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## UTILIZATION OF WASTE PLASTIC FOR SOIL STABILIZATION

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### ABSTRACT

Soil stabilization is a process that improves soil structure, such as an increase in shear strength, bearing capacity etc. For stabilization, black cotton soil is used, which is clayey soil seen grayishblack in color. Stabilization can be done by adding appropriate compounds such as cement, lime, and fly-like debris, ash, coconut shell, etc. The cost of these additives has increased in recent years which have opened the door wide to other types of soil ingredients such as plastic, bamboo etc. These options can be used to meet the community's challenges of reducing waste, generating useful stability from plastic waste. The use of plastic products such as polythene bags, bottles is increasing day by day leading to various environmental concerns. Therefore, disposing of plastic waste without causing any environmental hazards has become a real challenge & using plastic as a soil stabilizer is a natural and good option. The project includes research on the potential use of plastic waste. Plastic bottles are cut into thin strips and added to the soil, test was performed on black cotton soil only and soils with plastic content. After performing test, the result was found in which soil properties were improved such as CBR value, swelling property, etc., with an increase in plastic content in the soil.

**Keywords:** Black Cotton Soil Stabilization, Waste Plastic, California Bearing Ratio, Plastic Strips, Atterberg's Test.

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### I. INTRODUCTION

A developing country like India with a large population needs a lot of infrastructure. Everywhere the land is used for a variety of purposes from ordinary houses to skyscrapers, bridges to airports and from rural roads to highways. Soil Stabilization involves developing the properties soil to improve its strength, durability etc., by mixing it with various stabilizers. The different types of methods used to stabilize the soil are: Soil Stabilization using cement, lime, bitumen or various chemical methods and new emerging soil stabilization technologies are using Geo fabrics and Geo synthetic fibers. Stabilization also controls cracks and swelling areas, increasing shear and carrying capacity of the soil. Plastic is an inexhaustible and non-bio-degradable material. Plastic can be reused for example reprocessing this plastic and make some valuable items. Plastics can be utilized as admixtures for balanced out soil. The utilization of plastic waste for the improvement of the properties of soil is a viable and conservative method of adjustment. Employments of materials made of plastic are expanding day by day, yet the removal of plastic expanding the waste plastic substance. Plastic waste increasing in society day by day which leads to different problems hence the use of plastic waste as an admixture should be implied which increases the strength of the soil, reduces the cost of admixtures and leads to the economical use of plastic without causing any environmental and ecological hazards. Stabilized soil is more durable having comparatively high strength, good quality of soil, less permeability of the soil and useful for constructions of roads by reducing the thickness of pavement and also control the shrink, swell properties of soil, which helps in achieving better soil gradation. It can significantly improve the working platform for various construction operations.

Our aim is enhancing the physical properties of black cotton soil. The behavior of expansive soils is extremely uncertain once it's subjected moisture changes. These changes create wide challenge for the civil engineers during construction activities specially whereas constructing foundations. The strength of soil changes once water occupies large areas within the voids of the soil. the general recognizable features of this are excessive compression of soil, collapsing behavior, high porousness, high swelling capacity and low shear strength. These undesirable characteristics create the black cotton soil unfit for construction functions, hence black cotton soil needs to be stabilized before using it for construction purpose and for stabilizing this soil we are using waste plastic.

## II. METHODOLOGY

### MATERIAL USED –

#### BLACK COTTON SOIL –

- In this project, for soil stabilization black cotton soil is used which is clayey soil seen greyish and black in color.
- This soil possesses low shrinkage limit and high optimum moisture content. It is Water and Electrical resistance.
- The Black Cotton soils are highly compressible and have low bearing capacity.
- These soils have shrinkage and swelling characteristics and the shear strength of the soil is also low.

#### PLASTIC–

- In this study strips of plastic bottles are used. Plastic bottles come under Polyethylene terephthalate group.

Some properties of plastic are-

- It is hard, strong and dimensionally stable material.
- It absorbs very less water.
- It can be transparent and colorless but thick sections are opaque and off white.

### METHODOLOGY -

Plastic strips were used in varying percentage of 0.2%, 0.3%, 0.45% to the weight of the soil and one specimen with only black cotton soil. California bearing ratio, Atterberg's limit, Free swell index and standard proctor test were conducted. This test was performed of four specimen one with plain soil and other three with plastic content added in the soil.

## III. RESULTS

Following are the results obtained after performing the various Test. For each test four specimen were tested i.e., only soil, soil with 0.2% plastic, soil with 0.3% plastic, soil with 0.45% soil.

### 1. Atterberg's Limit

Liquid limit test, plastic limit test and plasticity index were found out by performing the test.

The results are shown below.

**Table 1: Atterberg's Limits**

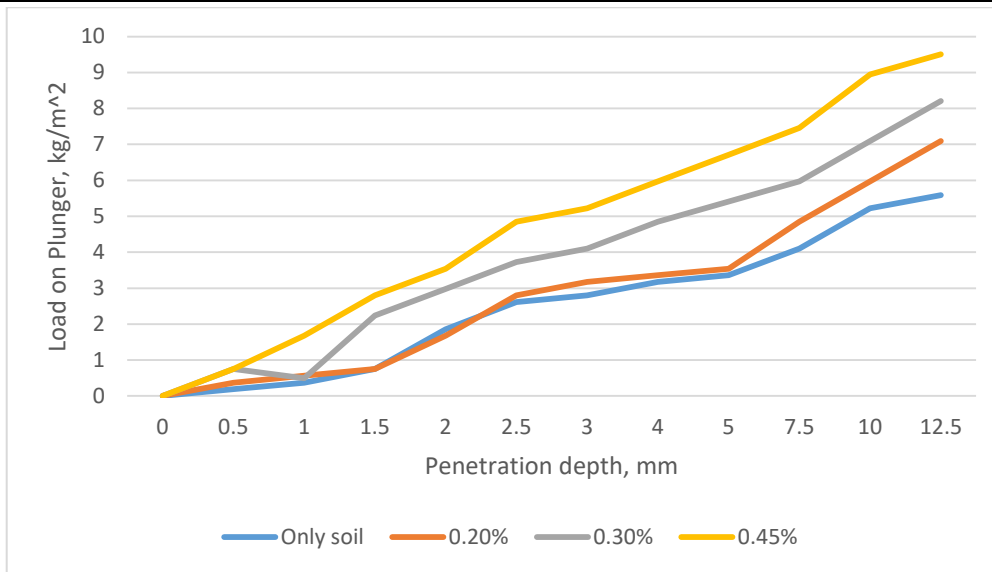
Parameters	BC Soil	BC Soil+0.2% Plastic	BC Soil+0.3% Plastic	BC Soil+0.45% Plastic
Liquid Limit	57%	57%	57%	56%
Plastic Limit	33%	31%	26%	26%
Plasticity Index, Ip	23%	26%	31%	30%

### 2. California bearing ratio test

This test is performed to measure the strength of the soil. Total four specimen were prepared with varying percentage of 0.2%, 0.3%, 0.45% plastic strips and one with only black cotton soil.

**Table 2: CBR test**

	For BC Soil	For BC soil+0.2%	For BC soil+0.3%	For BC soil+0.4%
At 2.5mm penetration	3.74%	4.01%	5.34%	6.95%
At 5 mm penetration	3.21%	3.38%	5.16%	35.19
CBR VALUE	3.74%	4.01%	5.34%	6.95%



Graph 1: CBR Test

### 3. Free Swell Index

This test gives us details about the swelling property of the soil. After performing the test following result were found.

Table 3: FSI

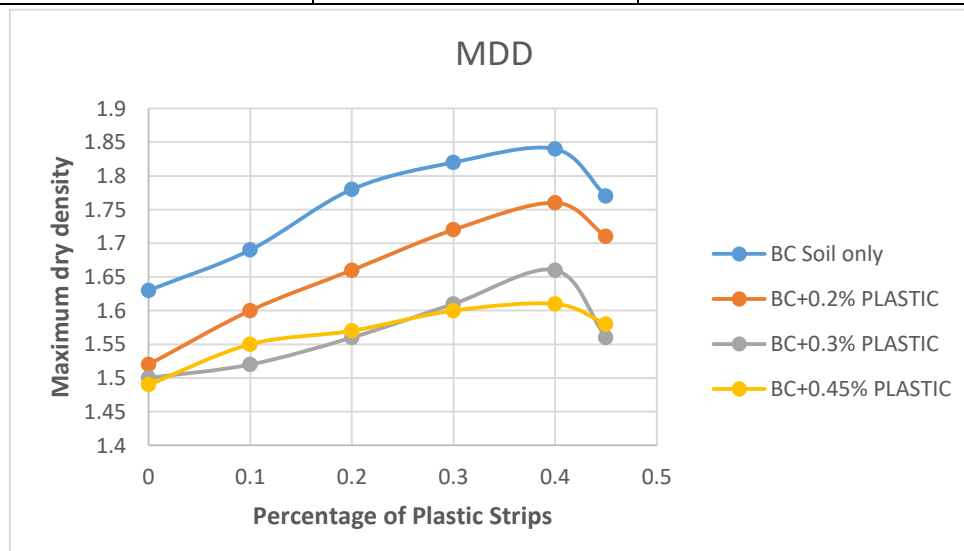
Parameter	For BC soil only	For BC soil +0.2%	For BC soil+0.3%	For BC soil+0.45%
Free Swell index	72.61	72.22	69.67	67.71

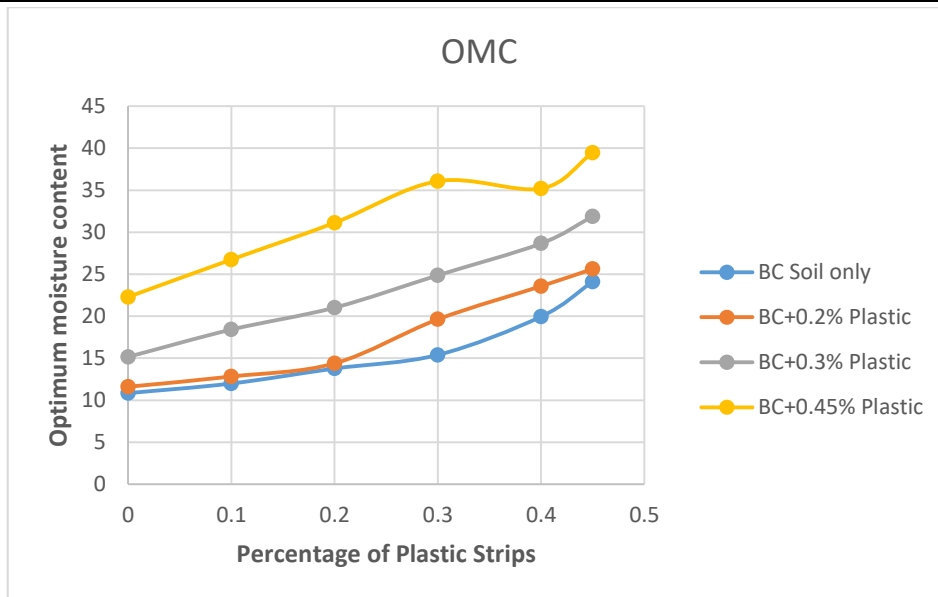
### 4. Proctor Compaction Test (Heavy compaction) (IS-2720)

Following are the result of the test performed.

Table 4: MDD & OMC

	Max Dry density, g/cm <sup>3</sup>	Optimum Moisture content%
For BC soil only	1.84	19.95
For BC soil +0.2% Plastic	1.76	23.57
For BC soil +0.3% Plastic	1.66	28.66
For BC soil +0.45%Plastic	1.61	35.19





Graph 2: ODD & OMC Test

#### IV. RESULTS AND DISCUSSION

To study the effect after adding plastic on the soil, all the test were conducted.

- **Atterberg's Limit**

In liquid limit test, as results shown in the above table of Atterberg's limit, there is no such huge variation in the result. For test on one specimen 4 times test were performed i.e., for varying no of drops. From this a graph is formed and the value is obtained for 25 blows. As liquid limit is not taken in decimal value, we have rounded it off. Similarly for every specimen, i.e., 4 specimens, test is performed for varying water content (No of drops). There were very minor changes in liquid limit after adding plastic.

- **California bearing ratio**

In CBR test, as shown in results, there is increase in CBR value with increase in plastic percentage. Thus, the strength of the soil can be improved by using plastic as a soil stabilizer. For BC soil we got CBR value 3.74% and CBR value for specimen with highest plastic % we added is 6.95%, So there is great improvement in the strength of the soil.

- **Free Swell index**

Swelling property of the soil was determined by this test. It was found that there was significant reduction in the swelling of the soil. As for BC soil it was 72.61 and for the highest value of plastic, we tested i.e., with addition of 0.45% plastic, it was found to be 67.71.

- **Proctor test (Heavy compaction)**

Maximum dry density reduced slightly with an increase in content of plastic. Optimum moisture content value had great improvement with increase in plastic content.

#### V. CONCLUSION

On the basis of the results of experimental test performed-

- In Atterberg's limit, there was slight increase in liquid limit of soil after adding plastic content to it.
- In plastic limit, with increase in addition of plastic strips there was decrease in plastic limit.
- In CBR test, there was an increase in CBR value with increase in percentage of plastic content.
- There was huge improvement in CBR value at 0.45% plastic content.
- The swelling property of soil can be improved as after conducting FSI, we noticed reduction in the swelling of the soil by addition of plastic
- For maximum dry density & optimum moisture content with increase in plastic percentage max dry density decreased & with increase in plastic percentage there was an increase in optimum moisture content.

- Hence, plastic can be used as a soil stabilizer. It can also overcome the problem of plastic waste. We can also use it with combination of some other stabilizer.

## VI. REFERENCES

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