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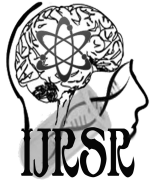
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Case Report

SOIL STABILIZATION USING WASTE PLASTIC STRIPS

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ABSTRACT

The stabilization can be done by usage of plastic strips. Plastic consumption is increasing day by day due to rapid growth in population and urbanization, recycling of these plastics is very less compared to its production and a large quantity of plastic is dumped in to landfills as waste. In present work, this plastic was made in to strips mixed with black cotton soils was studied by carrying unconfined compression tests and California bearing ratio tests. The plastic strips were added in different proportions by dry weight (0.05%, 0.1%, 0.15% and 0.2%) of the soils. The results showed that there is appreciable increase in strength and CBR value for the black cotton soils by the addition of plastic strips. The proposed method can be used for small projects like implementing for construction of pavements for village roads. The thickness of pavement layer can be reduced by using waste plastic strips.

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INTRODUCTION

General

Engineers are often faced with the problem of constructing facilities on or with soils, which do not possess sufficient strength to support the loads imposed upon them either during construction or during the service life of the structure. Many areas of India consists of soils with high silt contents, low strengths and poor bearing capacities. The poor engineering performance of such soils has forced Engineers to attempt to improve the engineering properties of poor quality soils. There are various methods that could be used to improve the performance of poor quality soils. The choice of a particular method depends mainly on the type of soil to be improved, its characteristics and the type and degree of improvement desired in a particular application. Stabilization of soils is an effective method for improving the properties of soil and pavement system performance.

The objectives of any stabilization technique used are to increase the strength, durability, erosion control, improve workability and constructability of the soil. For any given soil stabilization may be effective to improve the soil properties rather than removing and replacing the material. Availability or financial consideration may also be determining factor on which the stabilizing agent is selected.

Due to rapid growth in population and development activities suitable ground for constructions are depleting day by day. This situation leads to take unsuitable ground for construction by improving the properties of these soils. Soil stabilization is one of the best methods to improve the properties of soil. Inclusion of plastic waste strips comes in the category of reinforced earth technology of soil stabilization. Plastic products have become an integral part in our daily life. Once the plastic is discarded after its utility is over, it is known as plastic waste. We are using the plastic waste from waste worn out cement bags, it is a fact that plastics waste never degrades, and remains on landscape for several years. Mostly, plastic waste is recycled but, recycled plastics are more environment as they contain additives and colours. The usage of plastic strips in geotechnical engineering applications is one of the better method to improve the engineering properties of soil and to control the percentage of plastic waste in environment to use this plastic waste for improving the engineering properties of soil by adding waste plastic strips. The stability and performance of pavements are greatly influenced by the sub-grade as they serve as foundations for pavements. Roads on black cotton soils pose challenges in selecting suitable soil modification technique. The quality of a pavement depends on the strength of its sub-grade. A sub-grade soil must meet adequate strength requirements as per IRC -37 (2007). If not, there is a need to replace the natural soil by another soil with improved

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Aims & Objectives of the study

The aim of the research is to increase the physical properties of black cotton soil. The behavior of expansive soils is very uncertain when it is subjected moisture changes. These changes pose considerable challenge for the civil engineers during construction activities specially while constructing foundations. The strength of soil changes when water occupies large spaces in the voids of the soil. The general recognizable features of this effect are excessive compression of soil, collapsing behavior, high permeability, high swelling capacity and low shear strength. These undesirable characteristics make the black cotton soil unfit for construction purposes, hence they need to be stabilized before they can be put to use. Though black cotton has unfavourable characteristics for infrastructural developments, they are useful as agents of environmental protection and waste disposal.

MATERIALS USED

Black cotton soil (BC)

These soils have been formed from basalt or trap and contain the clay mineral montmorillonite, which is responsible for the excessive swelling and shrinkage characteristics of the soil. These soils have high clay content. They are rich in minerals like iron, lime, calcium, alumina. Lightly loaded structures are most susceptible to damage as a result of the volume changes in the soil. Black Cotton Soils are made of varying proportions of minerals like Montmorillonite, illite and Kaolinite, Chemicals, like Iron oxide and Calcium Carbonate and organic matter like humus. Montmorillonite is a Predominant mineral of black cotton soils. The swelling and shrinkage behaviour of black cotton soils originate mainly from this mineral. Clay minerals are hydra silicates of aluminium and magnesium. They are made of sheets of silica and alumina stacked one above the other forming sheet like structure with expanding lattice. The structure of some aluminium is by magnesium ions and the mineral becomes chemically active. They attract water molecules (dipoles) and various types of hydrated cat ions to the surface causing the soil to increase the volume.

Abundance of calcium in black cotton soils to yet another feature. It may be present in the form of saturating ions. Treatment with the Sodium about base exchange and the soils become softer and more plastic. Organic matter in the form of humus makes these soils more plastic and compressible. The dark colour of the black cotton soils is believed to be either due to humus or titanium oxide. Black cotton soils are found to have the following chemical properties. $\text{CaCO}_3=5-15\%$, $\text{SiO}_2=50-55\%$, $\text{SiO}_2/\text{Al}_2\text{O}_3=3.5\%$ Montmorillonite minerals = 30-50 %.

Table.1 properties of B C soil

Properties	Values
Dry density	1300-1800 Kg/m ³
Liquid limit(%)	50-120
Plastic limit(%)	20-60
Soil classification	CH-MH

Waste plastic strips

Plastic used in this study are disposal cement plastic bags. It has low weight and ease of transportation and very low impermeability. The disposal of waste plastic cement bags used

in this study collected from CIT gubbi campus. By collecting this plastic bags are cut in to the pieces. The thickness of the plastic strips consists of 10 μ . The length and breadth of the plastic strip is 3mm*20mm. fig (1) shows waste plastic bags. And fig (2) the strips are prepared from waste cement bags.



Fig.1 waste plastic bags



Fig.2 plastic strips

METHODOLOGY

Plastic strips are mixed at different percentage i.e., 0.05%, 0.1%, 0.15%, 0.2% to the dry weight of soil. Modified proctor test, unconfined compression strength test and California bearing ratio tests are conducted to determine the strength and C B R values of the soils. Mixing of plastic strips in soil have be done carefully such that these strips are distributed uniformly in the soil. The mixing is done manually and proper care is taken to prepare a homogeneous mixture.

Modified compaction proctor test:

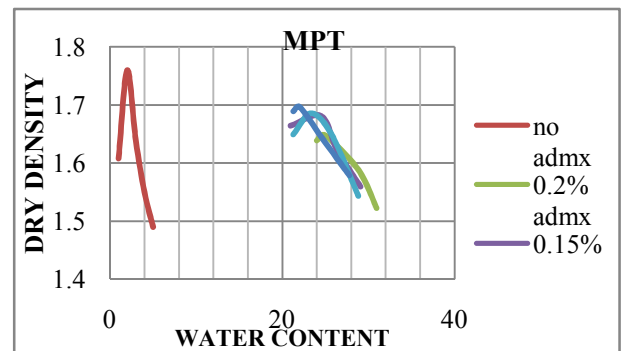
The modified proctor test was conducted to determine the optimum moisture content (OMC) and maximum dry density (MDD) of BC soil. The stabilizer such as plastic strips was added to the black cotton soil at varying percentage of 0.05%, 0.1%, 0.15%, 0.2%.



Fig.3 modified proctor apparatus

Table.2 Compaction values Comparison

Plastic strips	0%	0.05%	0.10%	0.15%	0.20%
Max dry density g/cm ³	1.64	1.695	1.68	1.68	1.65
Optimum moisture content	24.6%	22%	23%	24.5%	25%



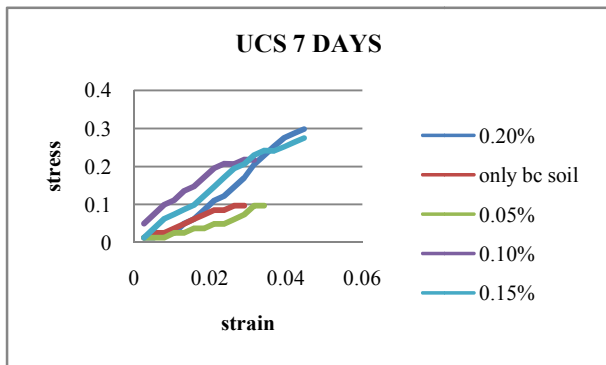
Graph 1 shows the comparison between the plain BC soil and soil with various percentages of admixture.

Unconfined compressive Strength test

The UN confined compression strength test gives the undrained shear strength of the soil a simple and quick way and is determined at which the cylindrical specimen fails in compression at 15% of strain. The strips are uniformly mixed in to the black cotton soil and prepared UCS mould as shown below fig (4). After completing the curing of mould, the mould is tested by UN compressive strength test apparatus.



Fig 4 sample prepared by plastic strips.



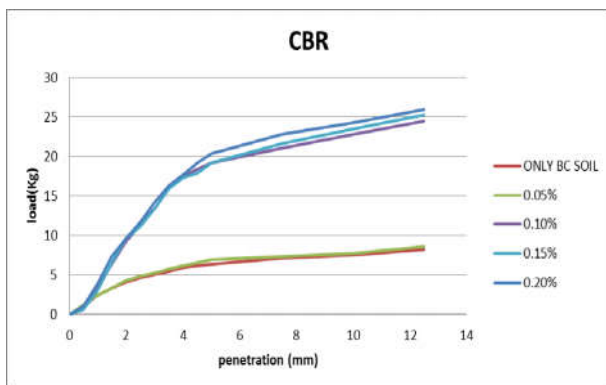
UCS value comparison with plain BC soil with soil containing plastic strips of varying percentage

California bearing ratio test

The specimens are prepared by mixing different percentage of plastic waste strips and then they are kept under CBR testing machine to determine CBR values.

Table.3 CBR value comparisons

CBR value	0%	0.05%	0.10%	0.15%	0.20%
2.5 mm	3.4	3.50	9.48	9.44	9.92
5 mm	3.06	3.26	9.24	9.28	9.88



Graph 2 shows the CBR values comparison between plain BC soil and soil with various admixture.

RESULTS AND DISCUSSION

At 0.05% plastic the Max Dry Density is very high compared to plain BC Soil, but the amount of water content to achieve the density is less when compared to untreated BC Soil. At 0.2% plastic the Max Dry Density is only 0.1% more than plain BC soil and is achieved at similar Water Content when compared to untreated BC Soil. But it is observed that beyond 0.2% of plastic the decrease in Max Dry Density with increase of Optimum Water Content was seen. It was found that the UCS value increased with the increase in curing days. Large change in UCS value was not observed with 0% and 0.05% and when 0.10% and 0.15% was compared. This was because there wasn't a significant increase in the weight of plastic added. The UCS value could be further increased with increase in the length of plastic strips, which provides better integrity to the mould.

CONCLUSION

There are many natural wastes being sent out to environment, plastic waste is one such waste. Being produced in large quantities, the cost towards the application is very less. After the experiment study made it was found that the plastic waste can be used as stabilizer in improving the properties of Black Cotton soil. However the application is bounded to minor projects.

1. Use of plastic products such as waste plastic bag strips is increasing day by day the disposal of plastic waste without causing ecological hazards has become a real challenge to the present society. Thus using plastic strips is an economical and gainful utilization since there is scarcity of good quality soil for embankment fills.
2. The unconfined compressive strength for BC soil is increased due to inclusion of plastic waste strips the strength of the soil is increased up to addition of 0.2% of plastic strips. This reduction in strength due to loss of integrity in soil-fibre system slippage between fibres.
3. The California bearing ratio values are increasing with the increase in percentage of waste plastic strips for the black cotton soil.

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