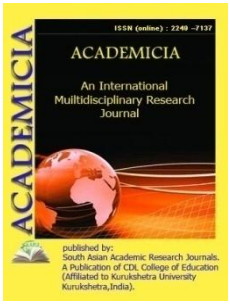
ACADEMICIA

ISSN: 2249-7137 Vol. 11, Issue 10, October 2021 Impact Factor: SJIF 2021 = 7.492

ACADEMICIA
An International Multidisciplinary Research Journal
(Double Blind Refereed & Peer Reviewed Journal)



DOI: 10.5958/2249-7137.2021.02186.8

SOIL STABILIZERS MADE OUT OF DIFFERENT PLASTIC WASTES

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ABSTRACT

The procedure known as soil stabilization for improving the physical characteristics of soil, through controlled compaction, the addition of appropriate admixtures, such as geo textiles, geo synthetics, and other materials, and other techniques. 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 current research is aimed at addressing problems in Amaravathi, the contemporary capital of the ancient state of Andhra Pradesh. The management of plastic trash without generating environmental risks is getting increasingly complex. As a consequence, utilizing plastic strips is cost-effective and efficient. There has been a positive impact on soil characteristics since adding plastic into the mix. Soil stabilizers may be manufactured out of plastic. An experimental programme was carried out for the Black Cotton Soils stabilization in Amaravathi, employing percentages of plastic strips (varying 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.*

1. INTRODUCTION

Soil is the most vital component of nature, since it supplies for all of life's basic requirements such as food, shelter, and clothes. Soil is a thin layer of soil formed 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 support life. The Pedosphere is the Earth's soil body, and it performs four important functions: it is a tool for plant growth, a source of water preservation,

transport, and purification, a modulator of the Earth's environment, and a sanctuary for species. Soil is the result of the interplay between temperature relief, plants, and parent materials over time. It occurs throughout time as a consequence of a number of physical, chemical, and biological processes, including weathering and erosion. The soil is the most essential component of this ecosystem since it includes all of life's fundamental requirements, including food, shelter, and clothing. India's largest soil deposit is black cotton soil, which has a strong propensity for development. Soil stabilization is the technique of utilizing geo textiles, geo synthetics, and other materials characteristics[1].

Laterite soils include fine-grained light-textured residual soils with red, orange, and yellow colors, as well as nodular gravels and cemented soils. They can be as small as a clump of dirt or as big as a giant rock. The presence of iron and aluminum oxides or hydroxides, especially iron oxides, which give the soils their hues, differentiates them. In engineering, the word laterite refers to coarse-grained vermicular concrete materials such as major laterite. The novel soil stabilization method may be utilized to help address social problems including waste reduction and material extraction. The exploitation of plastic in many activities and other goods is accumulative, and its disposal has long been an issue owing to environmental concerns. The current study is aimed at addressing problems with Amaravathi, the capital of Andhra Pradesh's newly formed state[2].Laterite soils mimic fine-grained sands, gravels, and soft rocks in their behavior. Laterite is usually transparent or vesicular in appearance. Under impact, some laterite particles seem to crush rapidly, disintegrating into a plastic-like soil material. When subjected to drying, laterite soils may self-harden, or they may include large amounts of hardened laterite rock or laterite gravel if they are not self-hardening. The present research used plastic garbage as a soil stabilizer to conduct an experimental project for the stabilization of Black Cotton Soils in Andhra Pradesh's newly formed Capital Region, namely Amaravathi. Plastic strips were added to the Black Cotton Soil in different amounts (from 0 percent to 8 percent by weight) [3].The Eastern Ghat of Orissa, the Southern part of the Western Ghats, the Malabar Coastal Plain and Rathnagiri of Maharashtra, and certain regions of Andhra Pradesh, Tamilnadu, and Karnataka are also home to laterite soil. Laterite soil makes up approximately one-sixth of all soil on the globe, and it spans 2.48 million square kilometers in India[4],[5].

1.1.Needs of Stabilization:

- Enhancedtensile strength as well asstiffness of the material.
- Decline in pavement thickness.
- Enhancedresistance to the effect as well asdurability of water.
- Decline in swelling potential.

1.2.Advantages of Soil Stabilization:

- It improves the strength of soil, thus, increasing the soil bearing capacity.
- Stabilization improves the workability and durability of soil.
- Reduce dust in work environment.
- Conserves aggregate materials.

- Reduce cost and conserves energy.
- It is also used to provide more stability to the soil in slope or other such places.

1.3.Disadvantages of Soil Stabilization:

- It does not destroy or remove the contaminants.
- It can be difficult to predict long term behavior.

1.4. Application of Soil Stabilization:

- The soil stabilization procedure can be used for the following purposes: • Reducing the permeability of the soil.
- Increasing the foundation soil's bearing capability.
- Increasing the soil's shear strength.
- Improving the durability of the product in high-moisture and high-stress environments.
- Improving natural soils in order to build motorways and airports.
- Controlling the grading of soils and aggregates in the building of roadway and airport bases and subbases.

1.5.Methods of Soil Stabilization:

- Mechanical stabilization
- Soil-cement stabilization
- Soil-lime stabilization
- Chemical stabilization
- Electrical stabilization
- Stabilization by grouting
- Stabilization by geotextile and fabrics
- Reinforced earth
- Using bio enzymes

1.6.Types of Stabilizers:

- Plastic
- Lime Cement-Fly Ash(LCF-A)
- Lime-Fly Ash
- Portland Cement
- Bitumen
- Lime

Plastic is a flexible organic substance that may be molded into solid structures and a range of synthetic compounds. Plastics are high-molecular-mass chemical polymers that also include other chemicals. Since plastic is utilized in a number of goods such as chairs, mugs, polythene containers, and polythene sheets, utilizing it as a soil stabilizer would alleviate the problem of disposing of the plastic while also improving the cost-effective way.

1.7.Importance of Plastic:

- It improves the soil's shear strength, tensile strength, and CBR.
- It may significantly enhance the characteristics of the soil used in road infrastructure construction.

It is becoming increasingly difficult to handle plastic trash without harming the environment. As a consequence, utilizing plastic strips is both cheap and dependable. Since putting plastic into the mix, the characteristics of the soil have improved. Plastic is able to be used to produce soil stabilizers. The addition of trash from plastic improves the laterite rock's unconfined compressive power. The CBR values rise when plastic trash is introduced. Plastics of a range of forms and sizes may be utilized. Stabilizers are available in a broad variety of forms and sizes. Limited concentrations of plastic may be detected. Plastics may be investigated in a number of soil types[6].The enhanced CBR advantage is designed to boost the natural ground subgrade and base courses beneath the new carriage building's load bearing capacity. Although recycling may help decrease trash that ends up in landfills, wetlands, and the environment, most local governments can only recycle a few kinds of plastic[7].

A permeable combination of soil particles is referred to as soil. Pores may hold both water and air. Voids are a word used to characterize pores. If the wet, and if the spaces are clear, the soil is termed dry. To evaluate moisture content, soil samples are dried to the point where only pore water evaporates. Calculate the liquid limit of a soil sample using the cone penetration technique. The water content is measured using the cone penetration method, while the depth of penetration of a typical 20 mm cone is acquired using the cone penetration technique. In five seconds, the depths to which a typical metal cone penetrates samples of soil paste produced with different water concentrations are evaluated. Normal and modified compact tests were conducted out on natural laterite soil. 3000g of oven-dried dirt was sieved at 20mm and compacted with a rammer in full. Weigh the mound and the sample, then enter the results on the data sheet. To evaluate the moisture content of the soil, a tiny sample was collected[8].

2. LITERATURE SURVEY

S. V. Singh *et al.*presented in the article that infrastructure is a major driver of the Indian economy's overall development. The cornerstone of any system is essential. The soil surrounding the foundation is important to its strength. Expansive soils, such as black cotton dirt, are infamous for creating foundation problems. Swelling, shrinking, and unjust settlement are the problems. Plastic pollution has been one of the world's most significant problems. Year after year, the usage of throwaway containers, bottles, and other plastic products increases rapidly. As a consequence, individuals are facing a range of environmental problems. The objective of this analytical study is to focus on soil stabilization utilizing waste plastic goods. To evaluate the changing properties, tests such as the liquid limit, plastic limit, regular proctor compaction measure, CBR test, and unconfined compressive strength (UCS) were conducted out[9].

S. Saravanan*et al.*articulated in the article describes a technique for characteristics of soil, through the use the addition of lime, as well as waste materials such as fly ash, phosphogypsum, and other minerals. This contemporary soil stabilization technique may be utilized to assist solve societal problems such as trash reduction and the extraction of useable polythene containers, bottles, and other similar things. The usage of polythene containers, bottles, and other similar products is on the increase, resulting in a plethora of environmental problems. As a consequence, disposing of plastic trash without harming the environment has become a serious issue. Since good quality soil for embankments is rare, utilizing plastic bottles as a soil stabilizer is a cost-effective option. This study includes a comprehensive examination of the use of discarded plastic bottles for soil stabilization. Plate load studies on soil reinforced laden bottles divided in half at one-third locations of the tank were utilized to conduct the research. When the test results were compared, it was found that applied pressure was the source of the issue. The proper percentage of plastic strips in the soil was calculated, and plate load tests were carried out using this proportion. The bottle strips have a direct effect on increasing soil strength[10].

3. DISCUSSION

The increased CBR rating reflects the natural ground subgrade and base courses beneath the existing carriage building's intended capabilities. While recycling may help to reduce the quantity of trash that gets up in land fields, rivers, and the environment, most local governments can only recycle a few types of plastic. The IS: 2720 defines a method for measuring the specific gravity of soils, which may be used to estimate the degree of saturation and unit weight of soils. In soil engineering, unit weights are needed for pressure, settlement, and stability issues. The Figure 1 illustrates Pycnometer is a gadget that is used to measure specific gravity.

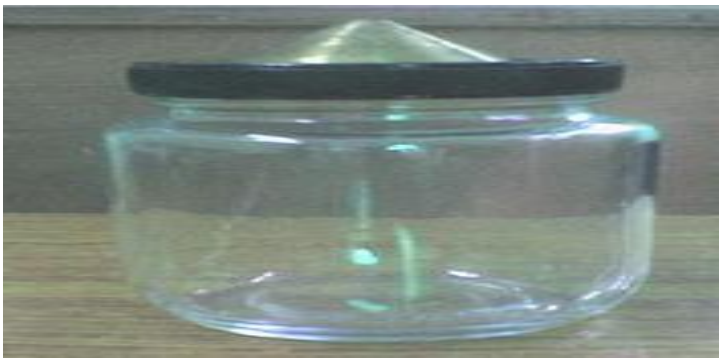

Figure 1: Pycnometer Which Is Used To Determine Specific Gravity.

Boulder> 300 mm,Cobble< 300mm and > 80mm, Gravel (G)< 80mm and > 4.75mili-meter, Coarse gravel = 80mili-meter to 20mili-meter, Fine gravels = 20mili-meter to 4.75mili-meter.

Sand (S)< 4.75mili-meter and >0.075mili-meter.

Coarse sand = 4.75mili-meter to 2mili-meter, Medium sand= 2mili-meter to 425µ, Fine sand = 425µ to 75µ.

Silt> 75µ and < 2µ and Clay< 2µ.

A porous mixture of soil particles is referred to as "soil." Pores may hold both water and air. Voids are a word used to characterize pores. If the gaps are filled with water, the soil is regarded

saturated, and if the spaces are empty, the soil is considered dry. To assess moisture content, soil samples are dried to the point where only pore water evaporates. Calculate the given soil sample using the cone penetration technique. The cone penetration technique is used to determine the water content of a soil sample when the extent is assessed. The depths at which a regular may be recognized in five seconds.

For natural laterite rock, both conventional and modified compact tests were conducted. A total of 3000g of oven-dried dirt was sieved at 20mm and compacted using a rammer. Weigh the mould with the sample and write down the findings on the data sheet. A tiny sample of soil was collected to assess the moisture content.

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

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, $\gamma_b$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 calculated, and the quantity of soil required for CBR is measured 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 examined in both unsoaked and wet circumstances. The load for 2.5mm and 5mm penetration is recorded, as well as the CBR for 2.5mm penetration. The main aim of this, according to the Indian Standards (IS) standard on techniques of test for soils.The IS: 2720 provides a formula for calculating the basic gravity of soils, which may be used to calculate the degree of saturation and unit weight of soils. In soil engineering, unit weights are required for strain, settling, and stability issues. The Table 1 displays Pycnometer which is used to measure specific gravity. In this current case study, the technique researchers have utilized is Mechanical stabilization method for soil stabilization.

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

The relative proportions of different grain sizes in the soil are determined using the standard grain size measuring test. Plotting the Figure 2 shows the percentages of grit, sand, silt, and mud. The results were disputed.

TABLE 1: CASAGRANDES METHOD UNDER CONSISTANCY LIMITS. FOR PRESSURE, SETTLING, AND STABILISATION PROBLEMS IN SOIL ENGINEERING, UNIT WEIGHTS ARE NEEDED.

No of blows	43	41	36	30	26	18
Moisture content determination	26%	28%	30%	32%	34%	36%
Weight of container (W1)	10	10	10	10	10	10
Weight of container + wet soil (W2)	20	20	20	20	20	20
Weight of container + dry soil (W3)	17.42	17.56	18.01	18.38	19.02	19.42
Moisturecontent (w) $w = \frac{Ww}{Wd}$	34.77	32.28	24.84	19.33	10.87	6.16

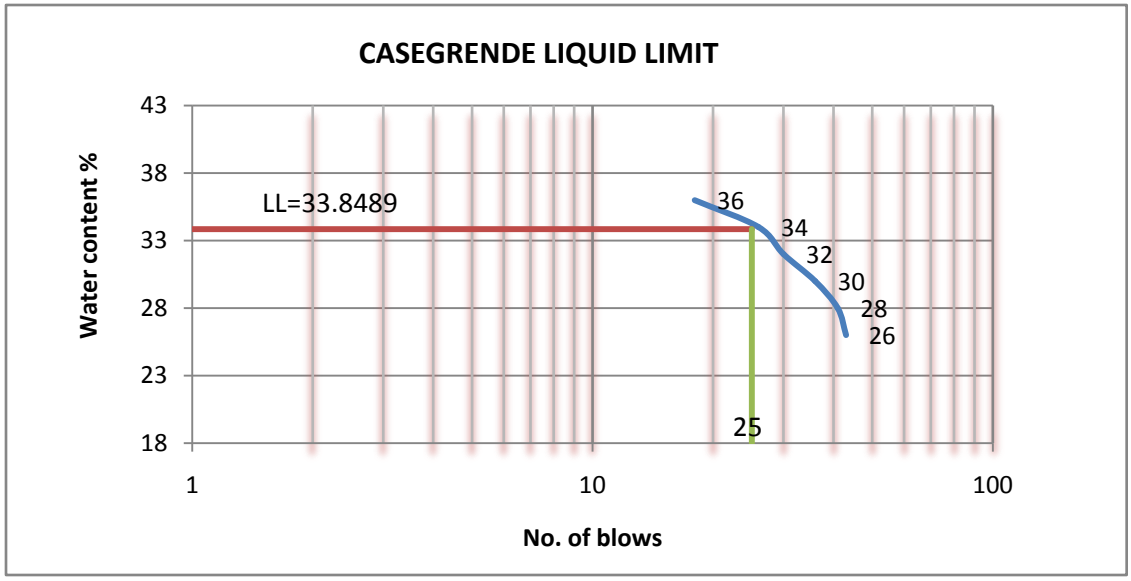

Figure2:Casegrende'sLiquid Limits. The Basic Grain Size Estimation Test Determines The Relative Proportions Of Different Grain Sizes In The Soil.

Result achieved for the technique used and formulas performed is stated as Liquid limit of the soil =33.8489 percent

The soil is the most crucial component of this ecosystem, since it supplies for all of life's basic requirements such as food, shelter, and clothing. One of India's major soil deposits is black cotton soil, which has a high tendency changes. Plastic is a pliable organic chemical combining of components into stable structures. Since plastic is utilized in a variety of products such as benches, mugs, polythene bags, and polythene sheets, utilizing it may solve while also raising a cost-effective manner.

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 plastics people have used Polyethylene sheet of plastic as a soil stabilizer.

Advantages of Plastics are Durability, it does not get rust or corrode, Good insulators, Resistance to chemicals, Can be formed into complex shapes whereas Disadvantages of Plastics are Expensive, Not friendly to the environment, Energy needed to produce them, don't break down or degrade easily.

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-clavable and Heat Sealing.

4. CONCLUSION

The soil is the most important component of this ecosystem since it holds all of life's needs, including food, shelter, and clothing. Black cotton soil, which has a strong propensity for swelling and shrinking owing to changes. Soil stabilization is a method for improving bearing capacity, through the use of geo synthetics, geo fabrics, and other materials. Soil stabilization approach is utilized to help solve societal issues including waste reduction and the extraction of valuable materials different tables, cups, and other products has been exponentially growing,

always due to environmental issues, using would lessen the issue of plastic dumping while increasing a cost-effective manner.The management of plastic trash without generating environmental risks is getting increasingly complex. As a consequence, utilizing plastic strips is cost-effective and efficient. There has been a positive impact on soil characteristics since adding plastic into the mix. Soil stabilizers may be manufactured out of plastic. The inclusion of plastic trash improves the unconfined compressive strength of laterite rock. With the buildup of trash from plastic, the CBR values increase. Plastics of different kinds may be utilized. Stabilizers come in a range of forms and sizes. Plastic may be found in tiny quantities and it can be evaluated for usage in different kinds of soil.

REFERENCES

1. P. Singh and S. Malhotra, "Review on improvement of engineering properties of soil using waste plastic bottles strips (Polyethylene terephthalate)," *International Journal on Emerging Technologies*. 2018.

2. V. Kumar Patidar and S. Kaur, "A Review Literature on the Use of Waste Plastic to Improve Geotechnical Properties of Soil," *Int. Res. J. Eng. Technol.*, 2016.

3. A. Kumar and V. H.P, "Effect of Discarded Plastic Waste as Stabilizer on Engineering Properties of Effect of Discarded Plastic Waste as Stabilizer on Engineering Properties of Cohesive Soil," *Int. J. Eng. Technol. Sci. Res.*, 2017.

4. A. Patil, G. Waghere, N. Inamdar, P. Gavali, R. Dhore, and S. Shah, "Experimental Review for Utilisation of Waste Plastic Bottles in Soil Improvement Techniques," *Int. J. Eng. Res.*, 2016.

5. M. Sai and V. Srinivas, "Soil Stabilization by Using Plastic Waste Granules Materials," *IOSR J. Comput. Eng.*, 2017.

6. S. V Biradar and M. K. Moniuddin, "Soil Stabilization using Waste Pet Fiber Material," *IJSRD -International J. Sci. Res. Dev.*, 2015.

7. C. Harish and H. . Ashwini, "Stabilization of Soil By Using Plastic Bottle Strips As a Stabilizer," *Int. Res. J. Eng. Technol.*, 2016.

8. A. Modarres and Y. M. Nosoudy, "Clay stabilization using coal waste and lime - Technical and environmental impacts," *Appl. Clay Sci.*, 2015, doi: 10.1016/j.clay.2015.03.026.

9. S. V. Singh and M. Dixit, "Stabilization of Soil by Using Waste Plastic Material: A Review," *Int. J. Innov. Res. Sci.*, 2017.

10. S. Saravanan and B. J. Ravindraraj, "Soil stabiliisation using raw plastic bottles," *Int. J. Civ. Eng. Technol.*, 2018.