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# Use of Plastic As a Soil Stabilizer

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***Abstract :*** *The main objective of this project is a process which improves the physical properties of soil, such as increasing shear strength, Bearing capacity, etc. The foundation is very important for every structure & it has to be strongly enough to support the structure. Soils such as black cotton soil have always problem of swelling, shrinkage, & unequal settlement. It will minimize the stability and shear strength of black cotton soil and red soil when compared to other types of soil. This is stabilization of black cotton soil through application of PET (Polyethylene Terephthalate) bottles and plastic bag which is efficiently used to come across the challenges of city, village, society to reduce the quantities of plastic wastes, to improve the physical properties of soil, such as shear strength, bearing capacity through controlled compaction. PET ( Polyethylene Terephthalate ) plastic bottle strips were prepared and added at three different mixing ratios (0.5%, 1% and 2%) by weight and in three different aspect ratios. Then Standard Proctor, Unconfined Compressive, Moisture Content and California Bearing Ratio are conducted to find the properties of soil which will increases the bearing capacity of soil.*

***Keywords :*** *Soil, Soil stabilization, plastic wastes, PET bottles.*

## I. INTRODUCTION

Soil stabilization is a process which improves the physical properties of soil, such as increasing shear strength, bearing capacity etc. This new technique of soil stabilization can be effectively used to meet the challenges of society, to reduce the quantities of waste, producing useful material from non-useful waste materials. Plastic such as shopping bags is used to as a reinforcement to perform the CBR studies while mixing with soil for improving engineering performance of sub grade soil. Plastic strips obtained from waste plastic were mixed randomly with the soil. A series of California Bearing Ratio (CBR) tests were carried out on randomly reinforced soil by varying percentage of plastic strips with different lengths and proportions. Results of CBR tests demonstrated that inclusion of waste plastic strips in soil with appropriate amounts improved strength and deformation behavior of sub grade soils substantially. Expansive clay soils are types of soils that show a significant change in volume once they come in contact with moisture. They expand when exposed to excess water and shrink in hot weather conditions where there is scarce amount of water. They can easily be identified in the field in dry seasons as they show deep cracks of polygonal patterns. This behavior of swelling and shrinking of expansive clay soils in turn affects the stability of structures that is built over these soils causing a serious hazard. It majorly affects the bearing capacity and strength of foundations by uplift as they swell and may cause from cracks to differential movements to structural failures. In order to build on expansive soils, they need to be stabilized to reduce their swelling and improve their mechanical capacities.

## II. OBJECTIVE OF PROJECT

I. To increase the density and California bearing ratio (CBR) of soil plastic as admixture.
II. To provide an alternative solution for the disposal of plastic waste.
III. To provide economical solution for soil stabilization using plastic waste.
IV. To arrive the optimum mix for Soil-Plastic strips combination.

## III. METHODOLOGY

### 3.1 STUDY AREA:

The soil sample is collected at the Dahanu, Dahanu in Maharashtra district with latitude of 19.821712° and longitude of 72.821712°.

### 3.2EUIPMENT:

The equipment used in the project is listed as follows:

- Set of IS sieves:4.75 mm, 2.0mm, 1.0mm, 600µ, 425µ, 300µ, 150µ, 75µ, Pan.
- Balances.
- Sieve brushes.
- Sieve shaker.
- Cylindrical metal mould.
- Sample extruder.
- Oven.
- 20 mm and 4.75 mm sieves.
- Mixing tools.
- Metal rammer weighing 2.6 kg falling through a height of 310 mm.
- Cylindrical metal mould with base plate, collar, spacer disc.
- Penetration plunger .
-

### 3.3EXPERIMENTAL METHODOLOGY

The procedures used in the project are given below:

#### 3.3.1Collection of samples:

Soil samples collected from Kota and tested for their geotechnical properties and strength characteristics. The various tests conducted to obtain geotechnical parameters are:

- Grain size distribution by sieve analysis
- Optimum moisture content
- California bearing ratio (CBR) test for sample
- California bearing ratio (CBR) test for sample adding different %of plastic

#### 3.3.2Methodology for tests conducted on soil:

#### 3.3.2.1. Grain size distribution by sieve analysis:

The percentages of various sizes of particles in a given soil sample is found by sieve analysis. The grain size distribution curve gives an idea regarding the gradation of the soil i.e. it is possible to identify whether the soil Is well graded or poorly graded. In mechanical stabilization, for proportioning the selected soils the grain size distribution of each soil is to be first known.

Table 3.1 Observations of sieve analysis

| Sr. No. | IS Sieve (mm) | Wt. Retain (g) | % Wt. Retained | Cum % Retained | Cum % Passing |
|---|---|---|---|---|---|
| 1 | 19.00 | 0 | 0 | 0 | 100 |
| 2 | 4.75 | 3.88 | 0.78 | 0.78 | 99.22 |
| 3 | 2.00 | 5.67 | 1.13 | 1.91 | 98.09 |
| 4 | 1.18 | 3.68 | 0.74 | 2.65 | 97.35 |

| | | | | | |
|---|---|---|---|---|---|
| 5 | 0.6 | 8.52 | 1.7 | 4.35 | 95.65 |
| 6 | 0.425 | 8.44 | 1.69 | 6.04 | 93.96 |
| 7 | 0.3 | 10.06 | 2.01 | 8.05 | 91.95 |
| 8 | 0.15 | 27.94 | 5.59 | 13.64 | 86.36 |
| 9 | 0.075 | 21.28 | 4.26 | 17.89 | 82.11 |

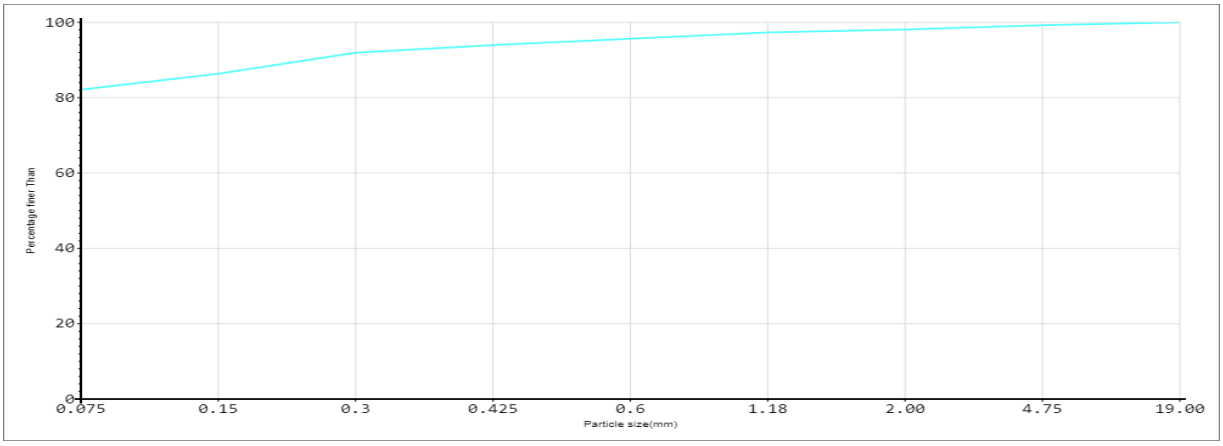


Fig 3.1 Particle size distribution curves

| Gravel % | Sand % | Silt & Clay % |
|---|---|---|
| 0.78 | 17.12 | 82.11 |

**3.3.2.2 California bearing ratio test:**

The C.B.R test was developed by California division of highway as a method of classifying and evaluating soil sub-grade and base course materials for flexible pavement. The C.B.R is measure of shearing resistance of materials under controlled density and moisture conditions.
The C.B.R is defined as ratio expressed in force per unit area required to penetrate soil mass with a circular plunger 50mm diameter at the rate of 1.25mm/min to that required for corresponding penetration in standard material.
C.B.R = Test load /standard load
Where standard load s penetration resistance of the plunger into a standard sample of crushed stone for the corresponding penetration. Standard loads adopted for different penetration for standard material with a CBR value of 100% are given below.

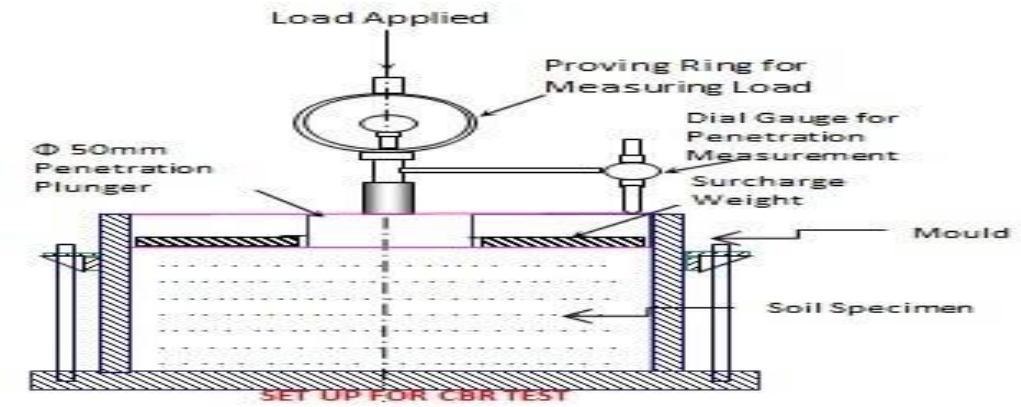


FIG 3.2 SET UP FOR CBR TEST

**California bearing ratio for 0.5%of plastic soil sample**

Table.3.2 Observations of California bearing ratio 0.5% of plastic.

| Penetration mm | Load Measuring Device Reading | Load Measuring Device Reading | Corrected Load FromGraph | Standard Load kg | California Bearing Ratio |
|---|---|---|---|---|---|
| | kN | kg | kg | | % |
| | Unsoaked | | | | Unsoaked |
| 0 | 0 | 0 | 0 | | 0 |
| 0.5 | 0.62 | 63.32 | 0 | | 0 |
| 1 | 0.87 | 88.92 | 0 | | 0 |
| 1.5 | 1.07 | 109.42 | 0 | | 0 |
| 2 | 1.28 | 130.42 | 0 | | 0 |
| 2.5 | 1.45 | 147.66 | 147.66 | 1370 | 10.78 |
| 4 | 1.91 | 194.26 | 0 | | 0 |
| 5 | 2.14 | 218.53 | 218.53 | 2055 | 10.63 |
| 7.5 | 2.64 | 269.41 | 0 | | 0 |
| 10 | 2.92 | 297.55 | 0 | | 0 |
| 12.5 | 3.19 | 324.98 | 0 | | 0 |

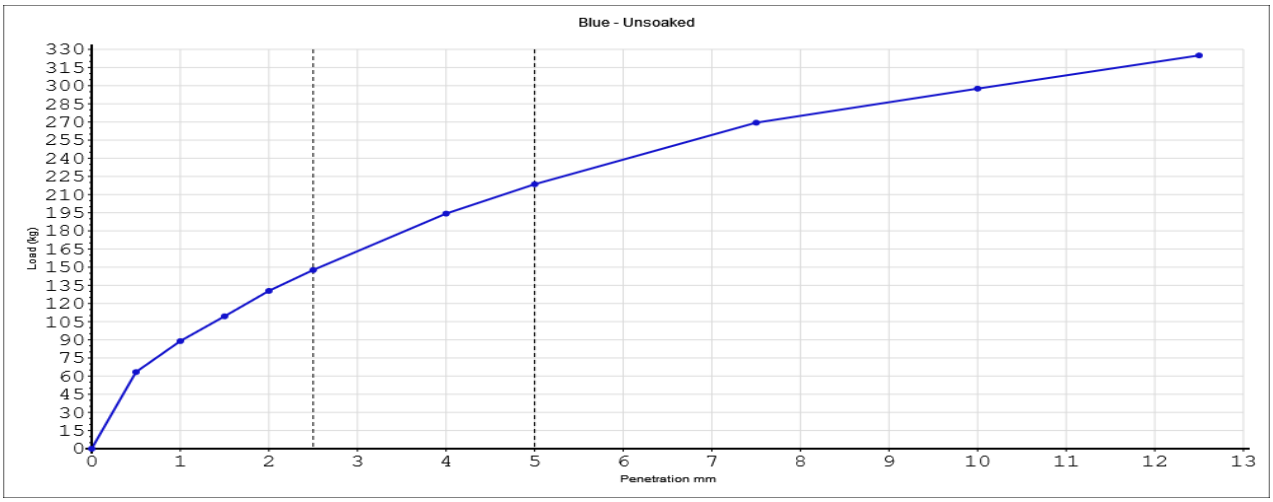


**Fig 3.3. load curves 0.5% of plastic**

## IV. FIGURES AND TABLES

| FIGURES | NAME |
|---|---|
| **1** | Particle size distribution curves |
| **2** | **SET UP FOR CBR TEST** |
| **3** | load curves 0.5% of plastic |
| **TABLE** | |
| **1** | Observations of sieve analysis |
| **2** | Observations of California bearing ratio 0.5% of plastic. |

## V. CONCLUSION

In the present study, the improved CBR value of the soil is due to the addition of plastic strips. Plastic can be utilized as one of the materials that can be used as a soil stabilizing agent but the proper proportion of plastic must be there, which helps in increasing the CBR of soil. It can be concluded that CBR percentage goes on increase up to 1.5% plastic content in the soil and thereon it decreases with increase in plastic content. Hence, we can say that 1.5% plastic content is optimum content of plastic waste in the soil. Utilization of plastic products in various forms in enormously increasing day by day. This has an adverse effect in nature and it is not possible to restrict its uses. In this regard, the disposal of the plastic wastes without causing an ecological hazard has become a real challenge to the present society. This, using plastic as a soil stabilizer. Is an economical and gainful usage because there is lack of good quality soil for various constructions. This work serves as a means to meet the challenges of Amaravati, the capital of newly formed Andhra Pradesh state and also to the whole society by reducing the amount of plastic waste and producing useful product from non-useful waste materials leading to the foundation of sustainable society.

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## REFERENCES

### JOURNAL PAPER

[1]. Behaviour of soil by mixing of plastic strips – Tarun Kumar, Suryaketan, Joyanta Maity Department of Civil Engg., Kolkata (IRJET) May 2018
[2]. Ch.Dimple Bahari , Sindhu Shankar, Kaushik.B, Pavan Siva Kumar – Soil Stabilization using plastics, Department of Civil Engineering, SET, Jain University, India (September 2017)
[3]. Engineering behavior of soil reinforced with plastic strips – Pragyan Bhattarai, K. Tejeswini, K. Santosh, Civil Engineering Department, K. L. University, India (Jun 2013)
[4]. P. Sanjay Chandra and Ch. Satish, Soma Siva , K. Srija, International journal of advance research, Shree Datta Institute of Engineering and Technology, Hyderabad, Telangana(2018)
[5]. Sayli D.Madavi, Divya Patel, Mamta Burike, - Soil stabilization using plastic waste, Department of Civil Engineering, SRPCE, Nagpur (IJRISE JOURNAL) April 2017
[6]. Soil stabilization by using plastic waste – Kiran Kumar Patil, Shruti Neeralagi, Arpitha G C, Dayanandha B V, Head of Department, Civil Engineering, AIEMS, Bangalore (IJATES) July 2017
[7]. Soil stabilization using plastics and bottle strips – N. Vijay Kumar, A. V. S. Prasad, Department of Civil Engineering, K. L. University, Vaddeswaram, Guntur, Andra Pradesh, India (August 2017)
[8]. Stabilization of soil by using waste plastic material - Sharan Veer Singh, Mahabir Dixit, Department of soil, Central soil and material research station, New Delhi (IJIRSET) February 2017.