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Experimental Study on Stabilization of Black Cotton Soil Using Waste Plastic Material

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Abstract: **Infrastructure is a major sector that propels the overall development of the Indian economy. For good foundation and pavement, soil plays an important role. Expansive soils like black cotton soil always create problems in the foundation. To make the soil to be strong the addition of waste plastic to the soil will be an innovative technique for more stabilization. Soil stabilization is a process which improves the physical properties of the soil, such as increasing shear strength, bearing capacity etc.. which can be done by the use of controlled compaction or addition of suitable admixture like waste plastic. Plastic wastes have become one of the major problems of the world. Due to which we are facing environmental problems. This new technique of soil stabilization can be effectively used to meet the challenges of the society, to reduce the quantity of waste and to produce useful material from the non-useful material. The basic properties of the soil such as liquid limit, plastic limit, shrinkage limit, standard Proctor test, California bearing ratio (CBR), unconfined compressive(UCC) strength were considered. The replacement of the soil by waste plastic was carried out in four stages of 1%, 2%, 3% and 4%. Then with the replacement of plastic tests such as standard Proctor test, California bearing(CBR) test, unconfined compression(UCC) test were studied. A comparison made between the black cotton soil and black cotton soil with the replacement of plastic by various percentages.**

Key Terms: **Soil Stabilization, Black cotton soil, Max. Dry density, Unconfined compressive strength (UCC), California bearing ratio (CBR), Plastic material**

I. INTRODUCTION

Black cotton soils are inorganic clay of medium to high compressibility and form a major soil group of India .Though black cotton soil is unfit for infrastructure development; they are characterized by high shrinkage, low bearing capacity and swelling properties. Black cotton soils are very hard when it dry but losses its strength completely when it is in wet condition. Soil stabilization improves the properties of soils such as shear strength, bearing capacity etc. and thus making it more stable. It is essential when the soil accessible for construction is not suitable for the anticipated purpose. The term stabilization is generally restricted to the process which alters to the soil material itself for improvement of its properties. Plastic wastes are added to natural soil for the purpose of stabilization in this study. They are useful to protect environment and waste disposal.

II. DOCUMENTATION ON MATERIAL

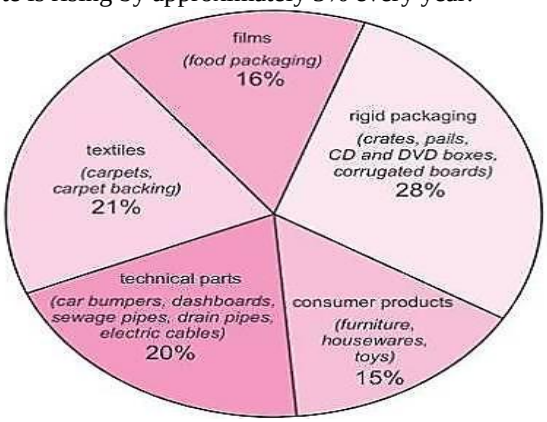
A. Soil

The black cotton soil used for the study was collected from "ILIKAL" in "BAGALKOTE" District. They are characterised by high shrinkage and swelling properties. This Black cotton soils are black in color due to presence of Titanium oxide in small concentration and occur mostly in the central and western parts and covers approximately 20% of the total area of India.

B. Plastic

More than 15342 tonnes of plastic waste generated in India every day, as per annual report of the CPCB 3.3 to 6.8 million tonnes of plastic waste are generated in country, in that 91% was collected, 27% was treated and remaining 73% was ejected at dump site.

In Bangalore about 1050 tonnes per day of plastic waste was consumed in 2015, since the consumption of plastic waste is rising by approximately 5% every year.



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III. EXPERIMENTAL DETAILS

For the experimental study we have utilized the black cotton soil and waste plastic materials. To know the properties of soil sample various tests was conducted and results were summarised as follows:

- Specific Gravity
- Moisture Content
- Liquid limit
- Plastic limit
- Shrinkage limit
- Standard proctor test
- Unconfined compressive (UCC) strength
- California bearing ratio (CBR)

IV. RESULTS

The soil properties:

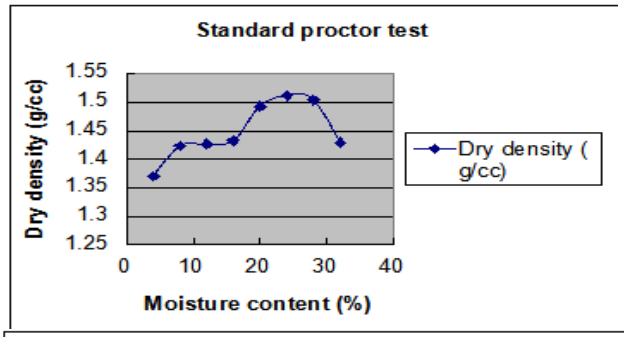
Table 1

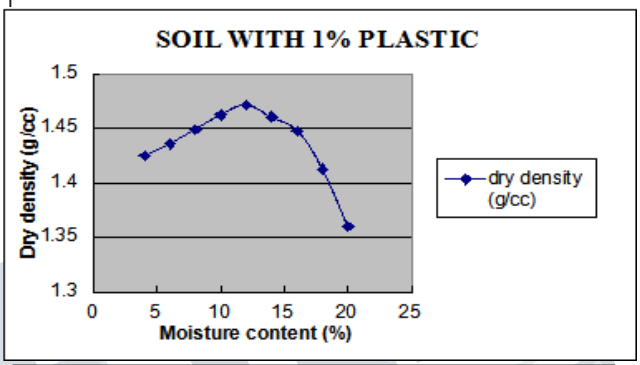
SI. NO	TEST	VALUE
1	Moisture Content	22%
2	Specific Gravity	2.5
3	Liquid Limit	78%
4	Plastic Limit	36%
5	Shrinkage Limit	21.5%

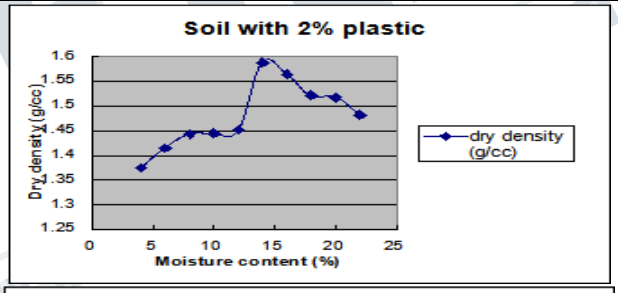
The Standard proctor test, Unconfined compression test and California bearing ratio tests was conducted by replacing soil with 1%, 2%, 3% and 4%, and results obtained are given.

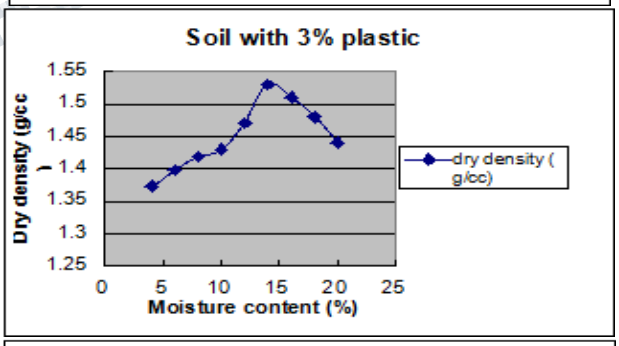
Table 2: Standard Proctor Test

SI. NO	Particulars	Standard Proctor test	
		OMC (%)	MDD (g/cc)
1	Soil Sample	24	1.511
2	Soil + 1% plastic	12	1.472
3	Soil + 2% plastic	14	1.538
4	Soil + 3% plastic	14	1.58
5	Soil + 4% plastic	16	1.52









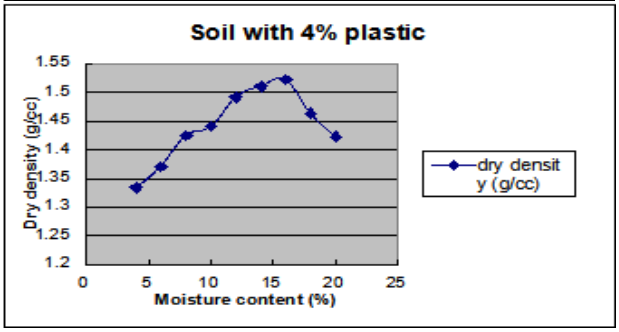


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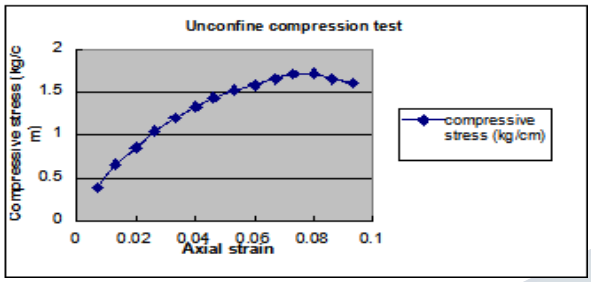
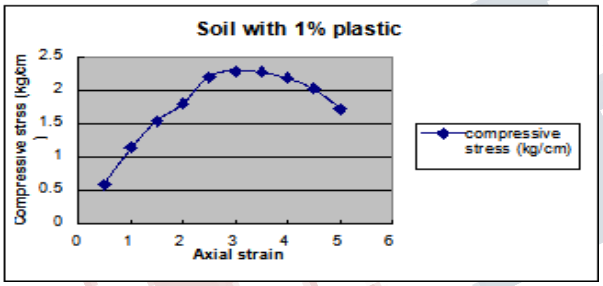
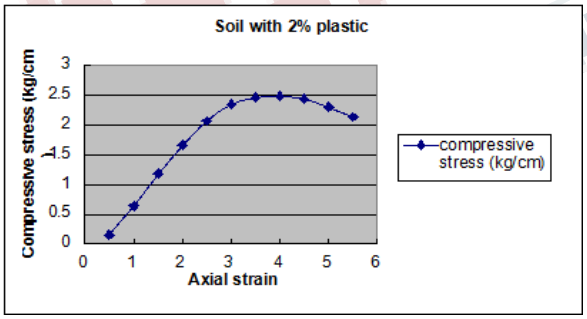
Table 3: Unconfined Compression Test

SI. NO	Particulars	Unconfined compression test (kg/cm^2)
1	Soil Sample	1.72
2	Soil + 1% plastic	2.28
3	Soil + 2% plastic	2.478
4	Soil + 3% plastic	2.713
5	Soil + 4% plastic	2.298







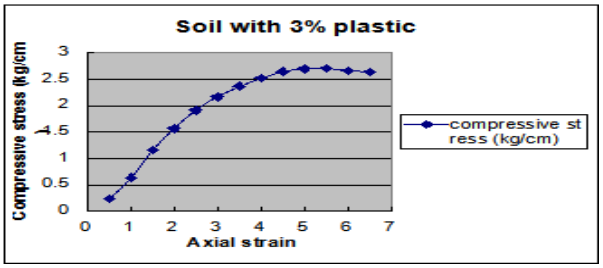
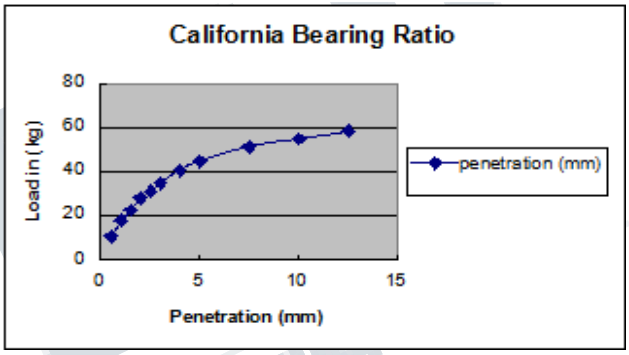
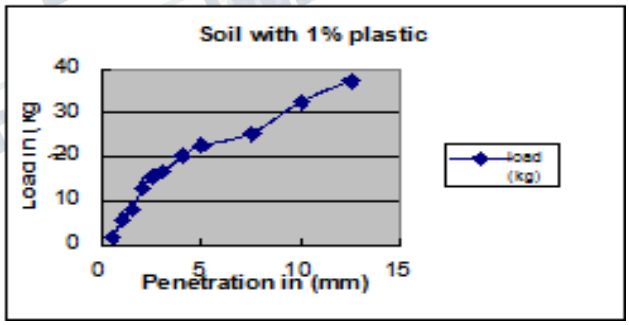
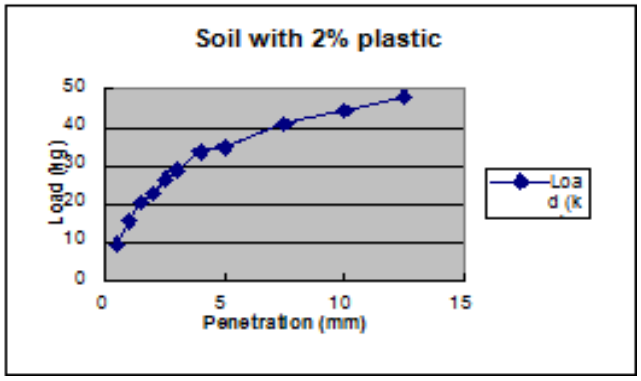


Table 4: California Bearing Ratio Test

SI. NO	Particulars	CBR penetration value	
		@2.5 mm	@5 mm
1	Soil Sample	2.2	2.18
2	Soil + 1% plastic	1.138	1.09
3	Soil + 2% plastic	1.489	1.45
4	Soil + 3% plastic	1.92	1.69
5	Soil + 4% plastic	1.48	1.28







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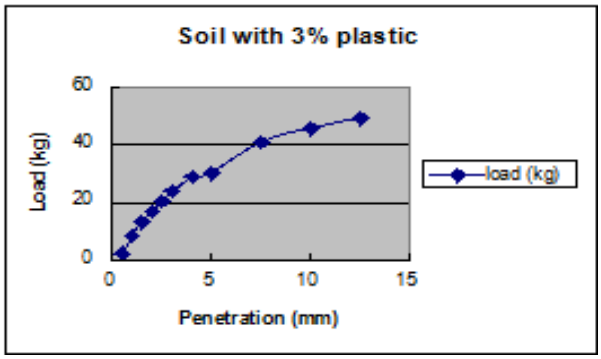

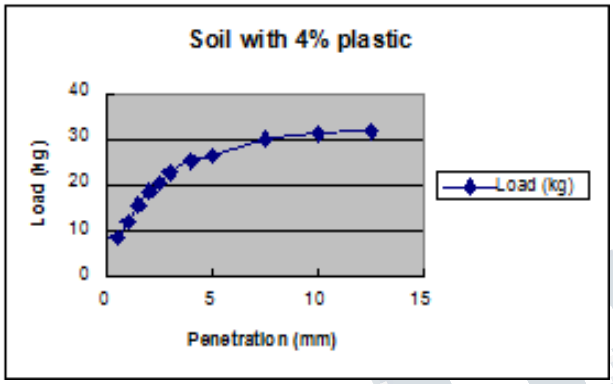

V. CONCLUSION

• The dry density of soil increased when 3% of plastic is added. Later on it started decreasing with increase in the percentage of plastic. So an optimum of 3% plastic can be used for increasing density of soil.

• The Unconfined Compressive strength of the soil increased when 3% of plastic is replaced and later on the strength decreased with further increase in plastic.

• The CBR value of soil increased with increase of plastic up to 3%, later on decreased with further increase in plastic.

• From the experiments conducted, it can be concluded that the addition of plastic can improve the strength of soil to some extent, thus increasing bearing capacity of soil.

• Hence, we can say that 3% plastic is the optimum content of plastic waste in the soil.
• Utilization of plastic in various forms day by day is not restricting its uses. In this look, using plastic as a soil stabilizer is an economical and profitable usage because there is lack of good quality soil for various constructions.

REFERENCE

[1] "Soil Stabilization Using Plastic Waste"- V. Mallikarjuna, T. Bindu Mani, V. R. Siddharatha Engineering College, Vijayawada, Andra Pradesh (2016).

[2] "Comparative study on Soil Stabilization with Polyethylene Waste Materials and binders"- Nicoleta-Maria Ilies, Alexandru-Petru circu,Andor-Csongor Nagy, Vlad-Costel Ciubotaru, Zsombor Kisfaludi-Back, Technical University of Cluj-Napoca, Romania (2016).

[3] "Stabilization of Soil by Using Waste Plastic Material"- Sharan Veer Singh, Mahadir Dixit, Central Soil and Material Research Station, New Delhi (2017).

[4] "Soil Stabilization by Using Plastic Waste"- Arpita G C Department of Civil Engineering, Amruta Institute of Engineering and Management Science, Bidadi, Bengaluru (2017).

[5] "Review Study of soil behaviour mix with waste plastic"- Devashish kushwah, Mukesh Pandey(professor and head), Rakesh Gupta(asst. Professor), Department of Civil Engineering, ITM University, Gwalior.

[6] Ref. IS: 2720 (Part 2) -1973, for moisture content.

[7] Ref. IS: 2720 (Part 7) - 1980, for light compaction.

[8] Ref. IS: 2720 (Part 16) - 1987 (Re-affirmed 2002), for CBR

[9] Text book on "Soil mechanics laboratory manual" (6th edition) by Braja. M. Das.

[10] Text book on "Soil Mechanics and Foundation" by Dr. B. C. Punmia, Dr. Arun. K. Jain, Er. Ashok. K. Jain.