SOIL STABILIZATION USING PLASTIC WASTE

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Abstract

Soil is the key element of this nature and all the basic needs of life such as food, house and cloths are fulfilled by the soil. Black Cotton soils with high potential for swelling and shrinking as a result of change in moisture content are one of the major soil deposits of India. Soil stabilization is the process which improves the physical properties of soil, such as shear strength, bearing capacity which can be done by use of controlled compaction or addition of suitable admixtures like cement, lime, sand, fly ash or by providing geo textiles, geo synthetics etc. The new technique of soil stabilization can be effectively used to meet the challenges of society, to reduce the quantities of waste, producing useful material from non-useful waste materials. Since the use of plastic in diversified forms such as chairs, bottles, polythene bags, etc., has been advancing speedily and its disposal has been a problem all the time regarding the environmental concern, using plastic as soil stabilizer would reduce the problem of disposing the plastic as well as increases the density and California Bearing Ratio (CBR) of soil in an economical way. The present study is focused to overcome the problems experienced in Amaravathi, the capital of newly formed Andhra Pradesh State. In the present study, an experimental program was conducted for stabilization of Black Cotton Soils in the Capital Region i.e., Amaravathi of newly formed Andhra Pradesh, with the utilization of Plastic waste as soil stabilizer. Different contents of plastic strips (% by weight varying from 0% to 8%) are added to the Black Cotton Soil and the optimum percentage of plastic strips in soil was found out by conducting California Bearing Ratio Test.

Keywords: *Amaravathi, Andhra Pradesh, Black Cotton Soil, California Bearing Ratio, Plastic, Soil And Stabilization.*

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1. INTRODUCTION

Soil deposits in nature exist in an extremely erratic manner producing thereby an infinite variety of possible combination which will affect the strength of the soil and the procedures to make it purposeful.

Major soil deposits in the capital Region (Amaravathi) of newly formed Andhra Pradesh are Black Cotton Soils which are very fertile and suitable for agriculture but not good for construction of Civil Engineering Structures because of its low Bearing Capacity and intensive shrink-swell process which results in development of cracks. With the formation of new capital, rapid Industrialization, bursting population and decrease of available land, more and more number of buildings and other civil engineering constructions has to be carried out on available Black Cotton soils which are having poor shear strength. Hence, a great diversity of ground improvement techniques such as soil stabilization and reinforcement are needed to be employed to improve behavior of soil, thereby enhancing the reliability of construction.

In the present situation, Stabilizing of soils is of utmost importance in Amaravathi region which makes them suitable for various construction activities. Various materials and methods may be used for stabilizing soils and are presented below.

1.1 Methods of Soil Stabilization

There are different materials in utilization for the stabilization of black cotton soils. Depending on the internal factor which describes the bonding between the soil and the stabilizer utilized, the methods are broadly classified into two types. They are

1. Mechanical Stabilization: It is based on the principle of friction i.e., when the admixtures are added to soil and compacted the strength is enhanced due to the friction between the soil and the material added. Examples for the materials which increase the strength by this principle are sand, plastic, geo textiles etc.

2. Chemical Stabilization: It is based on the chemical reaction between the material added and the minerals in soil. Examples for this type of stabilizers are lime, fly ash, bituminous materials, cement etc.

Plastics are considered as one of the important invention which has remarkably assisted in different aspects of life whether it might be in scientific field or others. The use of plastic has been enormously increasing these days. But now, plastic has become the significant pollutant of Environment because of the Use and Throw mechanism and everyone should think about this in the present scenario. The use of plastic has to be limited by now otherwise there would be harshly circumstance that human and environment has to face in near future. Since Plastic is a non-decomposable material, the necessity for recycling or reusing it, is also increasing thereby reducing its wastage. Utilizing this Plastic waste for a positive purpose assists in reducing its effect on environment also.

Stabilization was coined as to make anything in a stable condition which itself is a challenging task. Various researches are going on for incorporating the waste to the soil and stabilizing it so that it can be utilized for different purposes. Thus, using plastic as stabilizer will help in two ways, in addressing the problem of disposing the plastic waste and also using the most available black cotton soils wherever possible.

The present study deals with the stabilization of Black cotton soils in the Capital Region of newly formed Andhra Pradesh State i.e., Amaravathi by utilizing plastic strips produced from used plastic chairs. The proper proportion in soil helps in controlling the compaction factor and also makes it very useful. This study indicates that Plastic wastes can be utilized for stabilization of soil which is concluded from different tests performed on soil in various percentages of plastic content.

2. OBJECTIVES

- To increase the density and California Bearing Ratio (CBR) of soil using plastic as an admixture.
- To provide an alternative solution for the disposal of plastic waste.
- To provide an economical solution for soil stabilization using plastic waste.
- To determine the optimum plastic content to be used.

3. METHODOLOGY

The materials which are considered are soil and plastic with chemical composition of poly propylene. Tests are conducted to determine different properties of soil sample collected and results are tabulated and presented in Table 1.

Table 1: Properties of Soil Sample

S. No	Laboratory Test	Result
1	Swelling Index	65.3%
2	Specific Gravity	2.62
3	Sieve Analysis	
	Gravel	0%
	Coarse Sand	0%
	Medium Sand	0%
	Fine Sand	0%
	Silt and Clay	100%
4	Atterberg Limits	
	Liquid Limit, LL	68.5%
	Plastic Limit, PL	33.3%
	Plasticity Index, PI	35.2%
5	Unconfined Compression Test	
	Compressive Strength	90.8 kg/cm^2
6	Modified Proctor Test	
	Optimum Moisture Content, OMC	20.5%
	Maximum Dry Density, MDD	1.62 gm/cc
7	California Bearing Ratio Test, CBR	1.0%

The plastic which was collected from used plastic chairs are collected and are made into different strips. Plastic strips with a density about 0.42 gm/cc are added to the Black Cotton Soil in percentages of 2, 4, 6 and 8 and the modified proctor test has been conducted on the sample and graphs obtained are shown below in Figures1 to 4.

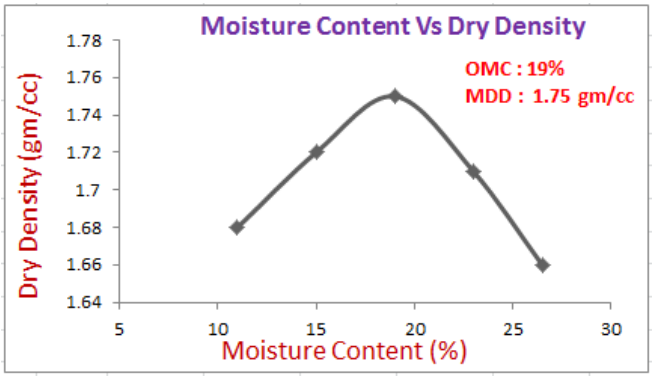

Fig. 1 Soil with 2% plastic

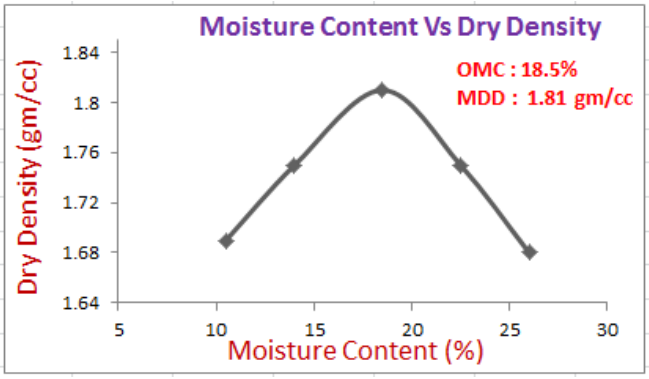

Fig. 2 Soil with 4% plastic

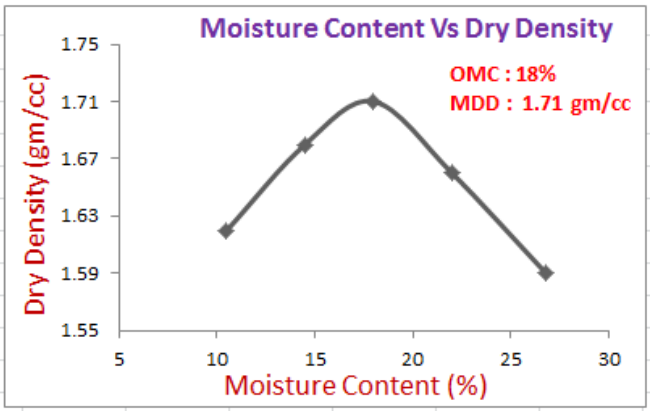

Fig. 3 Soil with 6% plastic

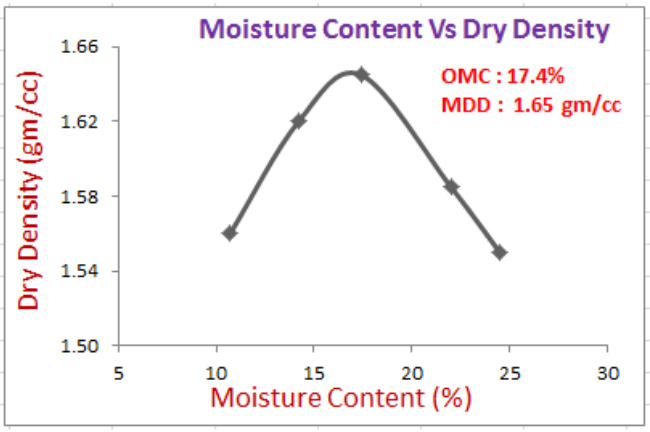

Fig. 4 Soil with 8% plastic

Similarly, California Bearing Ratio (CBR) Test was conducted to obtain the CBR Value on the samples with plastic strips in various percentages of 2, 4, 6 and 8 and the results obtained are presented as load vs penetration graphs below in Figures 5 to 8.

California Bearing Ratio, CBR = (Load / Standard Load) * 100

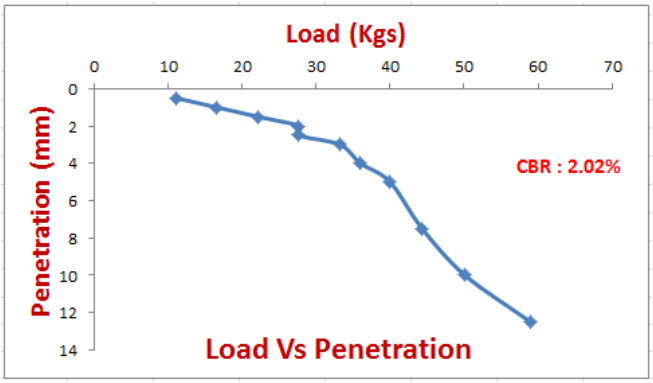

Fig. 5 Soil with 2% plastic

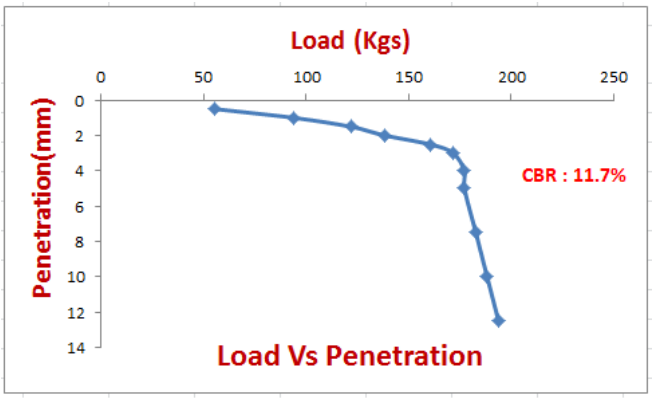

Fig. 6 Soil with 4% plastic

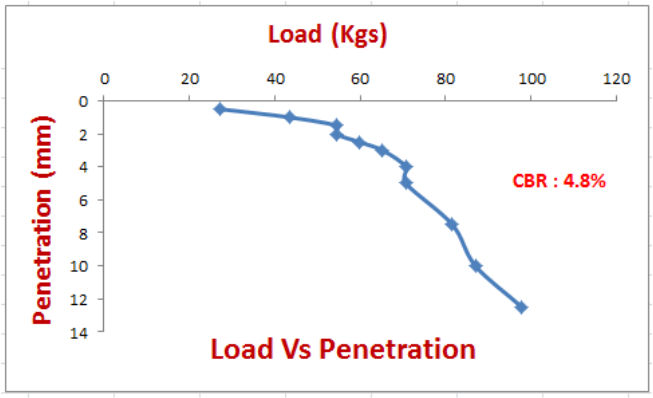

Fig. 7 Soil with 6% plastic

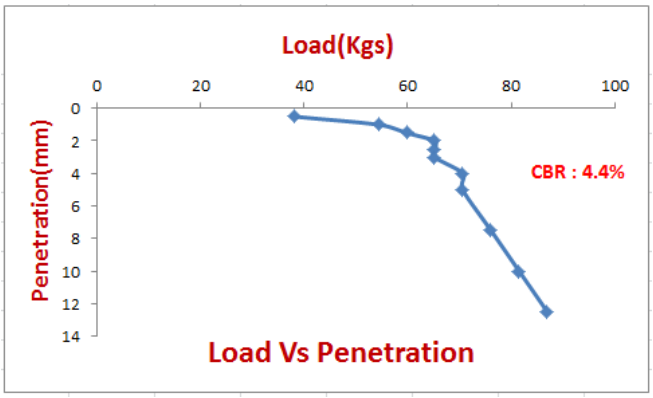

Fig. 8 Soil with 8% plastic

4. RESULTS AND DISCUSSION

CBR can be said as the indirect measure of the strength as soil deformed was shear in nature. From the results, it is evident that waste plastic increases the CBR value. There is a major increase in CBR value when the soil is incorporated with Plastic strips and compared to that of soil with no plastic. The results are tabulated and presented below in Table 2.

CBR test is performed on the samples with varying percentages of Plastic strips i.e., 2%, 4%, 6% and 8%. In this regard, the CBR value has been increasing up to 4% plastic content and thereon it started to decrease. From this, it can be inferred that, 4% plastic content is the OPTIMUM CONTENT of utilization of waste plastic in the soil.

Table 2: Test Results of Soil Sample Incorporated with Plastic Strips

Sample Description	MDD (gm/cc)	OMC (%)	CBR (%)
Soil	1.62	20.5	1.00
Soil with 2% plastic	1.75	19.0	2.02
Soil with 4% plastic	1.81	18.5	11.70
Soil with 6% plastic	1.71	18.0	4.80
Soil with 8% plastic	1.65	17.4	4.40

Where,
MDD is maximum dry density
OMC is optimum moisture content
CBR is California bearing ratio

5. CONCLUSIONS

In the present study**,** the improved CBR value of the soil is due to the addition of plastic strips. Plastic can be utilized as one of the material that can be used as a soil stabilizing agent but the proper proportion of plastic must be there, which helps in increasing the CBR of the soil.

It can be concluded that CBR percentage goes on increasing up to 4% plastic content in the soil and thereon it decreases with increase in plastic content. Hence, we can say that 4% plastic content is the optimum content of plastic waste in the soil.

Utilization of plastic products in various forms is enormously increasing day by day. This has an adverse effect in nature and it is not possible to restrict its uses. In this regard, the disposal of the plastic wastes without causing any ecological hazards has become a real challenge to the present society. Thus, using plastic as a soil stabilizer is an economical and gainful usage because there is lack of good quality soil for various constructions.

This work serves as a means to meet the challenges of Amaravathi, the capital of newly formed Andhra Pradesh State and also to the whole society by reducing the amount of plastic waste and producing useful product from non-useful waste materials leading to the foundation of sustainable society.

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BIOGRAPHIES

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