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Behaviour of Black Cotton Soil Using Soiltech MKIII Polymer as a Stabilizer

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Abstract

Black cotton soils are known to be expansive soils and possess low strength in construction of structure to bear the loads on it. These are considered to be problematic due to their volumetric changes such as swelling and shrinkage. Black cotton soils are efficient for construction purpose by using additives into it. By adding the additives will modify the properties of expansive soils. In present study an attempt has been made to stabilize the soil using Soil Tech MKIII polymer as a stabilizer. Laboratory experiments were done to check the improvement of the properties of the black cotton soil and studied the compaction, strength and CBR values by using the Soil Tech MK III polymer as a stabilizer in different percentages such as 1%, 2%, 3%, 4% and 5%. It is observed that the CBR value and shear strength is increased by adding Soil Tech MKIII to the soil.

Keywords: *Black Cotton Soil, Soil Tech MKIII Polymer, UCS, CBR.*

INTRODUCTION

Black cotton soils which cover 25% of total area in India are mostly present in central part and western part of India. Expansive behaviour of soil can be governed by different factors. The main factors that are considered in expansive soils are change in water content and soil containing amount and type of clay size particles. Other important factors affecting the expansion behaviour of soil such as type of soil (natural or fill), dry density by compaction,

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moisture content, magnitude of the surcharge pressure and amount of nonexpansive material such as gravel or cobble size particles. Black cotton soil shows low value at swollen stage and high bulk density in dry condition. Black cotton soils are also called as expansive soils. In these expansive soils expansion occurs due to wetting and shrinkage occurs due to drying. Due to these volumetric changes in soil causes cracking in structure. Shrinkage is more destructive than swelling regarding to structural issue. Stabilization improves the performance of soil material by increasing its stiffness, durability and strength. The most appropriate method for stabilization is which produces soil material with desired properties at the very minimum cost and the stabilized material should have better qualities than those of natural soil.

LITERATURE REVIEW

Strength characteristics of expansive soils were improved with additives such as cement, fly ash, Terrasil and renolith.CBR is increased [1] studied an effort on the epoxy based treatment of fine, poor graded soil. The increase in CBR is 11.1 by increase in 1% epoxy based resin. [12] In their work, laboratory tests were conducted on Black Cotton soil stabilized with Nano-chemicals. A chemical named Terrasil was used as stabilizer in varying percentages and the soil was cured for 7-28 days. Due to chemical reaction, the soil mass densifies by minimizing the voids between particles and it make the soil impervious. The important geotechnical properties were determined in the laboratory. It is noted that CBR value increases with increase in percentage of soil stabilizer. Permeability is found to be nil for treated soil. [14] Investigated the stabilization of English China clay and Mercia mudstone using BOS slag fines. Improved strength and durability combined with reduction in expansion was obtained.

OBJECTIVE

The main objective of the present work is to study the physical and geotechnical properties of Expansive soils available at kamalapuram, Kadapa district to study the strength properties of soil by addition of SoilTech polymer with water at different percentages i.e., 1%, 2%, 3%, 4% & 5% dosage.

MATERIALS AND METHODOLOGY

Following are the materials which are used in the present study:

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Expansive Soil:

In this study, the investigation is carried out on soil samples are collected from kamalapuram village, KADAPA (DT), which is in black colour with high moistures content. The following table shows the soil properties of the sample:

Table 1: Test Results of Soil Properties

S.No.	Description	Result
1	Specific Gravity	2.3
2	Free Swell Index	85 %
3	Liquid limit	65 %
4	Plastic limit	35 %
5	Plasticity index	30 %
6	Standard Proctor Compaction	OMC-26 %
		MDD- 1.36 g/cc
7	California Bearing Ratio	Unsoaked-2.58
		Soaked-2.14
8	Un Confined Compressive Strength	0.22 kg/cm^2
9	Indian Soil Classification	CH

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SOILTECH MKIII

SoilTech MKIII is a third generation polymer binder, it consists of finer particles at molecular level uses water as a carrier to lubricate it under mechanical compaction. It is a stabilizing agent specifically used for base and sub-base coarses. SoilTech has been extensively tested with in-situ materials in various parts of the world. SoilTech polymer gain binding strength from compaction. The greater the compaction, the better polymer binds occurs. SoilTech polymer will start binding when exposed to air.

Table 2: Physical and Chemical Properties of SoilTech MKIII Polymer

S.No	Property	Description
1	Appearance	Dark
2	Odour	Slight
3	pH	8.0 - 9.0
4	Boiling point	approximately 100 ºC (as per water)
5	Flammability	N/A
6	Vapour pressure	As per water
7	Water solubility	Fully miscible
8	Specific gravity	2.5

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RESULTS AND DISCUSSION

The experimental tests were conducted on black cotton soil with various percentages of SoilTech MKIII. A series of tests for untreated and treated soils using SoilTech MKIII as a stabilizer are determined. Following tests were performed such as compaction, CBR, UCS are done. The results are shown below for various tests:

Analysis of Results

Compaction is a mechanical process. While compacting it densifies the soil by expulsion of voids from soil.OMC and MDD values are obtained by compaction. Higher the compaction higher the dry density. The results obtained are given below:

Table No3: MDD Values for Different Percentages of Soil Tech MKIII

SoilTech MKIII (%)	0	1	2	3	4	5
MDD in g/cc	1.36	1.38	1.42	1.47	1.53	1.56

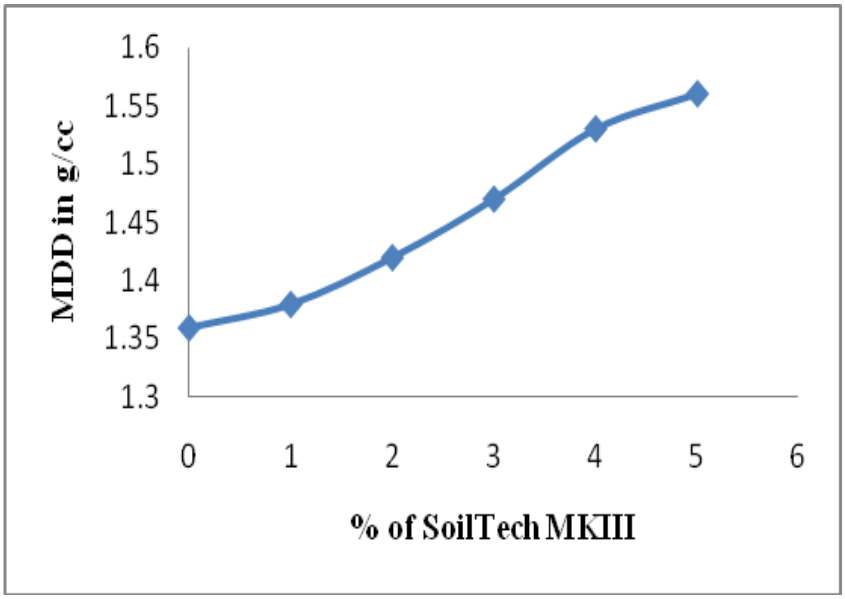


Fig 1: Variations in the MDD Values of Soil for Various % of SoilTech MKIII

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CBR values were increased with increase in various percentages of SoilTech MKIII polymer. Unsoaked CBR value increases from 2.58 to 10.05 indicating the increase of CBR value up to 290% at 5% when compared to the untreated soil. The soaked CBR value is less than the Unsoaked CBR due to the soaking period. Due to soaking of specimen moisture content increases due to the ion exchanges. By addition of SoilTech MKIII polymer, the CBR value is increased due to good compaction and binds with soil to reduce the penetration of water.

Table No 4: Unsoaked and Soaked CBR Values for Various Percentages of SoilTech MKIII

SoilTech MKIII (%)	0	1	2	3	4	5
Unsoaked CBR	2.58	4.12	5.78	7.24	8.83	10.05
Soaked CBR	2.14	3.75	5.3	6.85	7.42	8.23

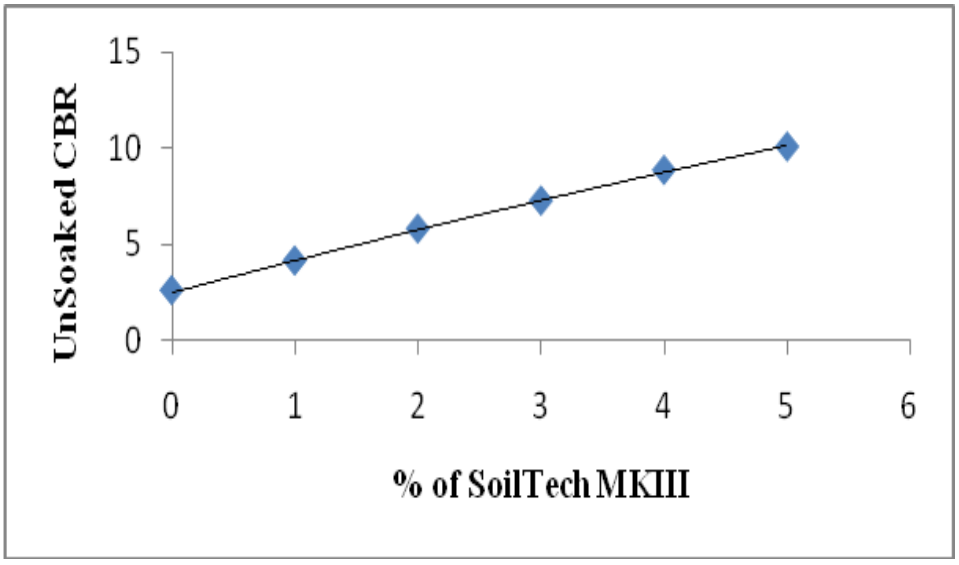


Fig 2: Variation in the Unsoaked CBR Values of Soil for Various % of SoilTech MKIII

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With increase in % of SoilTech MKIII polymer, Soaked CBR value increases from 2.14 to 8.23 when compared to the untreated soil.

The shear strength of soil is the resistance to deformation by continuous shear displacement of soil particles. Soil containing better shear strength used for pavements to bear the loads. With increase in % of SoilTech MKIII polymer, shear strength value increases from 0.16 kg/cm2 to 0.22 kg/cm2 when compared to the untreated soil.

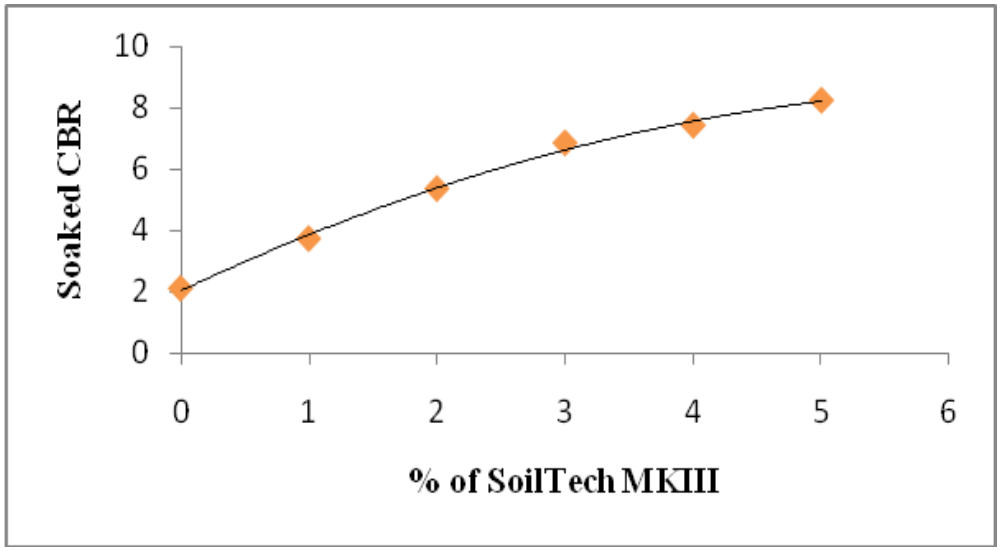


Fig 3: Variation in the Soaked CBR Values of Soil for Various Percentages of SoilTech MKIII

Table No 5: Shear strength Values for Various Percentages of SoilTech MKIII

SoilTech MKIII (%)	0	1	2	3	4	5
Shear Strength in kg/cm^2	0.11	0.15	0.16	0.18	0.19	0.22

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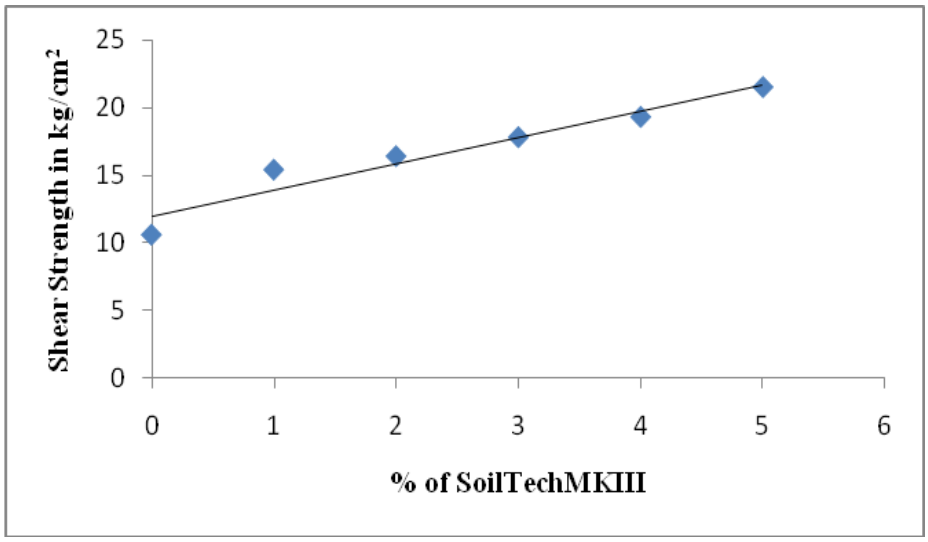


Fig 4: Variation in the Shear Strength Values of Soil for Various percentages of SoilTech MKIII

The below discussions are drawn from the experimental investigation using SoilTech MKIII polymer in varying proportions to the soil.

1) The shear strength of soil increases from 0.11 kg/cm2 to 0.22 kg/cm2 with increase in percentage of SoilTech MKIII polymer.

2) The dry density of soil increases from 1.36 g/cc to 1.56 g/cc with increase in percentage of SoilTech MKIII polymer. At 5% of addition of polymer, there is an increase in dry density value is 15%.

3) The Unsoaked CBR value increases from 2.58 to 10.05 with increase in percentage of SoilTech MKIII polymer. At 5% of addition of polymer, there is an increase in CBR value is 290%.

4) The soaked CBR value increases from 2.14 to 8.23 with increase in percentage of SoilTech MKIII polymer. At 5% of addition of polymer, there is an increase in CBR value is 285%.

Finally concluded that:

- SoilTech MKIII polymer is a available chemical stabilizer, used in the

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present study concludes that it is a potential stabilizer for expansive soils.

1) The UCS and CBR values of soil treated with SoilTech MKIII polymer increased compared to untreated soil.

2) Maximum values of CBR and UCS were obtained at 5% of SoilTech MKIII replaced to the OMC of the soil.

3) With increase in soaking period of soil, the values of CBR and UCS results were reduced because of increase in moisture content in specimen.

4) SoilTech MKIII polymer is an eco friendly in nature. So, it can be effectively used as a soil stabilizer.

The above conclusions are drawn from the experimental investigation using SoilTech MKIII in varying proportions to the targeted soil.

REFERENCES

1) Ajayi-Mejebi., Grisom, W.A., Smith, L. S., and johns, E.E. (1991). "Epoxy-Resin-Based Chemical Stabilisation of a Fine, Poorly Graded Soil System." Transportation Research Record, (1296), 94-107.

2) Anand Kumar raghuwanshi, Saurabh bhargava, Pallavi Gupta (2016) "Improvement of Black Cotton Soil with Cement & Flyash Treated with Terrasil", ISSN: 2395-1990, Volume-2, Issue 3.

3) Ansu Thomas, R.K.Tripathi, and L.K.Yadu, "Effect Enzymes on the Unconfined Compression Strength of Soil", IJAER, Volume-11, Number-10, 2016.

4) Bala Raju Teppala (2014) "Performance Evaluation of VG 30 Paving mix with and without Zycosoil Chemical Additive", ISSN 2347-5161, Volume-4, No.5.

5) C.E.G.Justo, Krishnamurthy (2008), "Laboratory studies on properties of soils treated with RBI-81stabilizer", RASTA Center for Road Technology

Page 13-23 © MANTECH PUBLICATIONS 2017. All Rights Reserved

6) JoydeepSen and Jitendra Prasad Singh, "Stabilization of Black Cotton Soil using Bio-Enzyme for a Highway Material", IJIRSET Volume-4, Issue-12, December-2015

7) Nandan A. Patel (2015) "Subgrade Soil Stabilization using Chemical Additives", ISSN: 2395-0072, Volume-2, Issue 4.

8) YSS Gopal Krishna (2013) "Stabilization of Black Cotton Soil Treated with Fly ash and Zycosoil", ISSN: 2223-487X, Volume.3, No.3.

9) Dr.MohdRaihanTaha, Tanveer A. Khan, IbtehajTaha Jawad, Ali Akbar Firoozi and Ali AsgharFiroozi, "Recent Experimental Studies in Soil Stabilization with Bio-Enzymes-A Review", Electronic Journal of Geotechnical Engineering volume 18-2013.

10) H.N.Ramesh and S.R.Sagar, "Effect of Drying on the Strength Properties of Terrazyme Treated Expansive and Non-Expansive Soils", 50th IGC Conference, Pune-2015.

11) IS: 2720-Part-3-1-1980 "Specific gravity of fine grained soil Determination" Bureau of Indian Standards, New Delhi.

12) Lekha.B.M. (2013) "Fatigue and Engineering properties of Chemically Stabilised Soil for Pavements", 43(1):96-104.

13) Nitesh Goli, Shakeel Abid (2015) "A Study on Strength Characteristics of BC Soil Treated with Zycosoil", 50th Indian Geotechnical Conference.

14) Poh, H Y, Ghataora, Gurmel S, Ghazireh, Nizar,(2206)," Soil Stabilization Using Basic Oxygen Steel Slag Fines", Journal of materials in Civil Engineering,vol 18 issue no 2,pg229-240.

15) Priyanka M shaka and Surekha M Shaka, "Laboratory Investigation on Black Cotton Soil and Red Soil using Enzyme", IRJET, Volume-3, Issue-6, June-2016.

16) Rintu Johnson and Dr.kodiRangaswamy, "Improvement

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of Soil Properties as a Road Base Material using Nano Chemical Solution", 50th Indian Geotechnical Conference 17-19 December 2015, pune.

17) SudeepaShetty, Dhanaraj V, AshwiniPai, Jeenu P Gopi, Prashantha, "Qualitative Study on Physical and Bio-Enzymatic Soil Stabilization of Lateritic Soil" JETIR, Volume-3, Issue-8, August-2016.

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