

STABILIZATION OF SOIL BY USING PLASTIC BOTTLE STRIPS AS A STABILIZER

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Abstract: Soil stabilization is a good method for improving the physical properties of soil i.e. increasing strength properties such as shear strength, bearing capacity etc. This process includes adding an admixture in the soil to increase the properties of the soil. The admixtures such as cement, lime and waste materials such as fly ash, phosphor-gypsum etc. These admixtures are very costly; cost rates are increasing day by day as technology improves in the society. In recent technology and research, utilization of waste materials likes plastic, bamboo etc. The plastics are widely used in the society. The disposal of these plastic wastes causes ecological hazards; such plastic wastes are useful for stabilization. Now a days there is a scarcity of good soil. Available of such soils makes difficulty in construction. To avoid such problems we have to overcome by adding suitable admixtures in the soil. This project includes the addition of suitable admixtures such as plastic wastes. The waste plastic material i.e. plastic bottles are used in this project. The waste plastic bottles are taken and cut into small strips. The addition of these small strips in the soil by different percentage and conduct tests such as liquid limit, plastic limit, compaction test, CBR test etc. Then soil becomes stabilized i.e. increasing the load bearing capacity of the soil and also strength properties such as shear strength with a controlled compaction. Soil stabilization by using waste plastic bottles which significantly enhance the strength properties of the soil.

- 1. Introduction:** Soil stabilization is a process, can be made by adding suitable admixtures such as cement, lime, fly ash (waste materials) phosphogypsum etc which increases the shear strength, bearing capacity etc, that leads to improve the physical properties of soil.

Soil Stabilization increases the bearing capacity by adding suitable admixtures, plastic bottle strips are used as an admixture. The utilization of waste plastic materials into a useful material for the stabilization of the soil. It controls

the shrink-swell properties, increases shear strength of soil, swelling potential should be reduced that leads to increases the durability and strength.

Plastic is a non-renewable source and bio-degradable. The disposal of waste plastic bottles causes environmental pollution, it's a sustainable waste. Plastic can be recycled or reused i.e. reprocessing these plastic wastes makes the useful products. Such wastes of plastics be used as additives for stabilized soil.

Waste plastic materials are reused because it can be remoulded /recycled by no. of times, thus wastage is reduced. Uses of these plastic waste for improving the properties of soil, effective method of stabilization. Inversely the soil shear strength and load bearing capacity. Uses of plastic materials are increased day by day, vice-versa disposal of plastic increases the waste plastic material in municipal soil waste.

As technology improves in the society, to meet a new challenge, a new technique of soil stabilization can be effectively done by using waste quantities such as plastic, bamboo, polythene bags and bottles etc, these waste materials are increasing in society step by step which prompts different natural problems. The utilization of waste plastic materials as mentioned above which increases the stability of soil, reduces the cost rates, of admixtures leads to economical utilization without causing ecological hazards.

The stabilized soil which has higher resistance values, more durable with a higher strength, improves the soil quality, reduction in permeability of soil, useful for road constructions which reduce the pavement thickness, and also control the shrink swell characteristics of soil, achieve better soil gradation. It can be significantly enhance the working platform for construction operations such as mainly in the road construction. The road tests are done

for the stabilized soil to check the strength properties for example, shear quality, load bearing limit and so on.

Stabilization can improve the physical properties of soil mainly improves the load bearing capacity, have a significant effect to enhance the strength of soil. Addition of suitable admixtures takes the main role for soil stabilization. As researches done so many attempts, introducing the new techniques and also utilization of waste materials, it leads to economy and improves the properties of soil, which makes the basement have good strength for any construction mainly construction of pavement, road embankments etc. The researchers make the challenge by utilization of waste plastic materials for the good improvement in soil stabilization i.e. producing good material from waste products. The additive such as plastic wastes i.e. using plastic bottle as a soil stabilizer analysis can be done by different methods such as load test on soil, California bearing ratio test, plate load test etc. Comparison can be done by testing the available soil and stabilized soil. Then designing for the pavement for durability makes the reduction of pavement thickness with lower permeability. Generally we need a good soil for construction, to enhance the stability of structure; it's all depended on good soil i.e. stabilized soil. This can be carried out by various methods by adding admixtures in the soil, testing by researchers and thinking to improve the stability of soil. If we have stabilized soil, construction does not get failure because stabilized soil improves the bearing capacity of soil.

2. Objective of the study:

- Utilization of waste plastic materials as an admixture for soil stabilization.
- Increase the shear quality of soil and load bearing limit of soil.
- Increase the higher resistance values by controlling shrink-swell properties of the soil.
- Reduces plasticity index, lower permeability and reduction of pavement thickness by increases the bearing capacity of soil subgrade i.e. addition of raw plastic bottles.
- Improving the soil gradation, useful for construction of good pavement.
- Increases the durability and strength of the soil.

3. Materials used:

- **3.1 Soil:** Soil is the principal material for the construction of embankment and subgrade of highways. The design and performance of the pavement, particularly the flexible pavement, depends on the type of subgrade soil and its properties. Some of the essential

laboratory tests were carried out to determine the engineering properties i.e., index properties, Atterberg limits, compaction and strength characteristics of the soils. Laboratory tests were carried out as per relevant IS codes

- **3.2 Raw Plastic Bottle Strips:** Plastic is a non-renewable source and bio-degradable. The disposal of waste plastic bottles causes environmental pollution, it's a sustainable waste. Plastic can be recycled or reused i.e. reprocessing these plastic wastes makes the useful products. Such wastes of plastics be used as additives for stabilized soil.

- 4. **Test Procedure:** The compaction tests were done to assess the amount of compaction and the water content required. The water content at which the maximum dry density is attained is obtained from the relationships provided by the tests. The California Bearing Ratio test is conducted for the soil by adding plastic strips with varying percentage of 0.2 i.e.0.2%, 0.4%, 0.6% etc. and determines the strength of soil until the strength reaches the highest level and stop at the interval when strength decreasing from the highest. Plot the graph and calculate the bearing value for 2.5mm penetration and 5mm penetration and value of 2.5mm penetration and 5mm penetration is recorded. Then finally plot a graph of Percentage of Plastic content and CBR value and obtained the maximum CBR value corresponds to percentage of plastic content.

5. Result and Discussion:

5.1 Red Soil: Red soil was collected from the flexible pavement. The soil consists of 4% gravel, 88% sand and 8% silt & clay. The soil has a maximum dry unit weight of 20.12kN/m³ and 20.03kN/m³ and an optimum moisture content of 14% and 11% under standard proctor and modified proctor condition respectively.

| Percentage of Plastic Content | CBR value |
|-------------------------------|-----------|
| 0.0 | 2.3 |
| 0.2 | 2.0 |
| 0.4 | 2.1 |
| 0.6 | 2.4 |
| 0.7 | 2.9 |
| 0.8 | 1.8 |
| 1.0 | 1.7 |

Fig-1: CBR value of Red Soil

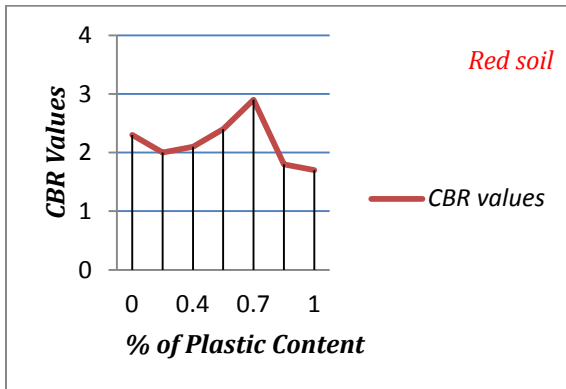


Fig-2: CBR values of Red soil with varying %of Plastic Content

5.2 Black Cotton Soil: Black cotton soil was collected from flexible pavement. It consists of 2.6% gravel, 15.1% sand and 82.3% silt & 0.18% clay. The soil has a maximum dry unit weight of 15.56kN/m³ and 18.33kN/m³ and an optimum moisture content of 13.63% and 10.78% under standard proctor and modified proctor condition respectively.

| Percentage of Plastic Content | CBR value |
|-------------------------------|-----------|
| 0.0 | 2.7 |
| 0.2 | 2.5 |
| 0.4 | 2.6 |
| 0.5 | 3.3 |
| 0.6 | 2.1 |
| 0.8 | 2.1 |

Fig-3: CBR value of Black Cotton Soil

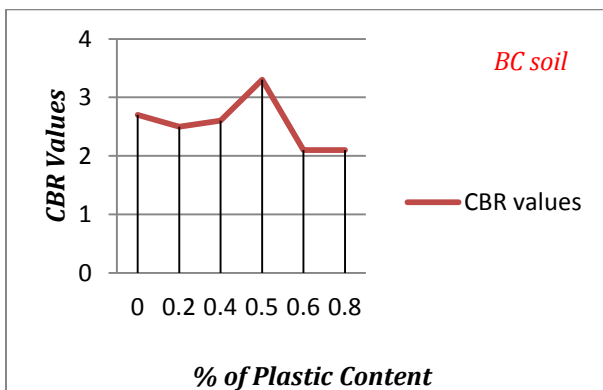


Fig-4: CBR values of Black Cotton soil with varying % of Plastic Content

6. Conclusion: In our day to day life the plastic material products such as bottles, polythene carry bags usage has become more, because of which today we find that more wastage is of the plastic material. Hence in order to get the best out of this wastage. The plastic stripes were made out of this plastic wastage and are used in making the payment and it is found that there is an increase in the strength of the soil. California Bearing Ratio test was carried out to find the maximum dry density and optimum moisture content. The CBR was conducted for soil mixed with plastic strips. The CBR test is conducted for the red soil and black cotton soil, adding the 0.7% of plastic stripes to red soil and 0.5% for the black cotton soil it is found that the strength of the soil is increased resulting the bearing ratio of 2.9 for red soil and 3.3 for the black cotton soil. As it economic in nature and hazard free it is the one of the best solution for re-utilization of the plastic wastage.

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