

Plastic Wastes Turning Into Soil Stabilizers

Ramoo Ram, Assistant Professor

Department of Civil Engineering, Vivekananda Global University, Jaipur

Email Id- ramu.ram@vgu.ac.in

ABSTRACT: The process known as soil stabilization for enhancing the physical properties of soil, via controlled compaction, the addition of suitable admixtures, such as geo fabrics, geo synthetics, and other materials, and other approaches. The modern soil stabilization strategy can be used to help address societal problems, such as reducing waste and extracting usable various types and other items were rapidly increasing, due to environmental concerns, using a cost-effective method to reduce the issue of plastic disposal while simultaneously boosting California Bearing Ratio (CBR). The present study is focused at resolving issues in Amaravathi, the modern capital of the ancient state of Andhra Pradesh. The handling of plastic garbage without creating environmental concerns is becoming more difficult. As a result, using plastic strips is cost-effective and efficient. There has been a beneficial effect on soil properties since introducing plastic into the mix. Soil stabilizers may be made out of plastic. An experimental programme was conducted out for the Black Cotton Soils stabilization at Amaravathi, using percentages of plastic strips (ranging from 0 percent to 8 percent by weight) determined using the California Bearing Ratio Test.

KEYWORDS: Bearing, Moisture Content, Plastic Waste, Properties, Shear Strength, Soil Stabilization, Water.

INTRODUCTION

Soil is the most important component of nature, because it provides for all of life's fundamental needs such as food, shelter, and clothing. Soil is a thin layer of soil produced by the weathering of rocks that covers the earth's surface. Soil is made up of organic matter, crystals, gases, liquids, and animals, all of which work together to sustain life. The Pedosphere is the Earth's soil body, and it serves four essential functions: it is a tool for plant development, a source of water preservation, transport, and purification, a modulator of the Earth's environment, and a refuge for species. Soil is the consequence of the interaction between temperature relief, plants, and parent materials through time. It happens over time as a result of a variety of physical, chemical, and biological processes, including weathering and erosion. The soil is the most important component of this ecosystem because it contains all of life's core needs, including food, shelter, and clothing. India's biggest soil deposit is black cotton soil, which has a high tendency for development. Soil stabilization is the method of using geo fabrics, geo synthetics, and other materials features (Fig. 1) [1].



Fig. 1: Soil Stabilization Using Waste Plastic Materials.

Laterite soils include fine-grained light-textured residual soils with red, orange, and yellow hues, as well as nodular gravels and cemented soils. They may be as tiny as a clump of dirt or as large as a gigantic boulder. The presence of iron and aluminum oxides or hydroxides, particularly iron oxides, which give the soils their colors, distinguishes them. In engineering, the term laterite refers to coarse-grained vermicular concrete materials such as major laterite. The new soil stabilizing technique may be used to assist solve societal issues like waste reduction and material extraction. The use of plastic in many activities and other products is accumulative, and its disposal has long been a problem due to environmental concerns. The present research is focused at resolving issues with Amaravathi, the capital of Andhra Pradesh's newly created state [2].

Laterite soils resemble fine-grained sands, gravels, and soft rocks in their behavior. Laterite is typically translucent or vesicular in appearance. Under impact, certain laterite particles appear to break quickly, dissolving into a plastic-like soil substance. When exposed to drying, laterite soils may self-harden, or they

may contain significant quantities of hardened laterite rock or laterite gravel if they are not self-hardening. The current study utilized plastic trash as a soil stabilizer to perform an experimental project for the stabilization of Black Cotton Soils in Andhra Pradesh's newly created Capital Region, namely Amaravathi. Plastic strips were applied to the Black Cotton Soil in various quantities (from 0 percent to 8 percent by weight) [3].

The Eastern Ghat of Orissa, the Southern portion of the Western Ghats, the Malabar Coastal Plain and Rathnagiri of Maharashtra, and some areas of Andhra Pradesh, Tamilnadu, and Karnataka are also home to laterite soil. Laterite soil makes up about one-sixth of all soil on the planet, and it covers 2.48 million square kilometers in India [4], [5].

Plastic is a flexible organic material that may be molded into solid structures and a variety of synthetic chemicals. Plastics are high-molecular-mass chemical polymers that also contain other substances. Since plastic is used in a variety of products such as chairs, mugs, polythene containers, and polythene sheets, using it as a soil stabilizer would relieve the issue of disposing of the plastic while also enhancing the cost-effective manner.

- It increases the soil's shear strength, tensile strength, and CBR.
- It may substantially enhance the properties of the soil used in road infrastructure development.

It is getting more difficult to manage plastic garbage without hurting the ecosystem. As a result, using plastic strips is both inexpensive and reliable. Since adding plastic into the mix, the properties of the soil have improved. Plastic is possible to be utilized to create soil stabilizers. The inclusion of garbage from plastic enhances the laterite rock's unconfined compressive strength. The CBR values increase when plastic garbage is added. Plastics of a variety of shapes and sizes may be used. Stabilizers are available in a wide range of shapes and sizes. Limited concentrations of plastic may be found. Plastics may be examined in a variety of soil types [6]. The increased CBR advantage is intended to strengthen the natural ground subgrade and foundation courses underneath the new carriage building's load bearing capability. Although recycling may help reduce garbage that ends up in landfills, wetlands, and the environment, most local governments can only recycle a few types of plastic [7].

A porous mixture of soil particles is referred to as soil. Pores may contain both water and air. Voids are a term used to describe pores. If the moist, and if the gaps are clean, the soil is called dry. To assess moisture content, soil samples are dried to the point when only pore water evaporates. Calculate the liquid limit of a soil sample using the cone penetration method. The water content is measured using the cone penetration method, whereas the depth of penetration of a typical 20 mm cone is obtained using the cone penetration technique. In five seconds, the depths to which a standard metal cone penetrates samples of soil paste generated with various water contents are examined. Normal and modified compact tests were carried out on natural laterite soil. 3000g of oven-dried soil was sieved at 20mm and compacted with a rammer in full. Weigh the mound and the sample, then put the findings on the data sheet. To assess the moisture content of the soil, a small sample was taken [8].

LITERATURE SURVEY

S. V. Singh et al. stated in the paper that infrastructure is a key driver of the Indian economy's overall growth. The cornerstone of any system is crucial. The soil around the foundation is essential to its strength. Expansive soils, such as black cotton dirt, are notorious for causing foundation issues. Swelling, decreasing, and unfair settlement are the issues. Plastic pollution has been one of the world's most serious issues. Year after year, the use of disposable containers, bottles, and other plastic goods grows quickly. As a result, people are confronting a variety of environmental issues. The aim of this analytical research is to concentrate on soil stabilization using discarded plastic products. To assess the changing characteristics, tests such as the liquid limit, plastic limit, regular proctor compaction measure, CBR test, and unconfined compressive strength (UCS) were performed out [9].

S. Saravanan et al. articulated in the article provides a method for features of soil, via the use the addition of lime, as well as waste products such as fly ash, phosphogypsum, and other minerals. This current soil stabilization method may be used to help address societal issues such as garbage reduction and the extraction of usable polythene containers, bottles, and other similar items. The use of polythene containers, bottles, and other similar goods is on the rise, resulting in a multitude of environmental issues. As a result, disposing of plastic waste without hurting the environment has become a major problem. Since high quality soil for embankments is uncommon, using plastic bottles as a soil stabilizer is a cost-effective alternative. This

research provides a thorough evaluation of the utilization of discarded plastic bottles for soil stabilization. Plate load tests on soil reinforced loaded bottles split in half at one-third locations of the tank were used to perform the study. When the test results were compared, it was discovered that applied pressure was the cause of the problem. The appropriate percentage of plastic strips in the soil was determined, and plate load tests were carried out using this proportion. The bottle strips have a direct impact on improving soil strength [10].

PYCNOMETER USED TO DETERMINE SPECIFIC GRAVITY

The enhanced CBR rating reflects the natural ground subgrade and base courses underneath the current carriage building's intended capabilities. While recycling may assist to decrease the amount of garbage that ends up in land fields, rivers, and the environment, most local governments can only recycle a few kinds of plastic. The IS: 2720 specifies a technique for measuring the specific gravity of soils, which may be used to determine the degree of saturation and unit weight of soils. In soil engineering, unit weights are required for pressure, settlement, and stability problems.

A permeable combination of soil particles is referred to as soil. Pores may contain both water and air. Voids are a term used to describe pores. If the gaps are filled with water, the soil is deemed saturated, and if the spaces are empty, the soil is considered dry. To evaluate moisture content, soil samples are dried to the point when only pore water evaporates. Calculate the provided soil sample using the cone penetration method. The cone penetration method is used to estimate the water content of a soil sample when the extent is examined. The depths at which a regular may be identified in five seconds.

For natural laterite rock, both standard and modified compact tests were performed. A total of 3000g of oven-dried soil was sieved at 20mm and compacted using a rammer. Weigh the mould with the sample and write down the results on the data sheet. A small sample of soil was taken to evaluate the moisture content.

$$V_b = \frac{W_1 - W_2}{\gamma_w}$$

Where, W_1 is equal to the Weight of mould with

w is equal to the moisture content

W_2 is equal to the Weight of empty mould.

V is equal to the Volume of mould.

The dry density of the soil is calculated as follows

$$\gamma_d = \frac{\gamma_b}{1+w}$$

Where, γ_b is equal to the wet density of the compacted soil

The Optimum moisture content (OMC) as well as the maximum dry density (MDD) of natural soil are determined, and the amount of soil needed for CBR is estimated using the matching dry density. The soil specimen was put in the mould, and the surcharge weight was placed on top of it. The samples are loaded and analyzed in both unsoaked and wet conditions. The load for 2.5mm and 5mm penetration is recorded, as well as the CBR for 2.5mm penetration. The primary objective of this, according to the Indian Standards (IS) standard on methods of test for soils.

DISCUSSION

The IS: 2720 offers a method for determining the basic gravity of soils, which may be used to determine the degree of saturation and unit weight of soils. In soil engineering, unit weights are needed for strain, settling, and stability problems. The Table 1 shows Pycnometer which is used to measure specific gravity. In this present case study, the approach researchers have used is Mechanical stabilization method for soil stabilization.

$$\text{Specific gravity of soil} = \frac{\text{Density of Water at } 27^\circ\text{C}}{\text{Weight of water of equal volume}}$$

The relative proportions of various grain sizes in the soil are determined using the standard grain size measurement technique.

The soil is the most important component of this ecosystem, because it provides for all of life's fundamental needs such as food, shelter, and clothing. One of India's main soil deposits is black cotton soil, which has a significant propensity changes. Plastic is a flexible organic chemical combining of components into stable

structures. Since plastic is used in a number of goods such as benches, mugs, polythene bags, and polythene sheets, using it may solve while also raising a cost-effective way.

1. Types of Plastic:

- Polystyrene (PS)
- Polypropylene (PP)
- Low-density polyethylene (LDPE)
- Polyvinyl chloride (PVC)
- High-density polyethylene (HDPE)
- Polyethylene terephthalate (PET or PETE)
- Other types of plastic

Out of these polymers humans have utilized Polyethylene sheet of plastic as a soil stabilizer.

Advantages of Plastics include Durability, it does not acquire rust or corrode, Good insulators, Resistance to chemicals, Can be molded into various forms while Disadvantages of Plastics include Expensive, Not good to the environment, Energy required to manufacture them, don't break down or degrade readily.

2. Plastic Characteristics:

- Plastics have a lengthy life span.
- Plastic is a reusable and recyclable material.
- Plastics are less expensive than tin glass and steel.
- Plastic has a high degree of mechanical strength.
- Plastic may be formed into a wide range of forms and sizes.
- Plastic has great optical properties
- Plastic is strong, light, flexible, and durable.

3. Applications of Plastics:

- Good chemical resistance.
- Good dimensional stability.
- Good electrical insulation.
- Good for friction and wear.
- Good weathering and bearing.
- Easy to weld, bond and fabricate.
- Auto-cleavable and Heat Sealing.

CONCLUSION

The soil is the most essential component of this ecosystem because it contains all of life's requirements, including food, shelter, and clothes. Black cotton soil, which has a high tendency for swelling and shrinking due to fluctuations. Soil stabilization is a technique for increasing bearing capacity, via the use of geo synthetics, geo textiles, and other materials. Soil stabilization method is used to assist address societal problems like waste reduction and the extraction of precious materials various tables, cups, and other goods has been rapidly expanding, always due to environmental concerns, utilizing would reduce the issue of plastic dumping while boosting a cost-effective manner.

The handling of plastic garbage without creating environmental concerns is becoming more difficult. As a result, using plastic strips is cost-effective and efficient. There has been a beneficial effect on soil properties since introducing plastic into the mix. Soil stabilizers may be made out of plastic. The addition of plastic garbage increases the unconfined compressive strength of laterite rock. With the accumulation of garbage from plastic, the CBR values rise. Plastics of various types may be used. Stabilizers come in a variety of shapes and sizes. Plastic may be discovered in small amounts and it may be assessed for use in various types of soil.

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