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Stabilization of Black Cotton Soil Using Plastic Waste

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ABSTRACT: Soil stabilization is a process that improves physical soil characters such as increased shear resistance; load capacity etc can be done by compacting or adding appropriate additives such as cement, lime, and waste materials such as ashes flying, foci, etc. The cost of introducing these additives has increased in recent years, which has opened the door for the development of other soil additives such as plastic, bamboo etc. This new technique can be used to stabilize the soil efficiently to respond to the challenges of society and to decrease the amount of waste, the production of useful materials from waste materials that are not useful. The use of plastic products such as plastic packets and covers, etc is increasing day by day, resulting in various environmental concerns. The use of plastic as a stabilizing reason reduces the problem of plastic disposal as well as the density and increases the proportion of California Bearing (CBR) soils in an economical way. This study focuses on overcoming the problems encountered at Amravati, the state capital of Andhra Pradesh. In the present study, an experimental program for the stabilization of black cotton soil in the new capital region Amravathi of the Andhra Pradesh has been carried out with the use of plastic waste as stabilizer. Different proportions of plastic fibers (% by weight from 0% to 1.5%) in the black cotton soil are added and the optimum percentage of plastic fibers is obtained on the floor by carrying test cushion of the California ratio.

KEYWORDS: Black Cotton Soil, CBR, OMC, MDD, Plastic fibers, UCS and Stabilization.

I. INTRODUCTION

Soil stabilization means the development of stability or bearing power of the soil by the use of controlled compaction, proportioning and the addition of appropriate admixture or stabilizers. Major soil deposits in the Amravati is 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 severe shrink-swell process which results in growth of cracks. Hence, a great range of ground development techniques such as soil stabilization and reinforcement are needed to be engaged to improve the behavior of soil, thereby enhancing the consistency of construction. In the present situation, Stabilizing of soils is of extreme 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.

1.2 Methods of Soil Stabilization

There are various 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 refers to either compaction or the introduction of fibrous and other non-Bio-degradable reinforcements to the soil. This practice does not oblige chemical change of the soil. There are a number of methods used to accomplish mechanical stabilization.

2. Chemical Stabilization: The method of improving the engineering properties of soil is by adding chemicals or other materials to improve the existing soil. This technique is generally cost effective: for example the cost transportation and

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processing of a stabilizing agent such as soil cement or lime to treat an in place soil material is probably more economical than importing aggregate for the same thickness of the base course.

1.3 Scope of Study

Plastics are considered as one of the important discovery which has remarkably assisted in different aspects of life whether it might be in scientific field or others. The use of plastic has been extremely increasing these days. But now, plastic has become the major 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 Situation that human and environment has to face in near future. Since Plastic is a non-decomposable material, the requirement for recycling or re-using it is also increasing there by reducing its wastage. Utilizing this Plastic waste for a positive purpose assists in reducing its effect on environment also.

The present study deal with the stabilization of Black cotton soils in the Capital Region of Andhra Pradesh State i.e., Amravati by utilizing plastic fibers produced from used plastic milk packets and covers. The proper quantity 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 fulfilled from different tests performed on soil in various percentages of plastic content

II.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 cheap solution for soil stabilization using plastic waste.
- >To determine the optimum plastic content to be used.

III. MATERIALS

Component Materials:

1. Soil
2. Plastic Fiber

Soil:The clayey soil used for the study was collected from Amaravati in Guntur district. Major soil deposits in the capital Region (Amaravathi) 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 serious 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.

Plastic fiber :Plastic fibers were obtained from waste plastic cover (milk and curd packets). After proper cleaning and air drying, the plastic covers were shredded into fibers each of average thickness of 2mm. These plastic covers are usually considered to be waste materials.

VI. RESULTS

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 are shown below.

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Table 1: Properties of Soil Sample

S.No	Laboratory Test	Result
1	Swelling Index	64.3%
2	Specific Gravity	2.58
3	Sieve Analysis	
	Gravel	0%
	Coarse Sand	0%
	Medium Sand	0%
	Fine Sand	0%
	Silt and Clay	100%
4	Atterberg Limits	
	Liquid Limit, LL	67.2%
	Plastic Limit, PL	33.4%
	Plasticity Index, PI	34.8%
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%

Engineering Property Tests:

Tests were conducted on untreated sample and Samples with 0.25%, 0.5%, 1% and 1.5% replacement of soil with plastic fibers. The tests were conducted as per the procedure specified in IS 2720 part VII- 1980.the standard proctor test and unconfined Compressive tests were conducted. The results from the two tests are shown below.

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Table 2
Results from Proctor test conducted

Soil Sample	Compressive strength (N/mm ²)
Untreated soil	0.0420
99.75%soil + 0.25% Plastic	0.0593
99.5% soil + .5% Plastic	0.0732
99% soil + 1% Plastic	0.0624
98.5% soil + 1.5% Plastic	0.0324

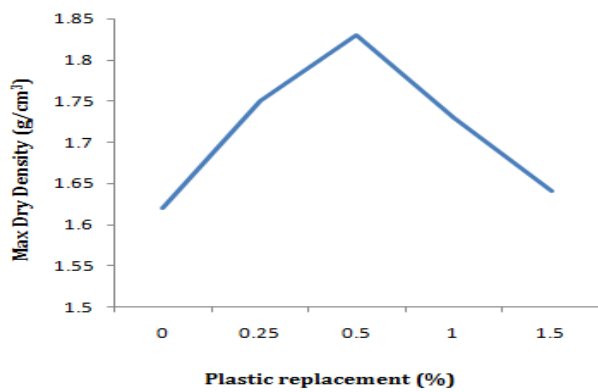


Figure 1

Figure1.shows the variation in the values of Maximum Dry Density for untreated soil sample, and treated soil samples with 0.25,0.5,1,& 1.5% plastic replacement. It can be seen that the Maximum Dry Density increased from 1.62 for untreated soilsample to 1.84for soil sample with 0.5% plastic replacement. But thereafter the value decreases. The increase in the maximum Dry Density is due to the decrease in the number o f voids due to the addition of plastic. This will improve compaction which in turns reduce the OMC and increase the Maximum dry Density.

Table 3
Results from UCS test conducted

Soil Sample	OMC(%)	MDD(g/cm ³)
Untreated soil	20.5	1.62
99.75%soil + 0.25% plastic	16.21	1.76
99.5%soil + 0.5% plastic	18.37	1.84
99%soil + 1% plastic	16.06	1.73
98.5%soil + 1.5% plastic	21.32	1.64

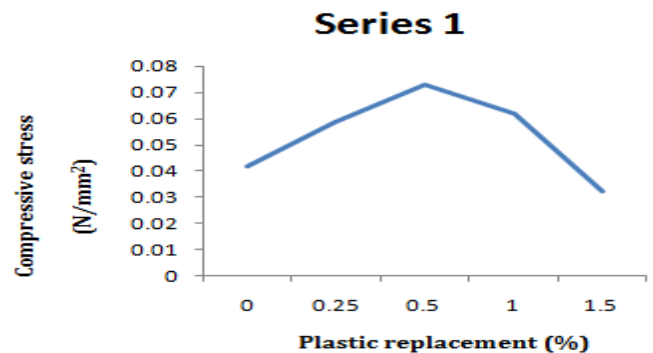


Figure 2

The Figure2. shows the variation in the values of UnconfinedCompressive Strength of the untreated soil sample and soil .Samples which are treated with 0.25,0.5, 1, and 1.5% plastic. The UCS is increased from 0.0420N/mm2 for untreated soil sample to 0.073 N/mm2 for soil sample treated with 0.5 %plastic. The strength of the samplethen decreases with

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further addition of plastic. The maximum value in strength is achieved corresponding to optimum plastic content i.e. 0.5% plastic content. With the addition of plastic to the sample of soil there is an increase in the cohesion of soil which leads to increase in UCS of the soil. But further increase in the plastic content leads to decrease in the cohesion and thereby decrease in the strength. Also the shear strength of the soil which is directly related to the cohesion shows a similar pattern such that a maximum value is obtained at 0.5% plastic replacement and then it decreases.

V. CONCLUSION

The project is focused on the performance of Plastic fiber as soil stabilization material. The study suggests that if the plastic fibers are properly mixed and applied then it can be used as a great soil stabilization technique on the basis of the results obtained.

- 1) 0.5% of replaced plastic fiber to the expansive clay soil reduces the OMC and increase the MDD.
- 2) The UCS of the soil was found to be increased for 0.5%.
- 3) With 1% replacement it was observed that the MDD & UCS was less than that of 0.5% replacement but was greater than that of untreated soil.
- 4) Further increase in the plastic replacement showed reduction in the MDD and the UCS of the soil.
- 5) Optimum percentage of plastic is recommended at 0.5% which will improve the engineering characteristics of black cotton soil.
- 6) Increase in the MDD of the soil is due to the decrease in the number of voids with the addition of plastic which leads to the effective compaction and also increase in the cohesion.

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