

Performance of Plastic Strip on Engineering Properties of Black Cotton Soil

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ABSTRACT: We all know about the engineering properties of the soil, that it can be used for the construction purpose and it is the oldest material we are using. Sometimes the soil is used for supporting the adjoining or beneath the structure. And in Gujarat we can find mostly black cotton soil in construction as it is available in large amount. Plastic waste is produced in about millions of tons annually and there disposal is very difficult. Due to rapidly growth of urbanization this situation has arisen. In present study, plastic strip from the cement bags were made of size 2.5 mm* 20 mm and used as the wastes, to be mixed with black cotton soil and to make the pavement as economic as possible. Here we have carried out unconfined compression test and soaked & unsoaked CBR test. The plastic strips were added in different proportion by dry weight of soil. the proportions were of 0.05% of soil and we have gone upto 0.15% replacement of soil. The result will show that there is increase in strength and CBR value of black cotton soil by addition of plastic strip. This proposed method can be implemented for construction of pavement for village road. The thickness of pavement layer will also get reduced due to plastic strip.

KEYWORDS: Plastic Strips, Unconfined compressive strength, Soaked CBR, Unsoaked CBR, Black Cotton Soil.

ABBREVIATIONS:

BCS	= Black Cotton Soil	CBR	= California Bearing Ratio
FSI	= Free Swell Index	LL	= Liquid Limit
MDD	= Maximum Dry Density	OMC	= Optimum Moisture Content
PL	= Plastic Limit	PS	= Plastic Strips
PW	= Plastic Waste	UCS	= Unconfined Compressive Strength

I. INTRODUCTION

Engineers are frequently facing problems like constructing materials, which do not have sufficient strength so as to resist the imposed load during construction or during service life of structure. Due to which the poor bearing capacity and low strength construction work of roadways and highways gets affected and results in to the damage of pavement which is very important for uniform mobility, smooth flow of traffic etc.

To increase the strength of a particular soil we can add the fibres to it. And we have taken this concept of fibre from the mother nature itself, like the roots of a tree holds the soil in a place same way the fibre will help us to keep the soil in a stabilize way. The fibre are mixed randomly into the soil and the soil is known as fibre reinforced soil. Now the fibres can be of many types like natural fibres and synthetic fibres. Natural fibres like coir and jute fibres and synthetic fibres like polypropylene fibre, glass fibre, rubber crumb and waste plastic fibre.

Due to rapid urbanization and growth in population the use of plastic has increased but it's disposal is a major problem. It has become an part of the daily life, but when it's utility gets over it is called as "Plastic Waste" but the fact is plastic waste never degrades and remain as it is for several years. And now there are many things which can be made from this plastic waste. We are going to use the plastic waste from waste worn out cement bags, as a plastic strips in improving the soil properties. By using this PS as an additive in soil we can improve the various properties of soil and it will also reduce the effect on PW on the environment. Stability and performance of pavement are greatly influenced by sub-grade as they serve as foundation for pavements. Roads on black cotton soil pose challenge in selecting suitable soil. For economic pavement, sub-grade soil must meet adequate strength requirements as per IRC-37(2007).

The main aim of this research was to increase the physical properties of BCS. The behaviour of expansive soils is very uncertain when it is subjected moisture changes. These changes can cause deformation for the foundation. The properties of the soil changes with increase and decrease in the moisture content. The effect of this features is excessive compression of soil, collapsing behaviour, high permeability, high swelling capacity and low shear strength. These

undesirable change in properties make the black cotton soil unfit for construction purposes, hence they are need to be stabilized before they can be used. Despite of this properties we can improve the property and save the environment by using PS in improving the property of BCS.

Material Used

Black Cotton Soil (BCS):

The BCS was collected from Gujarat region which is easily available for study purpose which is near by college. The soil was collected from 0.75 m depth after cleaning up the surface. And the soil was having lumps and a natural moisture content of 7%. The soil was having a FSI of 61.11% which is expansive in nature. From its liquid limit of 59.48% and plastic limit of 29.93%, the soil was classified into CH type as per the IS : 1498.

Plastic Strip (PS)

For this study we have selected the waste cement bag. And the strips of size 2.5 mm* 20 mm were cut from the waste cement bags. And the strip thickness was around 10 micron. Fig. 1 (a) shows the waste cement bags and (b) shows the strips of size 2.5 mm * 20 mm.



Fig. 1 (a) Shows the waste plastic bag and (b) strips.

II. LITERATURE SURVEY

Shiva Kumar K et. al.⁽¹¹⁾, “Soil Stabilization Using Waste Plastic Strips” 7had studied Improvement of clayey soil using plastic strip. In this study, plastic strip of various proportions is added in order to improve soil properties. It was concluded that plastic strip is more effective rather than using black cotton soil alone for stabilization. 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.

Mayank Dave, et. al.⁽¹⁰⁾, had studied Improvement of clayey soil using polyethylene strips. Standard proctor test, California bearing test, Direct shear tests were conducted for assessing the suitability of clay soil mixed with polythene strips. And from the test results it can be seen, CBR value was increased with its mix proportions. As the %PS was increasing the value of CBR was decreasing. The values of friction angle increases for certain amount of %PS after that it was decreasing.

III. METHODOLOGY

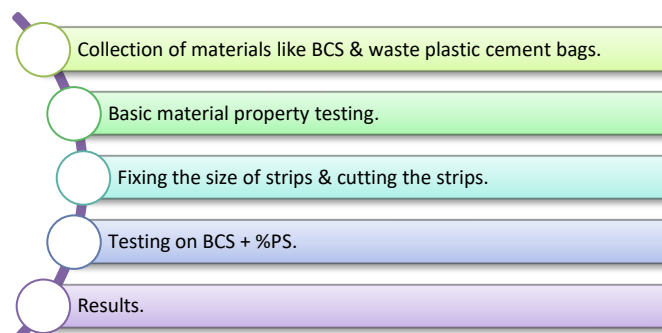


Fig. 2 shows the methodology of work

IV. EXPERIMENTAL SETUP

The experimental work was carried out as per the Indian Standard 2720 for finding out the various parameters. And the experiments were done at college campus only.

The plastic strips were added in proportions of 0.05%, i.e. 0.05%, 0.10% & 0.15%. The strips were mixed in the soil randomly first the soil is taken than fibre were added and then water is mixed to create a proper binding. Everything was done manually. The majority test were conducted on the UCS & CBR, CBR were soaked and unsoaked.

Standard Proctor Test (IS : 2720 (Part – 7))

The light compaction was done on the soil. First the soil was sieved from 19 mm and the soil air dried and then used for the test. The air dried soil was mixed with water and kept for 24 hours. The soil was filled in the 100 mm dia. mould in 3 different with 25 blows each layer. The experiment is repeated till the weight get reduced by 2-3 times.

California Bearing Ratio (IS : 2720 (Part - 16))

The MDD & OMC obtain from Standard Proctor Test was used to fill the mould and based on than CBR was conducted in two ways i.e. Soaked CBR & Unsoaked CBR.

Unconfined Compression Test (IS : 2720 (Part – 10))

The test was conducted on the MDD & OMC obtain from Standard Proctor Test. And variation in the strength was found out. The Dia. was 38 mm and height was 76 mm.

V. RESULTS & GRAPHS

The table – 1 shows the basic index and engineering properties of BCS.

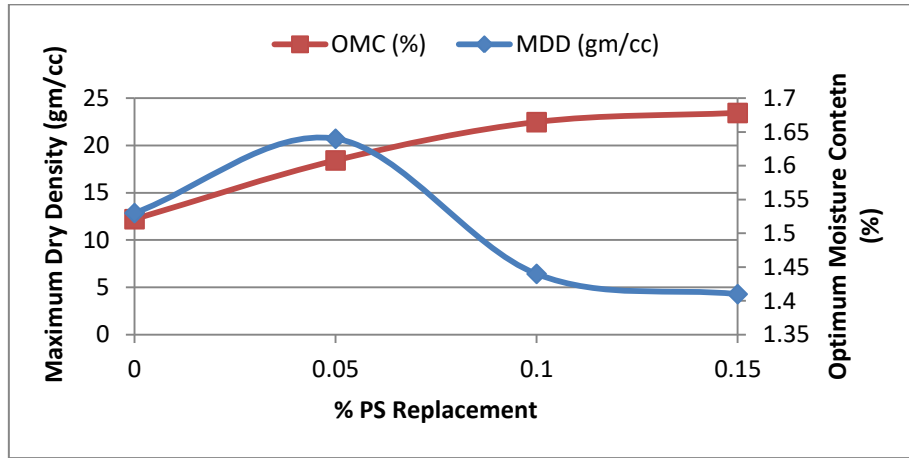
The table – 2 shows the results of MDD & OMC, UCS, Soaked CBR & Unsoaked CBR at 2.5 mm and 5.00 penetration with % variation of PS.

Table – 1 Engineering Properties of BCS

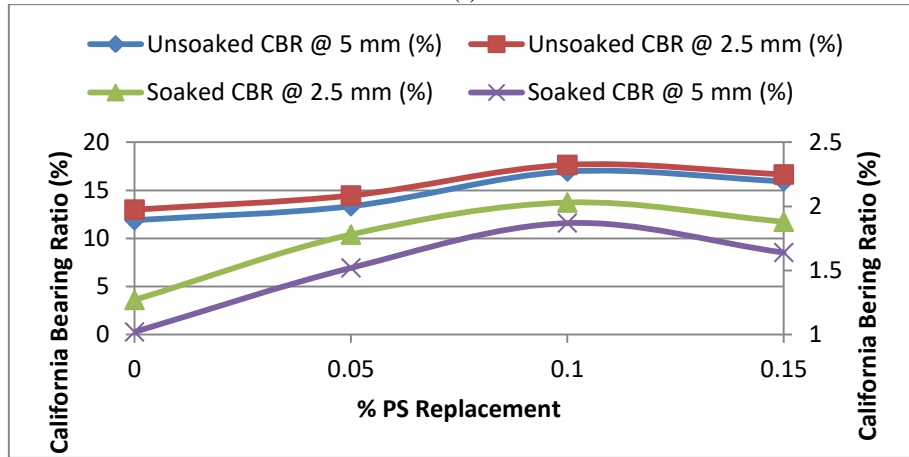
Test	Normal Soil
Specific Gravity	2.56
LL (%)	59.48
PL (%)	29.93
SL (%)	11
FSI (%)	61.11

Table – 2 Result of BCS +%PS

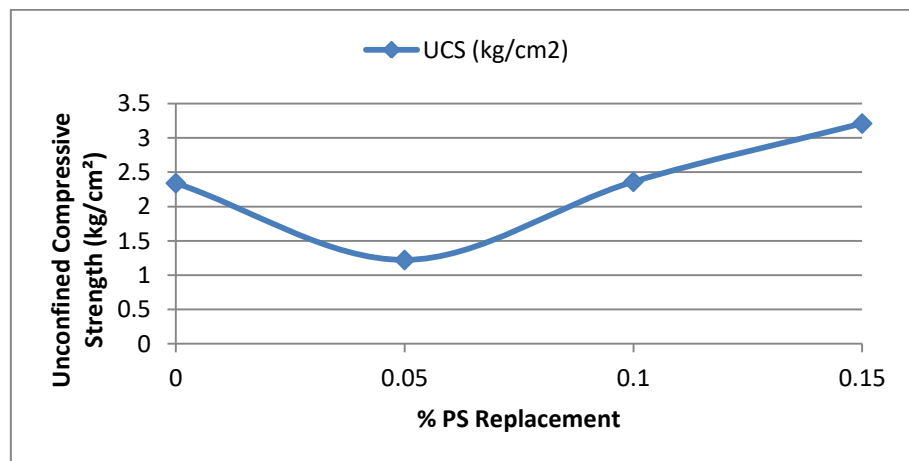
%PS	0	0.05	0.10	0.15
MDD (gm/cc)	1.53	1.64	1.44	1.41
OMC (%)	12.21	18.42	22.47	23.44
UCS (kg/cm ²)	2.34	1.22	2.36	3.21
Soaked CBR @ 2.5 mm (%)	1.27	1.78	2.03	1.88
Unsoaked CBR @ 2.5 mm (%)	12.99	14.46	17.64	16.65
Soaked CBR @ 5 mm (%)	1.02	1.52	1.87	1.64
Unsoaked CBR @ 5 mm (%)	11.89	13.35	16.96	15.94



(a)



(b)



(c)

Fig. 3 (a) Variation of (a) Maximum Dry Density & Optimum Moisture Content (b) California Bearing Ratio for 2.5 mm and 5 mm soaked & unsoaked (c) Unconfined Compressive Strength all with % PS Replacement

VI. DISCUSSION & CONCLUSIONS

After adding the %PS in the BCS, there was increase in the moisture content and decrease in the density of the soil. The research was stop at 0.15% only because the amount of PS was very much at 0.20% PS.

From the research we can conclude the following points:

- When the % PS were added it has shown the positive side and the readings were increased upto addition of 0.10% PS and after that there was decrease.
- The optimum % PS was found to be 0.10%.
- And due to that dosage there is increased in the value of soaked CBR by 59.84% for 2.5 mm penetration and for 5 mm penetration it was increased by 83.33%.
- The unsoaked CBR value was increased by 35.80% for 2.5 mm penetration and for 5 mm penetration it was increased by 46.64%.
- But the UCS was found maximum at 0.15% of dosage. And at 0.10% there is negligible increase in the strength.
- The PW can be used as an natural fiber in a BCS. Which helps in improving the properties as well as the save the environment.
- The PS can be used to increase and decrease the soil properties as per requirement.

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