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Stabilization of Black Cotton Soil Using Plastic Strips

[1]Shubham T. Chavan, [2]Nilesh S. Chavan, [3]Vivek S. Sapkal, [4]Pruthviraj L. Kadam, [5]Nilesh S. Pawar.
[1,2,3,4,5] *Department of Civil Engineering.*
[1,2,3,4,5] *Nanasaheb Mahadik College of Engineering, Peth, Sangli, Maharashtra, India.*

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ABSTRACT: Soil stabilization is a process which improves the physical properties of the soil, such as increasing in shear strength, bearing capacity etc. Which can be done by the use of controlled compaction or addition of suitable mixtures like cement, lime, and waste materials like fly ash, coconut shell etc. The cost of introducing these additives has also increased in recent years which opened the door widely for the other kinds of soil additives such as plastic, bamboo etc. This new technique of soil stabilization can be effectively used to meet the challenges of the society to reduce the quantities of waste, producing useful stabilization from plastic waste. Use of plastic products such as polythene bags, bottles etc is increasing day by day leading to various environmental concerns. Therefore, the disposal of plastic wastes without causing any ecological hazards has become a real challenge. Thus, using plastic as soil stabilizer is an ecological utilization since there is scarcity of good soil for construction. This project involves the study on the possible use of waste plastic. The results of CBR test have been done on Aspect Ratio of plastic strips and percentage ofplastic.

Keywords – Black Cotton Soil**,** Plastic Strips, Percentage of Plastic, Unconfined Compression test,CBR Ratio.

I. INTRODUCTION

The soil is weak and does not have enough stability to bear heavy loads. The aim of the study is to make use of waste material for stabilization of soil. For this project we have selected the use of waste plastic stripes which are generally found available as waste in abundance in every nook and corner of not only in our country but in the whole world as these days every day is found of consuming it as a food. After consumption all the plastic are thrown into the waste baskets or in the open. Soil reinforcement technique can be a significant secondary market for waste HDPE to improve the strength of sub-grade soils. This technique has been found effective and reliable method to improve the strength of sub-grade soils. A treated or stronger subgrade soils shall require relatively thinner section of a flexible pavement as compared to that of an untreated and weaker sub-grade resulting in significant cost advantage. Over the years, the use of geotextiles and other polymeric reinforcements such as geogrids has increased drastically in geotechnical engineering. However; in certain cases; especially for low cost. The study regarding the stabilization of black cotton soil by using plastic strips carried out by experimental work. These work are reviewed keeping in view the methodology, principal and various aspect for situation. Based on literature review, the gap in research work is identified to carry out further research work. Black Cotton Soils which you have referred basically falls under montmorillonite group having more swelling and shrinking characteristics. Depending on its application in civil engineering, different ways of stabilization are employed to give it more strength.

II. LITERATURE REVIEW

A. K. Choudhary et.al. [2010][1]It studied at demonstrated the potential of HDPE to convert as soil reinforcement by improving engineering properties of sub grade soil. From waste plastic HDPE strips are obtained and mixed randomly with the soil and by varying percentage of HDPE strips length and proportions a series of CBR tests were carried out on reinforced soil. There results of CBR tests proves that inclusion of strip cut from reclaimed HDPE is useful as soil reinforcement in highway application.

Mercy Joseph Poweth et.al. [2013][2] It investigated on safe and productive disposal of quarry dust, tyre waste and waste-plastic by using them in the pavements subgrade. In this paper a series of CBR and SPT test were carried out for finding the optimum percentages of waste plastics,

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and quarry dust in soil sample .Tyres alone are not suitable for sub grade. They concluded that soil plastic mixed with quarry dust maintains the CBR value within the required limit .Soil tyre mixed with quarry dust gives lesser CBR value than soil plastic quarry dust mix but it can be used for pavement subgrade.

Rajkumar Nagle et.al. [2014][3]It performed CBR studied for improving engineering performance of sub grade soil. They mixed polyethylene, bottles, food packaging and shopping bags etc., as reinforcement within black cotton soil, yellow soil and sandy soil.Their study showed that MDD and CBR value increases with increase in plastic waste. Load bearing capacity and settlement characteristics of selected soil material are also improved.

Dr.A.I. Dhatrak et.al. [2015][4] After reviewing performance of plastic waste mixed soil as a geotechnical material. It was observed that for construction of flexible pavement to improve the sub grade soil of pavement using waste plastic bottles chips is an alternative method. In his paper a series of experiments are done on soil mixed with different percentage of plastic (0.5%, 1%, 1.5%, 2%, 2.5%) to calculate CBR. On the basis of experiments that he concluded using plastic waste strips will improve the soil strength and can be used as subgrade. It is economical and eco-friendly method to dispose waste plastic because there is scarcity of good quality soil for embankment and fills.

Achmand Fauzi et.al. [2016][5]They calculated the engineering properties by mixing waste plastic HDPE and waste crushed glass as reinforcement for sub grade improvement. The chemical element was investigated by Integrated Electron Microscope and Energy-Dispersive X-Ray Spectroscopy. The engineering properties PI, C, OMC values were decreased and MDD, CBR values were increased and when content of waste HDPE and GLASS were increased

S.Dineshet.al. [2018][6]Day by day our environment is polluted by large amount of plastic wastes. However there is several plastic wastes recycled & reused. They are not done effectively. In order to prevent the environment pollution caused by plastic waste. We decided to utilize it effectively in the manufacturing of paver blocks. Large amount of plastic wastes have been collected from several places such as tourist and public places etc. High density polyethylene bags are collected, cleaned and used as a replacement for cement in the manufacturing of Paver Blocks

III. PROPOSED WORK

The material used for experimental study was black cotton soil. The various laboratory tests were performed on black cotton soil with relevant IS codes. Laboratory test were performed on black cotton soil are Water content in Black cotton soil, Specific Gravity, Liquid limit and Plastic Limit of Black cotton soil. The various tests conducted to obtain Engineering Geotechnical properties of black cotton soil.

i) SpecificGravity
ii) LiquidLimit
iii) PlasticLimit
iv) Standard proctor test
v) Unconfined compression test.
vi) California Bearing Ratiotest.

Following are the results obtained from the various tests conducted on the black cotton soil:-

Sr.No	Laboratory Test	Result
1	Water Content	21.01%
2	Liquid Limit	46%
3	Plastic Limit	28.57%
4	Plastic Index	17.43%
6	Specific Gravity	2.42
7	Maximum Dry Density	1.15 g/cm^2
8	Optimum Moisture Content	23.05%

Table 1: Engineering Properties of Black Cotton Soil

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IV. TESTSPERFORMED

Standard ProctorTest

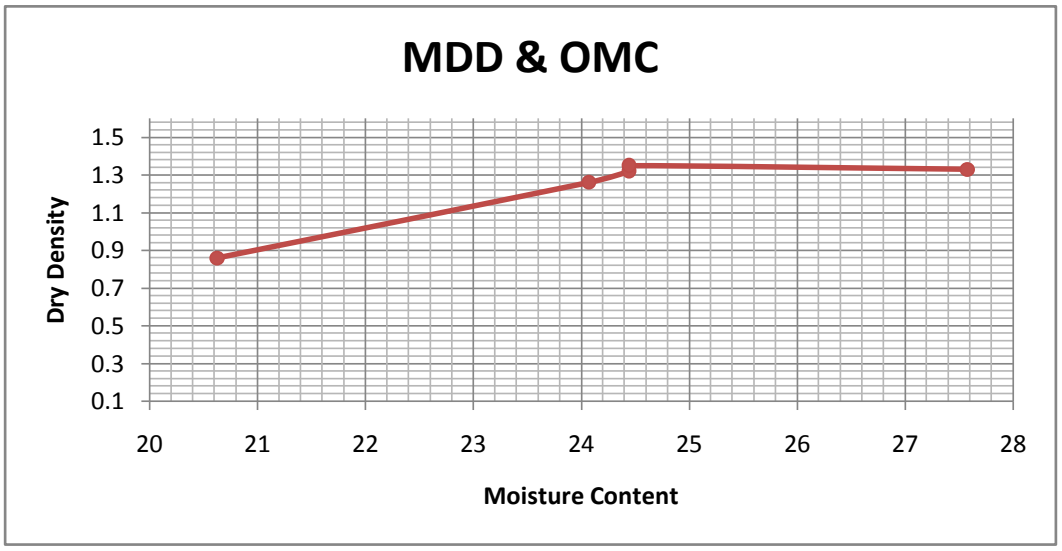
Compaction test of soil is carried out using Proctor's test to understand compaction characteristics of different soils with change in moisture content. Compaction of soil is the optimal moisture content at which a given soil type becomes most dense and achieve its maximum dry density by removal of air voids. Standard Proctor Test is used to determine the compaction of different types of soil and the properties of soil with a change in moisture content. According to Proctor, the compaction of a soil mass is dependent on the following four majorfactors:

1. Soiltype,
2. MoistureContent,
3. Compactiveeffort,
4. Dry density of thesoil

Maximum dry density is calculated by equation

Pd =M/1000(1+W)

Where,
Pd =Dry Density of soil
M= Mass of soil
w= Water content



Graph 1: MDD and OMC of Black cotton soil

The Maximum Dry Density of the Soil = 1.22 g/cm^3
The Optimum Moisture Content (OMC) =24.23%

Unconfined Compression Test

Ameasureofamaterial'sstrength.Theunconfinedcompressivestrength (UCS)istheMaximumaxial compressivestressthataright-cylindricalsampleofmaterial canwithstandunderunconfinedconditions—theconfiningstressiszero.

The primary purpose of this test is to determine the unconfined compressive strength, which is then used to calculate the unconsolidated undrained shear strength of the clay under unconfined conditions. According to the ASTM standard, the unconfined compressive strength (qu) is defined as the compressive stress at which an unconfined cylindrical specimen of soil will fail in a simple compression test. In addition, in this test method, the unconfined compressive strength is taken as the maximum load attained per unit area, or the load per unit area at 15% axial strain, whichever occurs first during the performance of a test.

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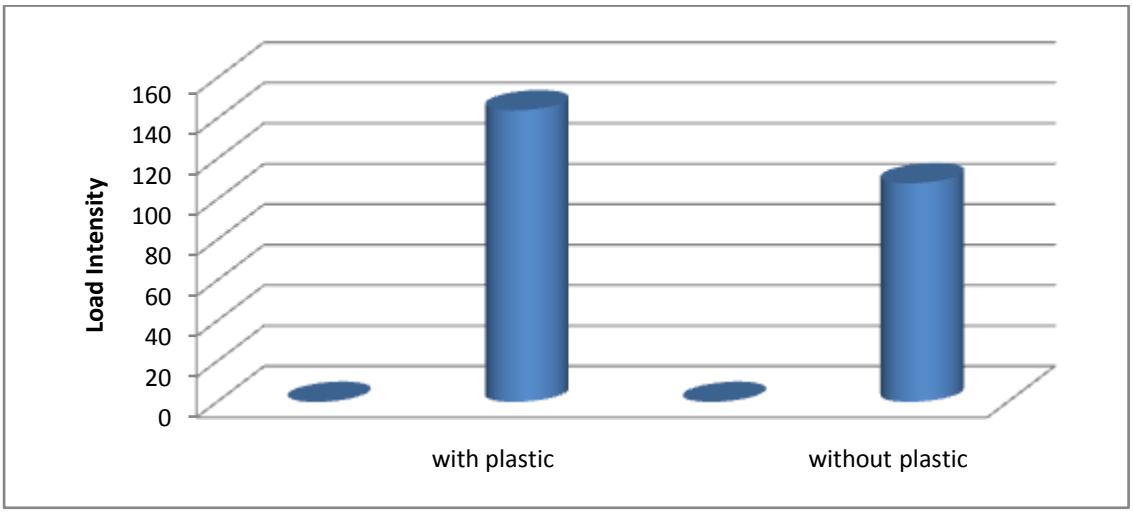
Two differentsampleare tested
A] Withplastic

Strain	D	H	Change in Length	Load	Actual Area Ac= Ao /1-strain	Compressive Strength
0.725	4cm	12cm	8.7cm	144N	45.67cm^2	3.15N/cm^2

B] Without plastic

Strain	D	H	Change in Length	Load	Actual Area Ac= Ao /1-strain	Compressive Strength
0.78	4cm	10cm	7.8cm	108N	57.09cm^2	1.89N/cm^2



Figure

No.1BarChart[DifferenceBetweenWithPlasticandWithoutPlastic]

- **California BearingRatio**

CBR test, an empirical test, has been used to determine the material properties for pavement design. Empirical tests measure the strength of the material and are not a true representation of the resilient modulus. It is a penetration test standard piston, having 50 mm diameter, is used to penetrate the soil at a standard rate of 1.25 mm/minute. The process of calculation of CBR test was done as per the prescribed IS code 2720 part 16 (1987) which was done in the remolded soil by the mean of static compaction. Then required amount of the strips in their appropriate sizes (2x12mm) were cut with the help of cutter, scale, and marker and weighed according to required percentage. The experimental study involved performing a series of laboratory CBR tests on unreinforced and randomly oriented plastic strip reinforced soil specimen. Required amount of strips as well as soil was first weighed and then the strips randomly mixed with dry soil at obtained moisture content. The soil mass formed must be a homogeneous specimen. The soil was compacted in three layers with the help of compression machine such that each layer is of 42mm. The laboratory CBR apparatus consists of a mould 150 mm diameter with a base plate and a

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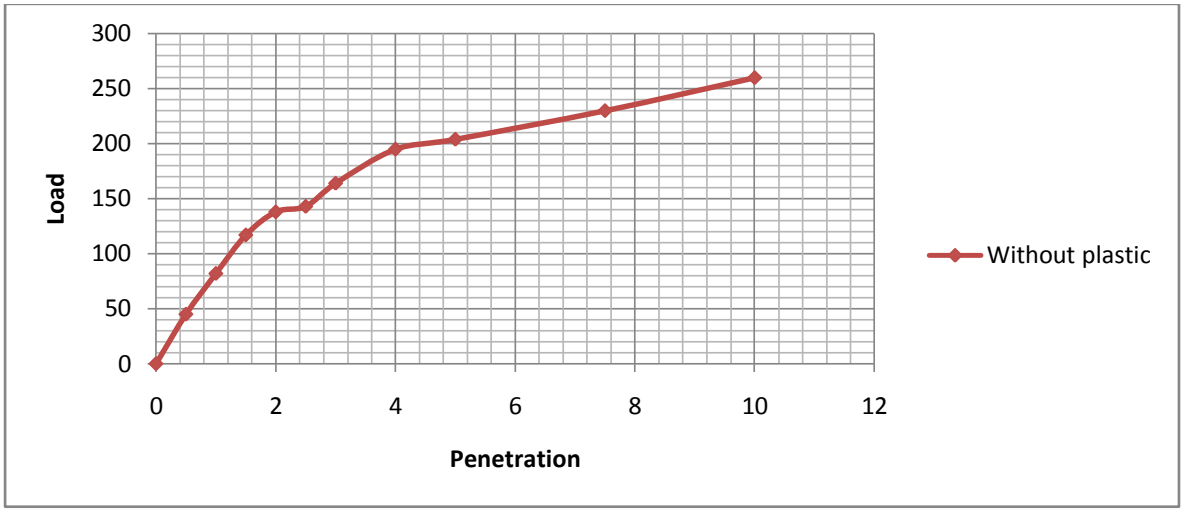
collar, a loading frame and dial gauges for measuring the penetration values. A surcharge weight of 2.5 Kg was placed over the specimen, clamped over the base plate and the whole mold with the weight is placed under the testing machine. Load is applied on the sample by a standard plunger with diameter of 50 mm at the rate of 1.25 mm/min. Reading of the load at penetrations of 0.5, 1.0, 1.5, 2.0, 2.5, 4.0, 5.0, 7.S, 10.0 are noted. After this the plunger raised and the mould detached from the loading equipment. About 20 to 50 g of soil was collected from the top 30 mm layer of thespecimen.

Size of plastic	Percentage of plastic
2x12	2.5%

Table 2: Size of Plastic and percentage of plastic used for CBR test

V. EXPERIMENTAL STUDY

The CBR test were performed on black cotton soil as per IS code 2720 part 16 (1987). The result are presented in form of load intensity-Penetration curve for black cotton soil



Graph 2: Load intensity Vs Penetration curve for Black cotton soil (without plastic

Comparison of Load intensity Vs penetration curves (Size of plastic strips 2x12) with 2.5% plastic the curves shown in graph

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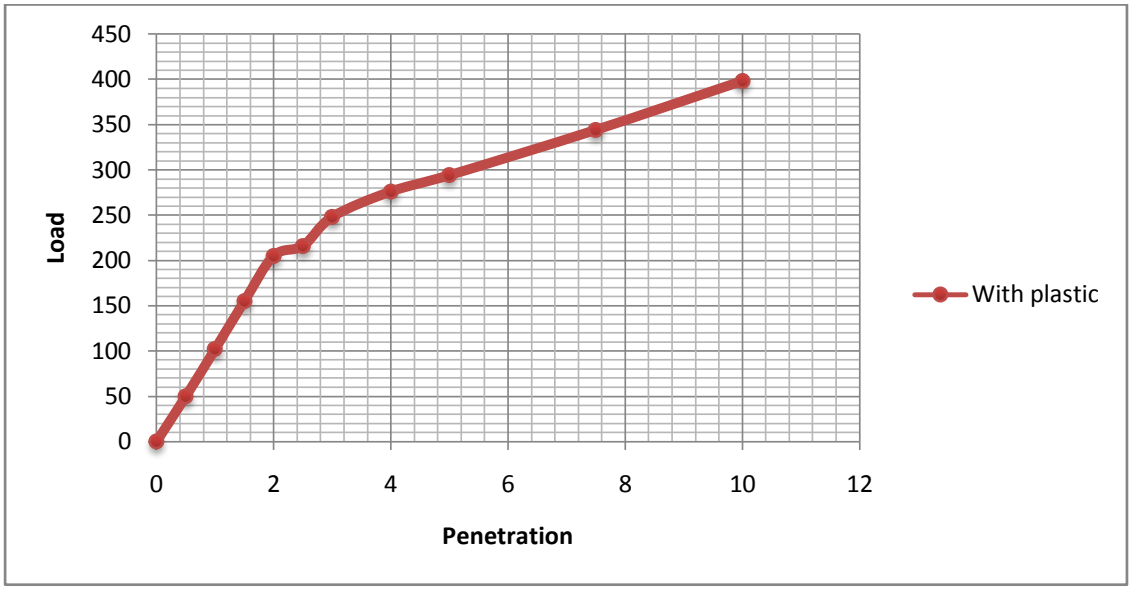

Graph 3: Comparison curves of Load intensity Vs penetration with percentage of plastic

VI. RESULTS ANDDISCUSSION

According to result obtainedlaboratory tests, it is concluded that stabilization of black cotton soil by using plastic strips. From the results it is observed that due to increase in plastic percentage in black cotton soil there is significant change in CBR value as compared to untreated black cotton soil.

C.B.R. = Test load/Standard load * 100

Without Plastic

C.B.R. of specimen at 2.5 mmpenetration: 143/1000*100=14.3%

C.B.R. of specimen at 5.0 mmpenetration: 204/1000*100=20.4%

With Plastic

C.B.R. of specimen at 2.5 mmpenetration: 216/1500*100=14.4%

C.B.R. of specimen at 5.0 mmpenetration: 294/1500*100=19.6%

VII. CONCLUSION

According to result obtained laboratory tests, we have concluded that,

1. In our day to day life the plastic material products such as bottles, polythene carry bags usage has become more, because of which today we find that more wastage is of the plastic material. Hence in order to get the best out of this wastage. The plastic stripes were made out of this plastic wastage and are used in making the payment and it is found that there is an increase in the strength of the soil.
2. From this study, we can conclude that plastic bottle strips and wastage can be used to increase the CBR value of a soil considerably. In this study we can see that the maximum CBR value can be achieved when 2.5% amount of plastic bottle strips are added to the soil.
3. Plastic waste added in soil two different manners with plastic soil sample and without plastic soil sample.
4. Load carrying capacity with plastic soil sample is more than without plastic waste.
5. Compressive strength increased using plastic waste in soil sample.

REFERENCES

[1]. Ref. IS: 2720 (Part 2) -1973, for moisture content.
[2]. Ref. IS: 2720 (Part 7) - 1980, for lightcompaction.
[3]. Ref. IS: 2720 (Part 16) - 1987 (Re-affirmed 2002), forCBR
[4]. Arora, K. R. (2004) 'Soil Mechanics and Foundation Engineering. Standard PublishersDistributors'
[5]. Dr Punmia.B.C., Jain Ashok Kumar & Jain Arun Kumar,Laxmi Publications (P) Ltd., New elhi,India,2005.
[6]. A. K. Choudhary, et al (2010): "A Study on Behaviour of Waste Plastic Strip Reinforced Soil" Emirates Journal for Engineering Research, 15 (1), 51-57 (2010).
[7]. Anas Ashraf et al(2011). "Soil Stabiliisation Using Raw Plastic Bottles" Proceedings of

Indian Geotechnical Conference December 15-17,2011,Kochi.

[8]. Mercy Joseph Poweth, et al (2013): "Study on use of plastic waste in road construction" IJIRSET march 2013,vol. 3,issue3

[9]. Rajkumar Nagle, et al (2014): "Comparative study of CBR of soil, reinforced with natural waste plastic material" Int. J. of Engineering and Science Research, Vol. 4, Issue.6, pp 304-308, 2014 .

[10]. Dr. A.I. Dhatrak, et al (2015): "performance of randomly oriented plastic waste in flexible pavement" IJPRET march 2015,vol. 3,no. 9,193-202.

[11]. Achmad Fauzi, et al (2016): "Soil Engineering Properties improvement by utilization of cut waste plastic and crushed waste glass as additive" International Journal of Engineering and Technology, Vol. 8, No. 1.

[12]. Soil stabilization using plastics and bottle strips – N. Vijay Kumar, A. V. S. Prasad, Department of Civil Engineering, K. L. University, Vaddeswaram, Guntur, Andra Pradesh, India (August 2017)

[13]. S.Dinesh, et al 2018): "Effective use of Waste Plastic as manufacturing of paver block" International Journal of Advanced Research in Basic Engineering Sciences and Technology, ISSN (ONLINE):2456-5717 Vol.4, Issue.5.