

Effect of HDPE Plastic on the Unconfined Compressive Strength of Black Cotton Soil

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ABSTRACT

Black Cotton soil which is a type of expansive soil, has the property of swelling excessively when wet and shrinks highly when exposed to dry conditions showing terrible surface cracks and due to this an uneven surface is created. This condition arises due to a mineral known as montmorillonite and presence of fine clay particles. The soil changes its shape rapidly due to addition of water. The soil occupies more than 20 % of the surface area of India.

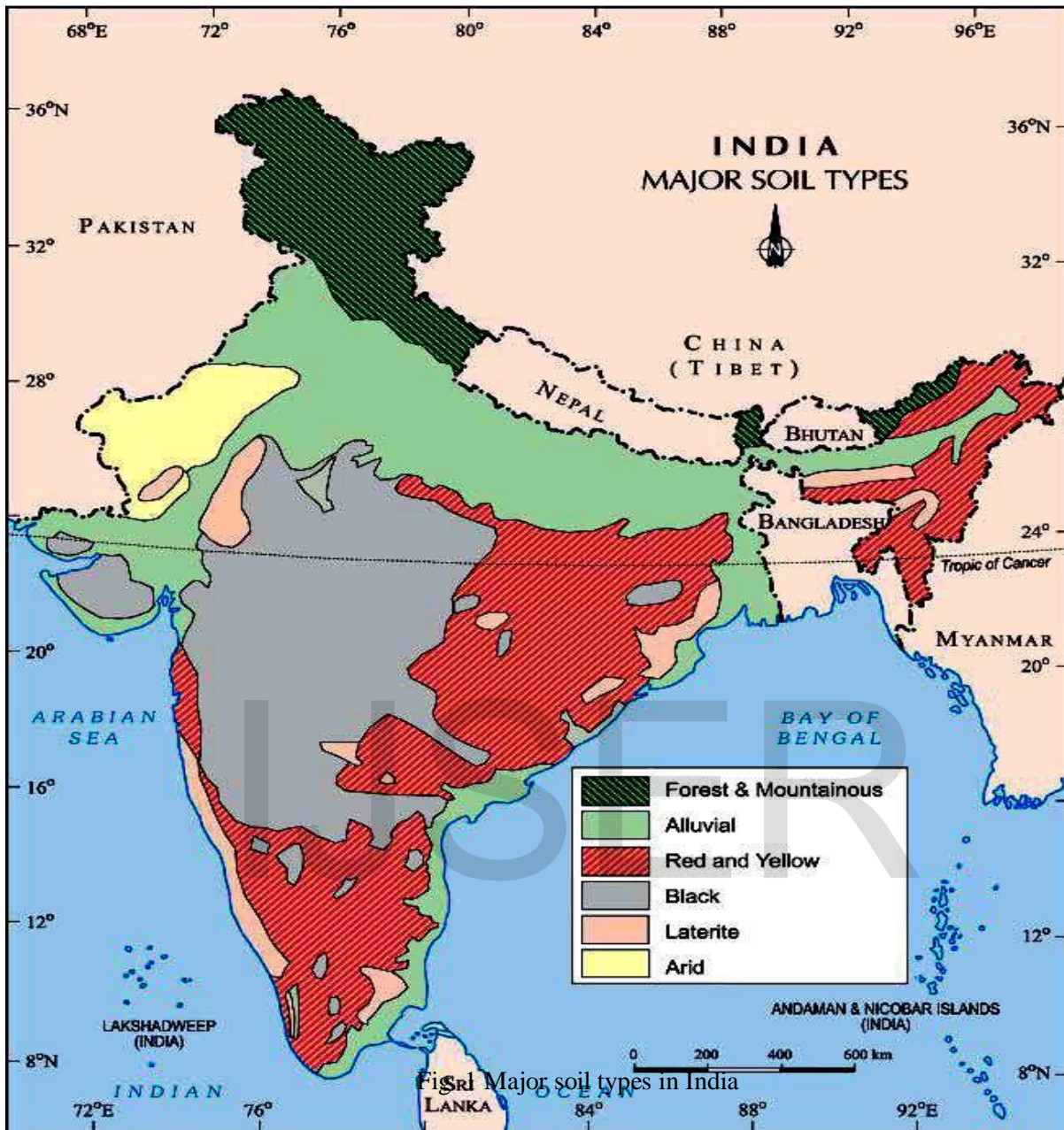
The aim of this research is to study the effect of HDPE plastic waste on the unconfined compressive strength of soil. The HDPE plastic (40 micron) waste was added at a proportion of 1.5%, 3%, 4.5% and of the weight of dry soil. At the end of the study it was concluded that the addition of plastic waste had increased the unconfined compressive strength of black cotton soil. For the waste added, the maximum strength obtained at 3% was 1.70708 kg/cm², and from natural soil it was 0.97858 kg/cm².

Keywords: HDPE plastic, black cotton soil, unconfined compressive strength, shear test.

I. INTRODUCTION

The behaviour 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 behaviour, high impermeability, 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.

Expansive soils like black cotton soils cover huge areas in several countries. It is dark grey to black in colour. In India alone it covers more than 20% of area. They are predominant in states of Maharashtra, Karnataka, Madhya Pradesh, Andhra Pradesh. These soils undergo huge volumetric changes when exposed to extreme dry or wet conditions. This is due to the presence of a mineral known as montmorillonate.



In this current study, high density polyethylene(HDPE) plastic was added to the soil and its unconfined compressive strength changes were studied. HDPE plastic is widely used as day-to-day carrier of materials.

II. LIST OF EXPERIMENTS PERFORMED

1.) Natural Soil

- a) Moisture content
- b) Specific gravity
- c) Atterberg limits
- d) Standard proctor test
- e) Unconfined compression test

2.) Reinforced Soil

- a) Standard proctor test

b) Unconfined compression test

III. MATERIALS

1.) Black Cotton Soil

Black cotton soil samples were collected from Sample is collected near “ KSRM College Of Engineering ” surroundings in KADAPA. The soil sample is collected from a vast area of black cotton soil. The experiments are conducted in Geotechnical laboratory of KSRM College of Engineering, which is located near Krishnapuram village, KADAPA.

The disturbed sample was then sealed in plastic bags to avoid loss of moisture during transportation. The soil was air dried and passed through IS425 Micron size Sieve and then oven dried at 110°C before putting it for test.

The properties of black cotton soil were found by performing different basic experiments and results have been shown in tabular form as follows:

Table: Properties of Black Cotton Soil

S.NO	PROPERTY	VALUE
1	Specific Gravity	2.05
2	Liquid Limit	78%
3	Plastic limit	45%
5	Plasticity Index	33%
6	Optimum Moisture Content(OMC)	12%
7	Maximum Dry Density(MDD) For Soil	1.4gm/cc
8	Maximum Dry Density(MDD) For Reinforced Soil	1.44gm/cc
9	Unconfined Compressive Strength	0.97858 kg/cm ²

NOTE 1: As plasticity index =33>17 the sample is high plastic (Degree of plasticity) and cohesive (Degree of cohesiveness)

NOTE 2: Graph obtained from standard proctor test is as bellow:

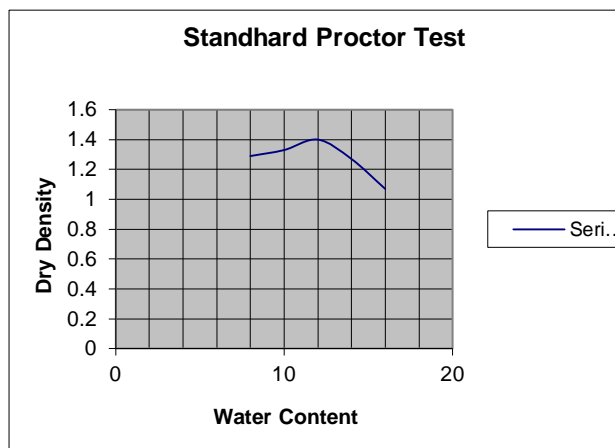


Fig. 2 Standard Proctor Test

2.) HDPE (40 Micron) PLASTIC BAGS

The plastic bags were obtained from local general merchandise stores. The type of plastic bag used for this experiment is HDPE (40 Micron).

IV. TEST SPECIMEN

In the beginning undisturbed sample of size 15cm and 3.7cm in diameter was made of original soil only. The specimen prepared was tested and the unconfined compressive strength of the soil was found without the waste plastic. Then the plastic was added in small pieces of 1cm x 1cm in proportions of 1.5%, 3%, and 4.5%. The size of specimen obtained was same as earlier.



Fig.3 Testing Machine

IV. PROCEDURE

The initial length and diameter of the sample was recorded. Both the sides of the specimen were levelled finely so that full surface contact was established between the specimen and the apparatus. It was then placed in the apparatus.



Fig. 4 Specimen

The dial gauge was adjusted to a suitable value. Load was applied on the specimen slowly and was increased in a suitable manner until a crack was seen. The apparatus was stopped and the value on the dial



Fig.5 Specimen after failure

V. RESULT

After performing all the necessary tests on the black cotton soil for unconfined compressive strength, the following observations were made :

1.) The unconfined compressive strength of black cotton soil indicated significant increase in strength on addition of HDPE plastic waste. The UCS value increased from **0.97858 kg/cm²** to **1.46497 kg/cm²** at 1.5%, **1.70708 kg/cm²** at 3%, **1.18256** at 4.5%. A decrease of strength was obtained at 4.5% as shown graphically

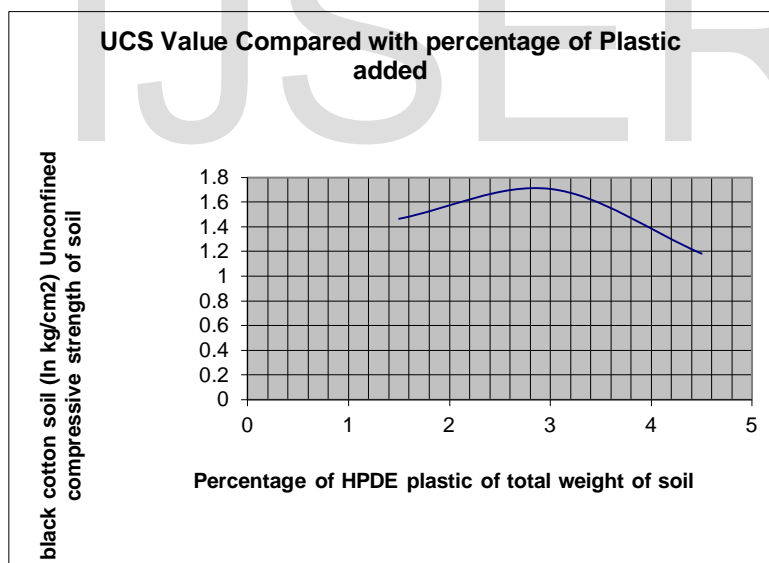


Fig.6 UCS value compared with percentage of plastic added

VI. CONCLUSION

The following conclusions were made on the results obtained from the experiments performed:

1. The unconfined compressive strength of the black cotton soil increased upon addition of HDPE plastic waste.
2. The optimum UCS value was obtained at 3% of addition of HDPE plastic.
3. Increase in UCS by adding HDPE occurred with increase in maximum dry unit weight at lesser OMC .
4. More detailed study can be done on the soil to observe the effect of plastic waste addition by conducting

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