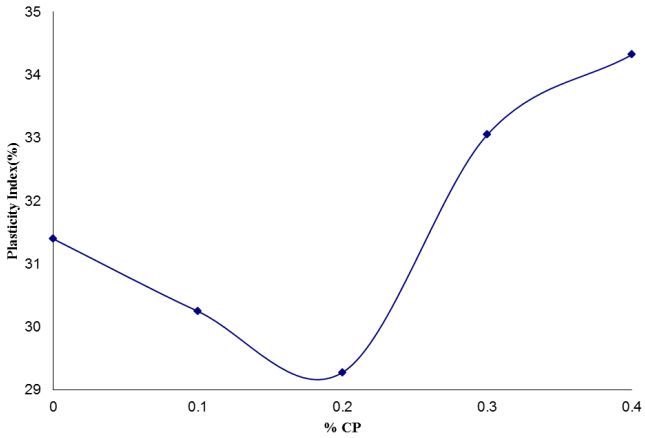

Fig 7: *Plasticity Index V/S % CP*

TABLE 3
EFFECT OF COIR PITH ON ATTERBERG'S LIMITS

Coir pith (%)	Liquid limit (%)	Plastic limit (%)	Plasticity index (%)
0.1	52.8	22.55	30.25
0.2	51.7	22.42	29.28
0.3	53.4	20.35	33.05
0.4	54.6	20.28	34.32

TABLE 4
EFFECT OF COIR PITH ON COMPACTION CHARACTERISTICS

Coir pith (%)	0.1	0.2	0.3	0.4
Maximum dry density (g/cc)	1.72	1.745	1.73	1.71
Optimum moisture content (%)	17	18.2	18.9	18.2

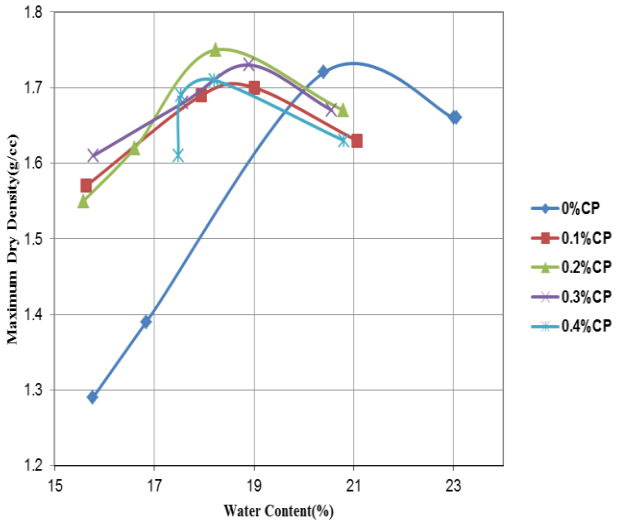

Fig 8: *MDD V/S Water Content for Various % of CP*

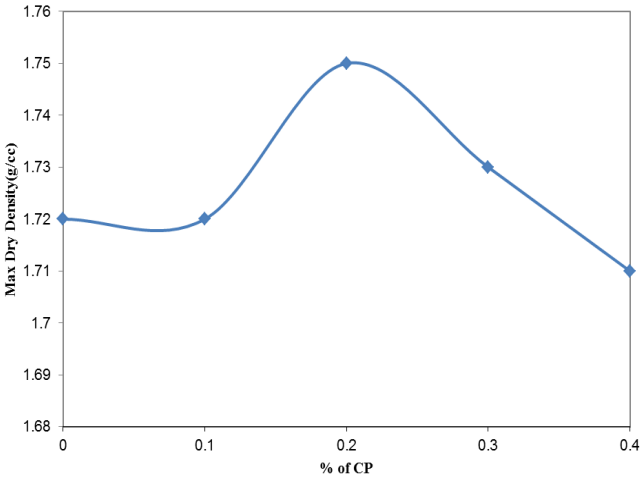

Fig 9: *Max. Dry Density V/S % of CP*

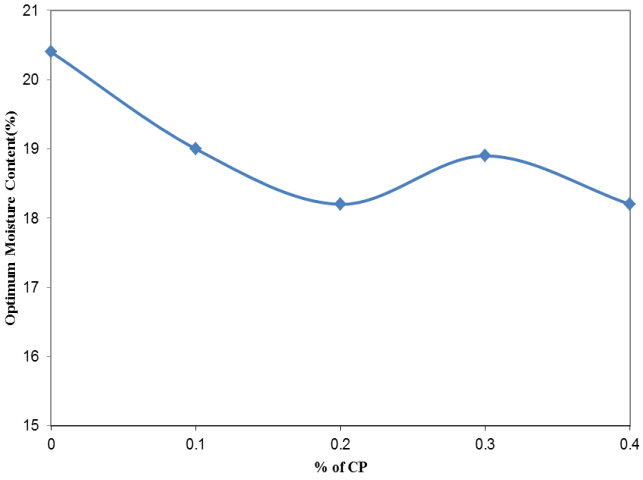

Fig 10*: % of CP V/S OMC for Various % of CP*

TABLE 5
EFFECT OF COIR PITH ON UCS

COIR PITH (%)	Unconfined Compressive Strength (KN/m2)		
	0 Day	7 Days	14 Days
0.1	42.02	49.18	54.16
0.2	34.86	55.8	56.29
0.3	32.7	44.39	49.05
0.4	30.17	42.2	45.04

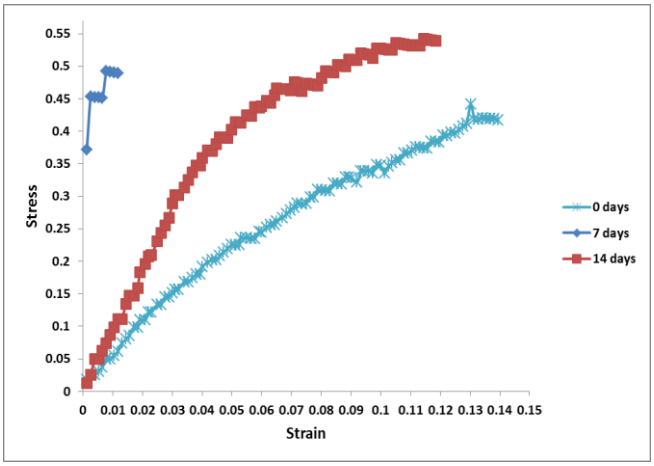

Fig 11: *Stress V/S Strain for 0.1% CP*

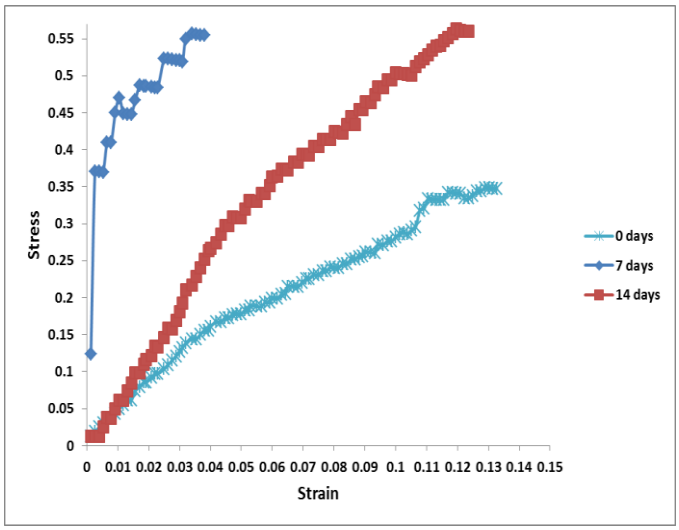

Fig 12: *Stress V/S Strain for 0.2% CP*

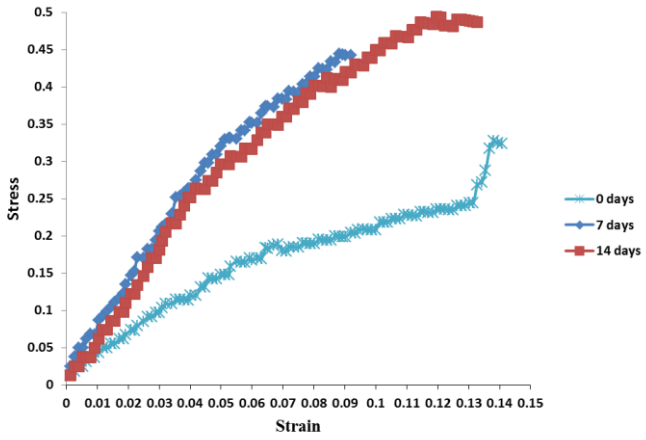

Fig 13: *Stress V/S Strain for 0.3% CP*

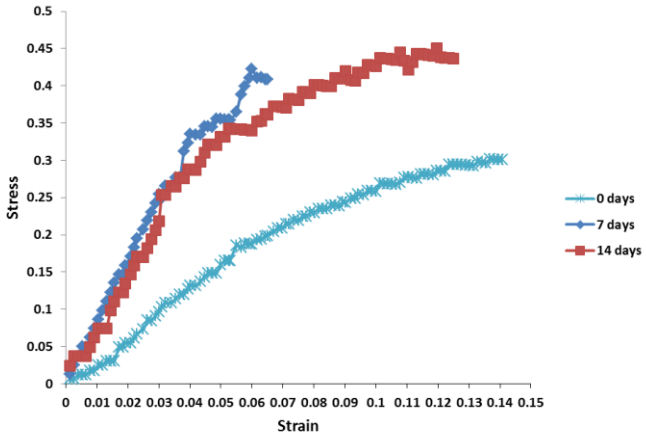

Fig 14: *Stress VS Strain for 0.4% CP*

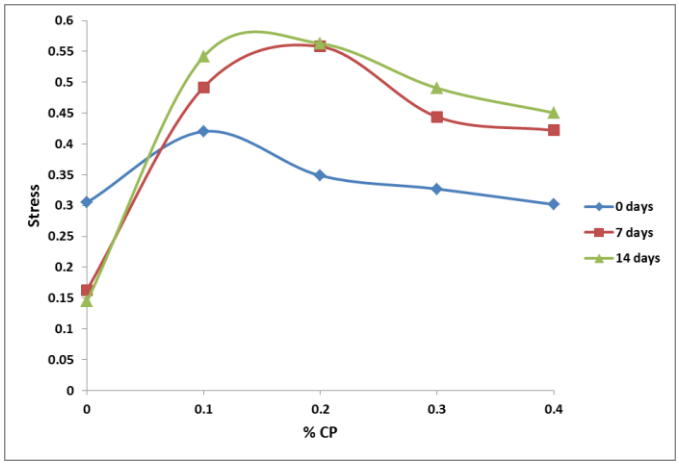

Fig 15: *Stress VS %CP for Different Curing Days*

4.2 DISCUSSION

4.2.1. Consistency Limits

1. Decrease in the Liquid Limit with increase in concentration of Coir Pith. The decreases for 0.1%,0.2%,0.3% and 0.4% of Coir Pith were 11.4%,12.5%,10.8% and 9.6% respectively.
2. But it is observed that beyond 0.2% of Coir Pith the decrease in Liquid Limit is not as pronounced as 0.1% and 0.2%.

4.2.2. Compaction Characteristics

1. At 0.1% Coir Pith the Max.Dry Density is almost similar to untreated BC Soil , but the amount of water content to achieve the density is less when compare to untreated BC Soil.
2. At 0.2% Coir Pith the Max.Dry Density is increased by 1.45% at lower Water Content when compare to untreated BC Soil.
3. But it is observed that beyond 0.2% of Coir Pith the decrease in Max.Dry Density with increase of Water Content is not as pronounced as 0.1% and 0.2%..this may be because the Liquid Limit is also increased.

4.2.3. UCS Characteristics

1 For untreated BC Soil the strength is decrease by increase of curing days.

2 At 0.1% and 0.2% Coir Pith the 0 day curing strength increased by 27.7% and 12.50% respectively, when compare to untreated BC Soil of 0 day strength.

3 For 7 day curing strength of 0.1% and 0.2% Coir Pith are increased by 66.87% and 70.8% respectively, when compared to untreated BC Soil.

4 For 14 day curing strength of 0.1% and 0.2% Coir Pith are increased by 73.35% and 74.36% respectively, when compared to untreated BC Soil.

5 The strength increased with the increase of curing days up to 0.2% Coir Pith when compared to BC Soil. But it is observed that beyond 0.2% Coir Pith the decrease in strength is not as pronounced as 0.1% and 0.2% Coir Pith.

5. CONCLUSION

There are many natural wastes being sent out to environment, Coir Pith is one such waste. Being a natural waste the cost towards the application is very less. After the experiment study made it was found that the Coir Pith can be used as natural stabilizer in improving the properties of Black Cotton soil. However the application is bounded to minor projects. The study can further be extending by conducting the test in combination with Coir Pith. That is Coir Pith and Lime, Coir Pith and Fly ash etc..

REFERENCES

[1] Parag M.et al.(2013). “Performance of coir fiber reinforced clayey soil” International Journal of Research and Reviews in Applied Sciences ISSN(e): 2319-1813 ISSN(p): 2319-1805. Volume 2, Issue 4.

[2] Nithin S. and Sayida M. K. (2012) “Stabilization of Silty Sand using Flyash and Coir Fiber” Recent Advances in Civil Engineering Race-2012.

[3] Vinod, and Ajitha B. Bhaskar. (2009). “Effective use of coir products in ground improvement”, Guntur, INDIA.

[4] Dr. Robert M. Brooks.(2009). “Stabilization of Expansive Soils Using flyash and rice husk ash”, International Journal of Research and Reviews in Applied Sciences ISSN: 2076-734X, EISSN: 2076-7366 Volume 1, Issue 3.

[5] Y.Keerthi, P.et al.(2013). “Stabilization of clayey soil using cement kiln waste” .international journal of Advanced structures and Geotechnical Engineering, ISSN 2319-5347,vol.02.

[6] K.V. Manjunath, et al.(2012). “Stabilization of Expansive Soils Using GGBS” Proceedings of International Conference on Advances in Architecture and Civil Engineering (AARCV 2012), 21st – 23rd June 2012 387 Paper ID GET114, Vol. 1.

[7] Monica Malhotra and Sanjeev Naval.(2013).“Stabilization of Expansive Soils Using Low Cost Materials” International Journal of Engineering and Innovative Technology (IJEIT) Volume 2, Issue 11.

[8] P. K. Jayasree et al.(2013). “Influence of Coir Pith on Swelling and Shrinkage Characteristics of Expansive Soil”, Proceedings of Indian Geotechnical Conference roorkee.

[9] Oriola, Folagbade. (2010). “Groundnut Shell Ash Stabilization of Black Cotton Soil” Vol. 15 Bund E.

[10] Amit Tiwari and H. K. Mahiyar(2014) “Experimental Study on Stabilization of Black Cotton Soil by Fly Ash, Coconut Coir Fiber & Crushed Glass”, International Journal of Emerging Technology and Advanced Engineering (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 4, Issue 11, November 2014).

[11] Dr.B.C.Punmia, Ashok Kumar Jain, Arun Kumar Jain “Soil Mechanics and Foundation”, 16th Edition.

[12] IS: 2720 Part III (1980). “Determination of Specific gravity.” Bureau of Indian Standards, Manak Bhavan, New Delhi.

[13] IS: 2720 Part IV (1975). “Determination of Grain Size.” Bureau of Indian Standards, Manak Bhavan, New Delhi.

[14] IS: 2720 Part V (1985). “Determination of Liquid and Plastic limit.” Bureau of Indian Standards, Manak Bhavan, New Delhi.ss

[15] IS: 2720 Part VII (1980). “Determination of Moisture content and dry density.” Bureau of Indian Standards, Manak Bhavan, New Delhi.

[16] IS: 2720 Part X (1973). “Determination of Unconfined Compressive Strength.” Bureau of Indian Standards, Manak Bhavan, New Delhi.