iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** VIII **Month of publication:** August 2020

DOI: https://doi.org/10.22214/ijraset.2020.31052

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VIII Aug 2020- Available at www.ijraset.com

Impact of SoilTech MK III Polymer on Problematic Soil: A Review Study

Taranpreet Kaur[1], Pardeep Singh[2]
[1]*M.Tech Student, Department of Civil Engineering, GNDEC, Ludhiana, Punjab.*
[2]*Assistant Professor, Department of Civil Engineering, GNDEC, Ludhiana, Punjab.*

Abstract: ***Construction of roads in India is increasing at a very high rate. A good pavement should be safe, comfortable, economical. Thickness of roads are generally depends upon the various geotechnical properties of the subgrade soil as well as on the intensity of the traffic. Black Cotton Soil is the most problematic soil due to its shrinkage and swelling characteristics which making challenging for highway engineers. SoilTech MK III polymer is a new and environmental friendly stabilizer. This techniques reduce the blasting operations which used to construct pits / quarries for aggregates, reducing the use and movement of construction machinery by reducing the length of the construction period, which reduces CO2 emission. Emission of CO2 reduced upto 92%. The main aim of this paper is to study properties of SoilTech MK III polymer, because of which we can reduce not only the movement of heavy machineries which produce CO2 but also reduce the cost of construction.***
Keywords: Expansive Soil (Black Cotton Soil), SoilTech MK III polymer, Liquid Limit, Plastic Limit, California Bearing Ratio (CBR).

I. INTRODUCTION AND MATERIAL USED

Black cotton soil is a very problematic soil, swelling and shrinkage occurs on the pavement during wetting and drying generally seasonal moisture variation, because of which pavement generally settles down, cracks occurs, heavy depression etc. noticed on the pavements. 25% of the total are of India is approximately covered with Black Cotton Soil, which includes state of Andhra Pradesh, Madhya Pradesh, Uttar Pradesh, Rajasthan, Gujarat, Maharashtra, Karnataka and Tamilnadu. Black Cotton Soil remains hard until it is dry but again when it is wet, it loses its strength.

It is a Chemical stabilization technique in which soil are stabilized by adding different chemicals to the soil. The curing and setting time can be controlled by chemical stabilization. SoilTech MK III, a third era polymer cover. It is a stabilizer which is specifically designed for mine-haul roads, industrial plants, railway yards, parking lots, ware house and coal handling areas. This technique uses about 60% of the existing soil and only 40% smaller aggregates as opposed to the use of 100% aggregates as a traditional crust forming method. Bituminous and base layers are reduced at very high rates with the use of this chemical. Because of SoilTech MK III polymer, the OMC decreases whereas MDD increases. Which reduces failure on pavements and increases there life span with less maintenance and money. The percentage of SoilTech MK III polymer have huge influence on the stabilization[3][6].

Roads which are constructed of fly ash, coconut coir ash etc., when heavy traffic movies on it after time interval cracks occur on it because of which maintenance cost also increases, but SoilTech MK III polymer creates a strong bond with soil and reduces the cracks and increases life span of pavements. It is long chain of repeated molecules units that gives a shapeless structure which provide good strength and toughness. So, when water disperses, the polymers interlocked and it forms a strong bond which gains strength under mechanical compaction. As the compaction increases, the better results achieved in stabilized soil. After evaporation of water between the soils particles, SoilTech MK III polymer leaves a subbing layer preventing water entrance. In short, better results or binding occurs if great compaction is done. This chemical is an eco-friendly chemical which is very essential and important for environment as well as mankind.

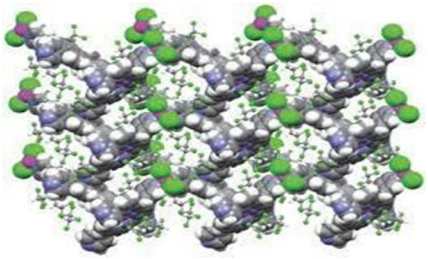


Fig 1: Long chain of repeated molecules units

Table- 1: Physical and Chemical properties of SoilTech MK III polymer [6]

Sr. No.	Property	Description
1	Appearance	Dark Brown/ Black Liquid
2	Odor	Slight
3	pH	8.0-9.0
4	Boiling Point	Approximately 100o (as per water)
5	Flammability	N/A
6	Vapor Pressure	As per water
7	Specific Gravity	>1.0
8	Water Solubility	Fully miscible

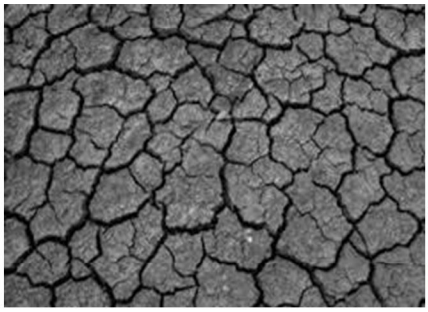


Fig 2: Cracks in Black Cotton soil

Fig 3 : Cracks on pavement and building constructed on Black Cotton Soil

II. METHOD OF TESTING

Procedure for calculation of geotechnical properties of Black Cotton Soil is similar as other experiments where Specific Gravity, Liquid Limit, Plastic Limit, Plasticity Index tests are performed firstly. After this Proctor density, Unconfined Compressive Strength Test, California Bearing Ratio Test is conducted by varying percentages of SoilTech MK III polymer. The polymer is used to check the optimum dosage for stabilization in Black Cotton Soil. Before performing any test, the optimum dosage is mixed with water. For example, if we are performing test using 0.2% of SoilTech MK III polymer, the polymer of 2ml is added to 1 liter of water and mixed thoroughly. When solution is ready, it is mixed thoroughly into weighed quantity of soil. Now this solution is used and it's added to the weighed quantity of the different soil and mixed thoroughly and then different tests will be performed. After preparing the sample, Standard Proctor test, Unconfined Compression test and California Bearing Ratio test, Direct Shear test with different dosage is performed on soils. And note down the dosage at which the CBR and UCS of soil will become maximum.

III. LITERATURE REVIEWS OF DIFFERENT RESEARCHERS

A. Bhavsar *et al*(2014) studied the effect of marble dust in black cotton soil. For this he mixed expansive soil with marble dust with different percentages(30% to 50%). Liquid Limit decreases from 37.4% to 27.45%. Plastic Limit decreases from 15.37% to 9.3%. Plasticity Index decreases from 22.02% to 18.144%. MDD increases from 1.91g/cc to 1.95g/cc. OMC decreases from 12.36% to11.28%.Increasing marble powder content the linear shrinkage is reducing. For 30% marble powder it reduces 74.68 %, for 40% reduces to 78.9% & for 50 % reduces 83.12% than the black cotton soil. Increasing the amount of marble powder reduces the swelling index to negative.

B. Dubey and Jain (2015)investigated on the influence of Common Salt (NaCl) on the engineering properties of Black Cotton Soils. Black Cotton Soil was mixed with Common Salt (NaCl) at 0%, 2%, 4%, 6%and 8%. It lowers the vapor pressure Water. It reduces or prevents frost in the soil by lowering the freezing point of water. OMC decreases from 21.16% to 14.95%. MDD increases from 1.64 to 1.79 gm/cc. At 8%, CBR value increases from 1.43% to 3.10%. UCS increased from 73.54 KN/m2 to 119.64 KN/m2. DFS reduced from 41% to 19%, indicates that the degree of expansiveness has reduced from high to low. Therefore result shows that common salt (NaCl) has the ability to modify the engineering behavior of black cotton soil and makes it suitable for geotechnical purposes.

C. Lekha and Shankar (2014) studied the effect of new Proprietary Cementitious Stabilizer (RBI Grade 81) to study the improvement in engineering properties of Black Cotton Soil. At 6% MDD is 17.20 KN/m whereas OMC is 16.00% which is decreasing. At 6%, CBR offers good improvement. During curing time of 7 and 28 days, high fatigue life at 1/3rd corresponding UCS strength values. So, RBI 81 Stabilizer provide better results at 6% of the stabilizer in soil.

D. Patidar and Dr.Mahiyar (2014) has worked to improve the properties of Expansive soil with the help of High density polyethylene fibers (0.5%, 1.0%, 1.5%), Stone Dust (5%, 10%, 15%) and Lime (3%, 6%, 9%). Liquid Limit & Plastic Limit of the soil is reduced by adding of any ingredient individually. With 1% of Fiber CBR is maximum, 10% with Stone Dust and 6% with Lime. UCS also increase with varying % of Fiber, Stone Dust and Lime. However, Permeability decreases with increasing % of stone dust and lime. Thus, using HDPE Fiber, Stone Dust & Lime is a good method for improving engineering properties. Moreover it cost effective.

E. Rajput and Yadav (2015) studied the effect of Fly Ash on Expansive Soil. Fly-ash is added in 10%, 20%, 30%, 40%, 50% . Liquid Limit decreased from 55.2% to 36.3% as fly-ash content increased from 0% to 50% whereas Plasticity Index decreased from 27.1% to18.1%. DFS decreased from 52% to 14%.OMC increased from 19.3% to 24.1% and MDD decreased from 1.63% to 1.52%.Hence, at 20% maximum CBR is recorded. From research, the result is that fly-ash has a potential to modify the characteristics of expansive soil and to make it suitable for construction.

F. Ranjitha *et al* (2016) investigated that a new third era polymer SoilTech MK III polymer improve the properties of Black Cotton Soil as well as provide strength of the soil. Percentages of 0.2%, 0.4%, 0.6%, 0.8%, 1.0% of SoilTech MK III polymer used to estimate the optimum dosage. OMC decreases, MDD increases with 0.4% of polymer CBR increases from 47% to 9.98% for unsoaked condition and from 1.58% to 7.48% for soaked condition with 0.4% of polymer. Stabilizer SoilTech MK III polymer increases the strength of soil.

G. Tiwariand Mahiyar (2014) has studied that the geotechnical property of the Black Cotton Soil with Fly Ash, Coconut Coir Fiber and Crushed Glass can be improved. Total 48 trial samples test were carried in two phase. Different percentages of Fly Ash (FA) at 10%, 15%, 20%,25%, Coconut Coir Fiber (CCF) at 0.25%, 0.5%, 0.75%, 1% & Crushed Glass (CG) at 3%, 5%, 7% (glass crushed to have gradation of sand size) are used. The results shows that after adding Fly Ash, CBR value is maximum at 25%, at 7% CBR is maximum in case of Crushed glass and 1% maximum of the CBR when Coconut Coir Fiber is added. Direct Shear Test value Of C(Cohesion) decreases and Value of ø (Angle of internal friction) increases. This tests shows that they are weak individually to produce good result but when used together provide better results. Hence, using them together in Black Cotton Soil helps to strengthen the soil.

H. Verma and Abhishek (2019) has used two different stabilizer, and stabilized the soil. RBI 81 Stabilizer(1%, 3%, 5%) and Fly Ash(10%, 20%, 30%) with different percentages. After performing different tests researchers reported that OMC increases to 16.2, 16.6 and 17.4% when Fly Ash was added and when added RBI added OMC increased to 16.4, 16.9 and 17.9%. MDD reduced to 1.60 g/cc,1.59, 1.58 and 1.57 g/cc with addition of RBI and MDD decreased to 1.58, 1.56 and 1.54 g/cc, when Fly ash was added. The CBR increased from 1.76% to 3.76, 6.87 and 9.64% with RBI. CBR increased from 1.76% to 2.74%, 3.98% with Fly Ash. Hence, MDD decreases and OMC increases when these two stabilizers were used in poor soil.

I. Yadu *et al* (2011) studied the comparison between Fly Ash and Rice Husk Ash when used to stabilize the Black Cotton Soil. Percentage of Fly Ash 5, 8, 10, 12, and 15% and Rice Husk Ash 3, 6, 9 11, 13, and 15%. With RHA, OMC increases and MDD decreases while addition of FA these values decrease. At 12% with FA CBR and UCS is obtained at 12% whereas for RHA is obtained at 9%. Optimum amount of FA and RHA increased the soaked CBR by approximately 190% and 50% respectively. UCS with FA and RHA is approximately 200% and 80% higher than raw soil. Fly Ash provides better result than the Rice Husk Ash.

IV. CONCLUSION

A. SoilTech MK III polymer is a new technique of stabilization without effecting the environment, Base/ Sub-base strength increases with increase in substantial. Increases the strength of soil upto 300% which is really good.

B. Process of stabilization with this chemical is very simple, no skilled labor required and even no special equipment is required. After mechanical compaction, the polymer achieve higher strength.

C. Its cost is very low compared to other chemicals, By the use of SoilTech MK III polymer, road construction costs reduces by about 20-30% whereas construction time reduces upto 30%.

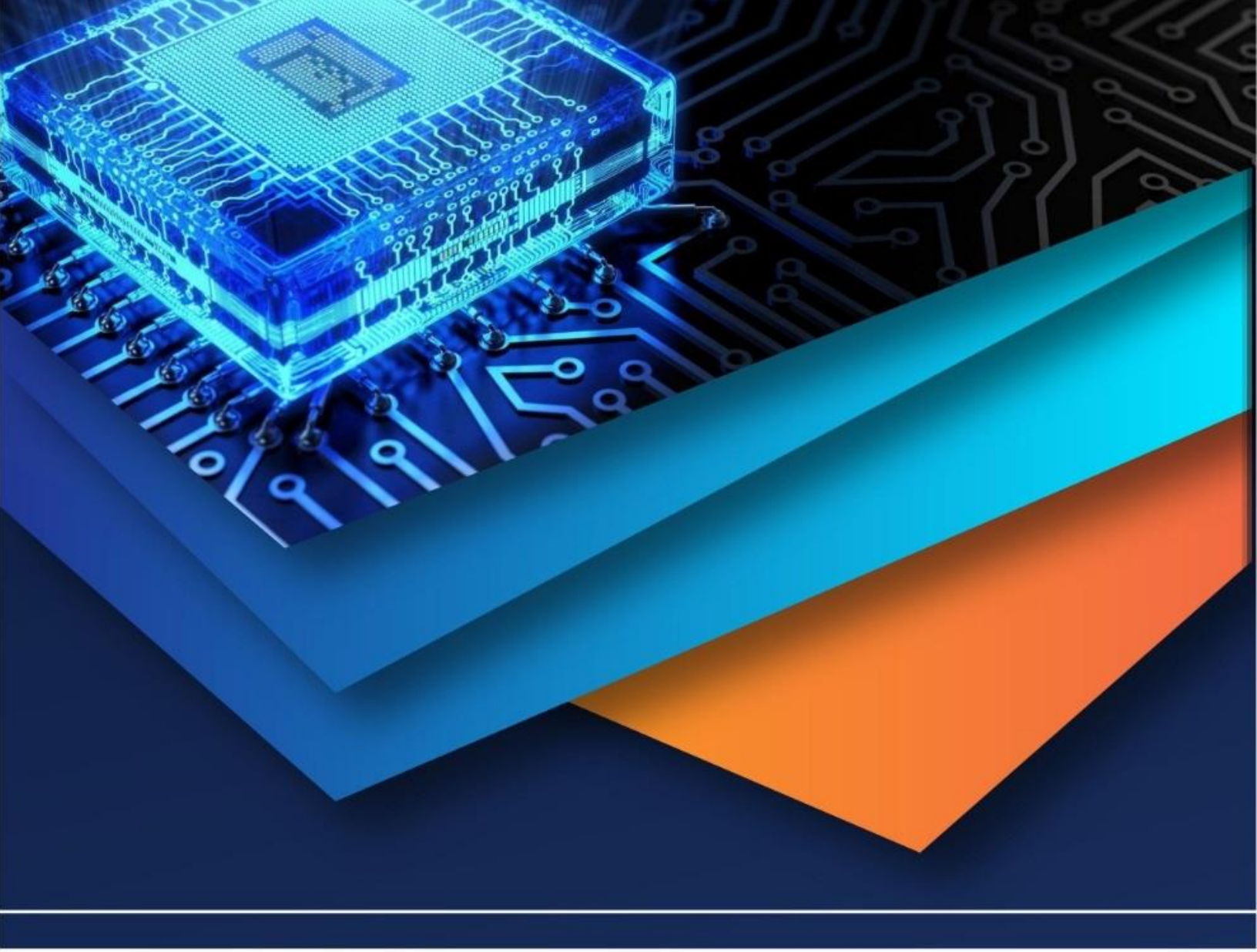
D. With this chemical, after 24 hours of stabilization we can use that road for the movement of traffic.

V. ACKNOWLEDGEMENT

I would like to express my special thanks to my guide "MR. PARDEEP SINGH" whose guidance and support motivated me to completing my paper and I also want to specially thank to "MR. PRASHANT GARG" who suggest me this topic. And "MR. GAURAV SHARMA" who helped me throughout my degree.

REFERENCE

[1] Bhavsar,S.N., Joshi, H B., Shrof,P.K., Ankit, P. J. (2014).). Impact of Marble Powder on Engineering Properties of Black Cotton Soil. International Journal for Scientific Research & Development,2(02), 136-139.
[2] Dubey,P., and Jain, R.,(2015).). Effect of Common Salt (NaCl) on Engineering Properties of Black Cotton Soil. International Journal of Science Technology & Engineering ,2(01), 64-68.
[3] Lekha,B.M., and Shankar,A.U.R.,(2014).). Laboratory Performance of RBI 81 Stabilize Soil for Pavements. International Journal of Civil Engineering Research, http://www.ripublication.com/ijcer.htm, 5(02), 105-110.
[4] Patidar,A., and Dr.Mahiyar,(2014).). An Experimental Study On Stabilization Of Black Cotton Soil Using HDPE Wastage Fibers, Stone Dust & Lime. International Journal of Advanced Scientific and Technical Research, http://www.rspublication.com/ijst/index.html , 6(04),90-98.
[5] Singh. S., and Yadav R.R.K., (2015).). Effect of Fly-Ash on Geotechnical Characteristics of Black Cotton Soil. International Journal for Innovative Research in Science & Technology, 2(03), 9-13.
[6] Ranjitha J., Supritha D.K., Hitaishi P., Kumar P.,(2016).). Experimental Study On Black Cotton Soil Stabilized Using SoilTech MK III Polymer. International Journal of Research in Engineering and Technology, http://www.esatjournals.org, 05(04),30-34.
[7] Tiwari1 A., and Mahiyar H.K.,(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, www.ijetae.com ,04(11).
[8] Verma and Abhishek, (2019) "Stabilization of Clayey Soils Using Fly Ash and RBI Grade 81", Springer Nature Switzerland, LNCE 21, pp. 95–102.
[9] Yadu L., Tripathi R.K., and Dharamveer Singh (2011).). Comparison of Fly Ash and Rice Husk Ash Stabilized Black Cotton Soil. International Journal of Earth Sciences and Engineering,04(06), 42-45.
[10] Soil Mechanics and Foundation Engineering By "DR.K.R.ARORA"
[11] I.S.2720(Part-XVI), 1979; "Indian Standard Methods of test for Soils, Laboratory Determination of CBR".
[12] IRC:37-2018 Guidelines for "DESIGN OF FLEXIBLE PAVEMEMNTS"



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY