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# EFFECT OF PLASTIC WASTE STRIPS ON GEOTECHNICAL PROPERTIES OF LIME STABLIZED BLACK COTTON SOIL

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**Abstract** - ***The study aims to stabilize black cotton soil using lime and reinforced with waste plastic water bottles, which have the potential to enhance the soil's qualities and reduce environmental pollution. Stabilization techniques are commonly used to improve the characteristics of black cotton soil, which is known for its high swelling and shrinking nature. Lime is a commonly used additive, but in this study, the focus is on the use of waste plastic as admixtures for soil stabilization. Various percentage of plastic waste strips (0.2%, 0.4%, 0.6%, 0.8%, 1%) of weight of dry soil mixed with a proportion of 5% lime to enhance the geotechnical properties and strength parameter of normal expansive soil.***

***Key Words***: **Black Cotton Soil, Plastic waste strips, lime, plasticity index, free swell.**

## 1.INTRODUCTION

Black cotton soil have a unique behaviour of shrinkage and swelling when it comes in contact of moisture during wetting and drying season therefore known as Expansive Soil in nature. It occurs due to the presence of montmorillonite clay mineral. The complex behaviour of BC Soil is not suitable for direct implementation of engineering works on them. Expansive soils are need to be treated before they can be used for work purpose. The most widely used technique to improve the expansive nature of BC Soil is stabilization. Stabilization is of two types i.e. mechanical stabilization and chemical stabilization. The production of plastic increases on daily basis with the time, which is a global concern for everyone because the disposal of plastic is not that easy.

Lime stabilization enhances the work behaviour of expansive soil by reducing the liquid limit and increases the plastic limit, due to which plasticity index of soil decreases. The result of which shows that the workability of stabilized soil enhanced as compressibility and volume changes of the soil reduces.

This study aimed to examine the effect of plastic waste strips and lime on the geotechnical properties of expansive soil by performing laboratory test on soil samples considering 0.2%, 0.4%, 0.6%, 0.8% and 1% plastic waste strips and 5% lime of dry weight of soil. The result obtained from the plasticity index and free swelling test are showing the relevant use of plastic waste strips and lime to stabilize the black cotton soil

## 2. Body of Paper

## I. LITERATURE REVIEW

**S.C. Boobalan et al. (2023)** made the study on the use of "PLASTIC WASTE ", waste plastic sheets were employed at different depths (H, H/2 and H/3) to stabilize the soil, improve shear strength, and enhance bearing capacity. The results of the test indicated that the plastic sheet placed at the depth of H/2 within the soil sample exhibited superior bearing capacity properties.

**Preeti Gangwar et al.(2021)** The main motive of this research is to evaluate the result of incorporating waste plastic bottles on the geotechnical properties of soil. Various percentages of waste plastic bottles (0%, 0.5%, 1.0%, 1.5% and 2.0%) added in the soil sample and sequel the engineering properties of soil.

**Amit Kumar Rai et al.(2020**) This review paper is aimed at providing two solutions, the first one is towards a comparative study of modern wastes like glass powder, plastic, and e-waste in soil stabilization and the other one is with the disposal problem of these wastes. For this various laboratory

test were studied and compared by analyzing the known test results of the previous research.

**Isaac I. Akinwumi et al.** This research work was aimed at investigating the suitability of making compressed earth bricks (CEB) with a mixture of soil and varying percentages (0, 1, 3, and 7%) of shredded waste plastic. Specific gravity, particle size distribution, Atterberg limits and compaction tests were carried out on the soil to determine the engineering properties of the soil.

**C.K. Subramaniaprasad et al**. [6] This paper highlights the results of an experimental investigation, on the Sorption Characteristics of plastic fiber reinforced soil, done to study the possibility of utilization of waste plastics in soil masonry blocks.

## II. METHODOLOGY

### Sample Collection and Preparation:

- Obtain representative samples of black cotton soil from Ghana Khamaria Jabalpur (M.P.).
- Collection of plastic waste materials (waste plastic water bottles) ensuring variation in types and sizes for experimentation.
- Collection of quick lime.
- Prepare specimens of lime-stabilized black cotton soil with varying proportions of plastic waste.

### Experimental Testing:

- Conduct standard geotechnical tests on the soil samples, including Atterberg limits and free swell test, compaction tests, to characterize the natural soil properties.
- Perform laboratory tests on lime-stabilized black cotton soil specimens with different percentages of plastic waste strips to determine their geotechnical properties.

**Table -1: Abbreviation Table**

| S.NO. | ABBREVIATION | FULL FORM |
|---|---|---|
| 1 | PWS | Plastic Waste Strips |
| 2 | BC SOIL | Black Cotton Soil |
| 3 | LL | Liquid Limit |
| 4 | PL | Plastic Limit |
| 5 | IP | Plasticity Index |
| 6 | DFS | Differential Free Swell |

**Table -2: General Properties of PWS**

| S.NO. | DESCRIPTION | VALUES |
|---|---|---|
| 1 | Compressive Strength | low |
| 2 | Resistance to acid and alkali | good |
| 3 | Unit weight ,g/cc | 0.90 |
| 4 | Ultimate tensile strength | 54 |
| 5 | melting point (degree C) | 200 |
| 6 | Elasticity modulus , MPa | 110-450 |

## III. RESULT AND DISCUSSION

### ATTERBERG LIMIT

**LIQUID LIMIT:** The test is determined with the standard apparatus designed by A. CASAGRANDE, therefore known as Casagrande apparatus.

About 120 gm of airdried soil sample is passing through IS sieve of 425 micron and mixed with required amount of water such that soil attains a putty like consistency. A portion of the paste is placed in a cup and a cut is drawn through the sample along the symmetrical axis of the cup. The water content reported at 25 no. of blows is known as liquid limit.

**PLASTIC LIMIT:** A soil sample is mixed with sufficient quantity of water which would enable the soil mass to become plastic enough to be easily shaped into a ball. A portion of the ball is taken and rolled in between glass plate and palm of the hand into a thread. The process is continued till the thread at a diameter of 3 mm just start crumbling, avg of sample of water content is taken as plastic limit.

**PLASTICITY INDEX:** The numerical difference between the liquid limit and plastic limit is known as plasticity index.

**FREE SWELL TEST:** Two air dried sample weighing 10gm each, passing through 425micron sieve. One sample is put in a graduated cylinder containing kerosene oil and other one in a similar cylinder containing distilled water . Both the sample are left undisturbed for 24hrs and their volumes are noted.

**Table -3 Summary of the effects of lime and plastic on geotechnical properties of black cotton soil**

| S.NO. | CONTENT | DFS% | LL | PL | IP |
|---|---|---|---|---|---|
| 1 | Normal BC Soil | 61.3 | 57.27 | 28.025 | 29.2 |
| 2 | BCSoil+5%L | 35.2 | 56.43 | 36.30 | 20.1 |
| 3 | 5%L+0.2%PWS | 30.6 | 48.78 | 32.17 | 16 .68 |
| 4 | 5%L+0.4%PWS | 29.3 | 44.17 | 31.05 | 13. 11 |
| 5 | 5%L+0.6%PWS | 27.4 | 38.39 | 27.34 | 11 .04 |
| 6 | 5%L+0.8%PWS | 25.3 | 33.58 | 22.68 | 10. 90 |
| 7 | 5%L+1%PWS | 22.7 | 31.41 | 22.11 | 9.30 |

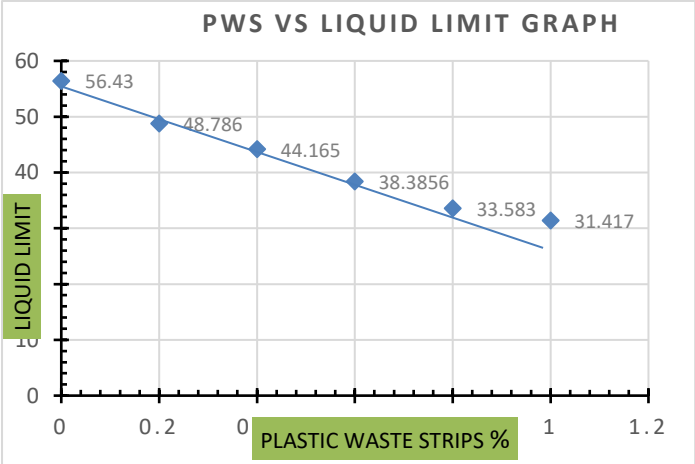


Fig: Graph of variation in plastic waste strips values vs liquid limit

**Fig -1**: Figure

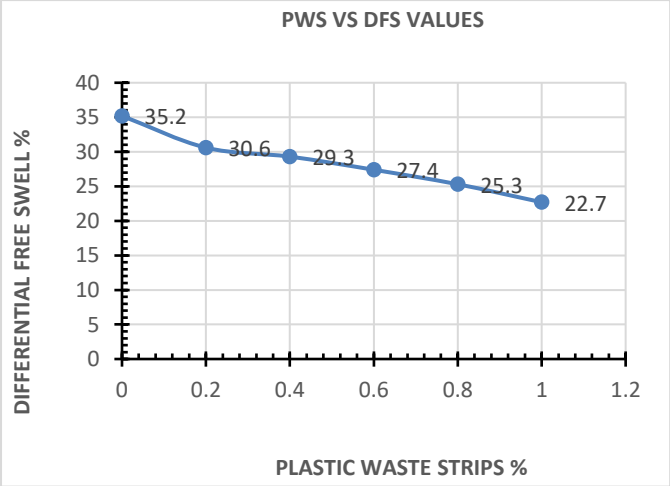


Fig: Graph of variation in Plastic Waste Strips vs DFS Values

## 3. CONCLUSIONS

[1] As the lime added to the untreated soil, the liquid limit decreased and the plastic limit increases, which results in decrease in plasticity index of soil.

[2] At a constant percentage of lime and increase in percentage of plastic waste strips resulted in a decrease in liquid limit and plastic limit.

[3] Due to decrease in plasticity index , plasticity property of soil reduces, which increase the strength of soil.

[4] The normal black cotton soil have free swell percentage of 61.3%.

[5] Addition of lime reduced the swelling property of soil from 61.3% to 35.2%.

[6] When the plastic waste strips added to the soil the swelling property of soil reduced from 35.2% to 22.7%, which is a significant reduction in swelling property of soil.

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