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# Soil Stablization by Using Plastic Waste

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***Abstract:*** ***The process of improving the physical and engineering properties of soil such as shear strength and bearing capacity is known as Soil Stabilization. Indian terrain is mostly occupied by black cotton soil. It is highly expansive soil which shows more swelling, shrinkage and settlement problems. Thus, Construction of buildings and other Civil Engineering structures on this soil is risky. Use of compaction technique or suitable admixtures like cement, lime and waste material like fly ash, etc can bring out the soil stabilization. But these are expensive additives. That we studied here suggest and proved that the use of plastic waste for stabilization of soils would reduce the problem of disposing plastic waste and also reduce environmental problems. It is seen that CBR test, Proctor test, Sieve analysis are performed to check the suitability of plastic waste as soil stabilizer. Sieve Analysis gives the physical properties of the soil sample. Modified Proctor Test gives the OMC and Dry Density of soil sample. CBR Test results the Optimum Plastic content. Optimum Plastic content is the percentage of plastic added in the soil sample above which the CBR value falls. Modified Proctor Test is recommended than Standard Proctor Test because the soil which is tested will be used for road construction which requires high compaction. soil stabilization is possible by plastic waste which is a cheap method of soil stabilization.***

***Keywords: Optimum Plastic Content, Plastic Waste, Dry Density, Plastic strips, Shear strength, California Bearing Ratio (CBR) test, Compaction test.***

## I. INTRODUCTION

Due to omnipotent scope of plastic other different materials such as paper and other are being replaced with it which was used for different purposes like household packing purposes, used by restaurant and all. It has omnipotent use in today's context but the use of plastic and its effect in the environment has made the use of this material in an ambiguity. It has become one of the major problems for the environment. The use of plastic has to be limited by now otherwise there would be harshly circumstance that human and environment has to face in near future. It is the fact that we can reuse the plastic and make it usable for number of times so that its wastage will be reduced remarkably.

This steps are still in progress but this only hasn't been able to paced up as per expectation because the use of this materials has increased in such a way that it is very difficult to limit them instead the alternative for those must be identified and process must be taken accordingly. India itself has witnessed a substantial growth in the consumption of plastics and increased production of plastic waste. It has become very tedious job to limit it. It is fact that the plastic waste is now considered as environmental hazard due to the "Use and throw" mechanism.

So it can be used for the alternative method where its important will be counted and stabilization of soil is the best place where this material can be used up. Soil stabilization is the process of altering some soil properties by different methods, Soil mechanical or chemical in order to produce an improved soil material which has all the desired engineering 1 properties and it is made more stable. It is used to decrease the soil's unqualified characteristics such as permeability and consolidation potential and increase the shear capacity.

The method is mainly adopted for highway and airfield construction projects. Commonly, activities such as compaction and pre-consolidation are used to improve types of soils which are already in good form. But soil stabilization goes way up to encouraging usage of weak soil and reducing the uneconomical process of weak soil replacement. Other than working on the soil mass interaction, chemically altering the soil material itself is also the focus of this process. Sometimes, soil stabilization is used for city and suburban streets to make them more noise-absorbing.

## II. LITERATURE REVIEW

Hatein Nsaif et al (2013) "Behaviour of soil by mixing of plastic strips." At different mixing ratios (0.2,4.6,8) by weight respectively that, there is significant improvement in the strength of soils because of increase in internal friction. The percentage of increase in the angle of internal friction for sandy soil is slightly more than that in clayey soil, but there is no significant increase in

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cohesion for the two types of soils. Also, it was concluded that due to low specific gravity of plastic pieces there is decreases in MDD and OMC of the soil.

Rajkumar Nagle et al (2014) ”comparative study of CBR of soil, reinforced with natural waste plastic material” They mixed Polyethylene, Bottles, Food packaging and shopping bags etc as rein forcement with black cotton soil, yellow soil and sandy soil. Their study showed that MDD and CBR value increases with increase in plastic waste. Load bearing capacity and settlement characteristics of selected soil material are also improved.

K Gopinath, K Anuratha (August 2015) “Utilization of saw dust in cement motor and cement concrete” in these study as the percentage saw dust increases the density is found to decrease. Wastage of saw dust is minimized and recycled for construction work.

Chebet et al (2014) ”laboratory investigation on re-using polyethen (Plastic) bag, waste material for soil reinforce ment in geotechnical engineering” Tests and analysis indicates that the increased strength for the reinforced soil is due to tensile stresses mobilised in the reinforcement. The factors identified to have an influence on the efficiency of reinforcement material were the plastic properties (concentration, length, width of the strips) and the soil properties (gradation, particle size, shape).

## III. OBJECTIVES

*1)* To study the impact of proposed admixture i.e; plastic waste on the properties of clay soil through laboratory experimentations.
*2)* To evaluate the performance of clay soil when stabilized with proposed ad mixture i.e; plastic waste and their suitability for pavement construction.
*3)* To improve the characteristics at the site and make soil capable of carrying load and to increase the shear strength of soil.
*4)* To improve the soil stability.
*5)* Provide the economical solution for soil stabilization by using plastic waste.

## IV. PROPOSED METHODOLOGY

*1)* Methods of Soil Stabilization: There are different materials in utilization for the stabilization of black cotton soils. Depending on the internal factor which describes the bonding between the soil and the stabilizer utilized, the methods are broadly classified into two types. They are
*2)* Mechanical Stabilization: It is based on the principle of friction Le.. when the admixtures are added to soil and compacted the strength is enhanced due to the friction between the soil and the material added. Examples for the materials which increase the strength by this principle are sand, plastic, geo textiles etc
*3)* Chemical Stabilization: It is based on the chemical reaction between the material added and the minerals in soil. Examples for this type of stabilizers are lime, fly ash, bituminous materials, cement etc. In this project we use a mechanical stabilization.

## V. EXPERIMENTAL INVESTIGATION

### *A. Sieve Analysis*

*1)* Take a suitable quantity of oven-dried soil. The mass of soil sample required for each test depends on the maximum size of material.
*2)* Clean the sieves to be used, and record the weight of each sieve and the bottom pan.
*3)* Arrange the sieves to have the largest mesh size at the top of the stack. Pour carefully the soil sample into the top sieve and place the lid over it.
*4)* Place the sieve stack on the mechanical shaker, screw down the lid, and vibrate the soil sample for 10 minutes. Remove the stack and re-weigh each sieve and the bottom pan with the soil sample fraction retained on it. Obtain the mass of soil retained on each sieve. The sum of the retained masses should be approximately equal to the initial mass of the soil sample.
*5)* Calculate the percent retained on each sieve by dividing the mass retained on the sieve with 1 the total initial mass of the soil.
*6)* Calculate the cumulative percent retained by adding percent retained on each sieve as a cumulative procedure. 9. Calculate the percent finer by subtracting the cumulative percent retained from 100 percent.
*7)* Make a grain size distribution curve by plotting sieve size on log scale and percent finer on brdinary scale.

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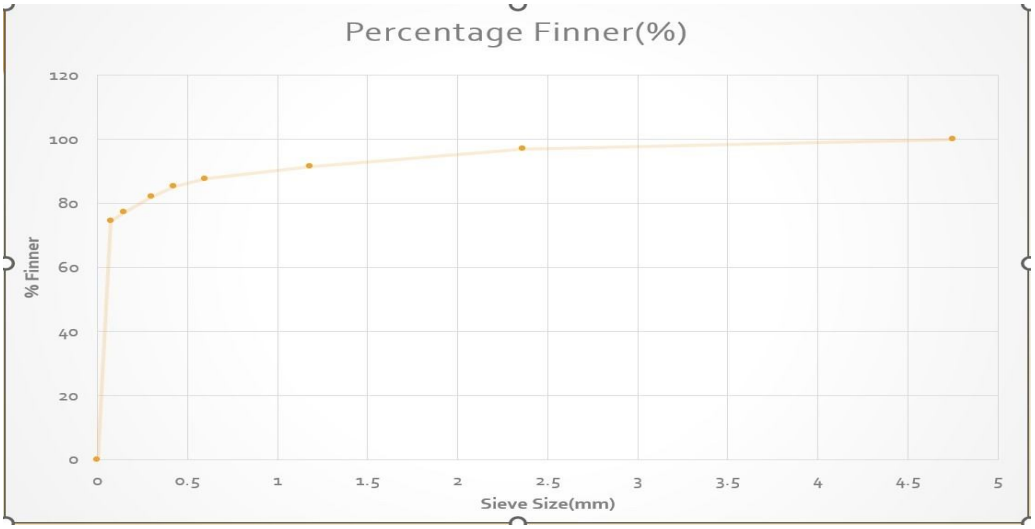


Figure: graph between % finner and sieve size

Results:
% Gravel=0
% Sand=100-74.4=25.6 %
% Slit and clay=74.4 %

*B. Specific Gravity*

- Wash, dry and weigh the pycnometer/density bottle.
- Place about 200g/10 g of dry soil sample in the pycnometer/density bottle. Weigh the bottle with the soil.
- Add sufficient de-aired water to cover the soil, and connect the bottle to a vacuum pump to remove all entrapped air.
- Disconnect the pump and fill the pycnometer/ density bottle with water up to the calibration mark.
- Clean the exterior surface of the pycnometer/density bottle with dry cloth, and weigh the bottle with contents. Empty the pycnometer/density bottle and clean it. Fill it with distilled water up to the mark and record its weight.
- Conduct the test for 3 times.

| TEST NO | 1 |
|---|---|
| Mass of Density Bottle ,W1(g) | 434 |
| Mass of Density+dry soil,W2(g) | 611 |
| Mass of Density+soil+water,W3(g) | 1475 |
| Mass of Density +water,W4(g) | 1362 |

Figure: calculations

$$Specific Gravity of fine aggregate = \frac{W_2 - W_1}{W_2 - W_1 - (W_3 - W_4)}$$

= (611-434)/(1362-434)-(1475-611)
Specific Gravity of given Sand is=2.76

*C. Compaction Test*

The maximum dry density and optimum moisture content were determined by conducting standard proctor compaction test. In this test, the soil was compacted using a test mould and a rammer at different water contents until the wet density started decreasing. Moisture content of the soil at different water additions was obtained, and the dry density for each compaction level was graphed with its respective water content. The peak of the curve provided the maximum dry density that the soil can be compacted to, with the optimum moisture content that can yield the maximum compaction. how dry density can be calculated, where is dry density, wet density and water content.

| TEST NO | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Water content ( %) | 14.5 | 16.7 | 17.18 | 21.86 | 24.21 |
| Dry Density(g/cc) | 1.58 | 1.722 | 1.703 | 1.633 | 1.561 |

Figure: compaction tabular

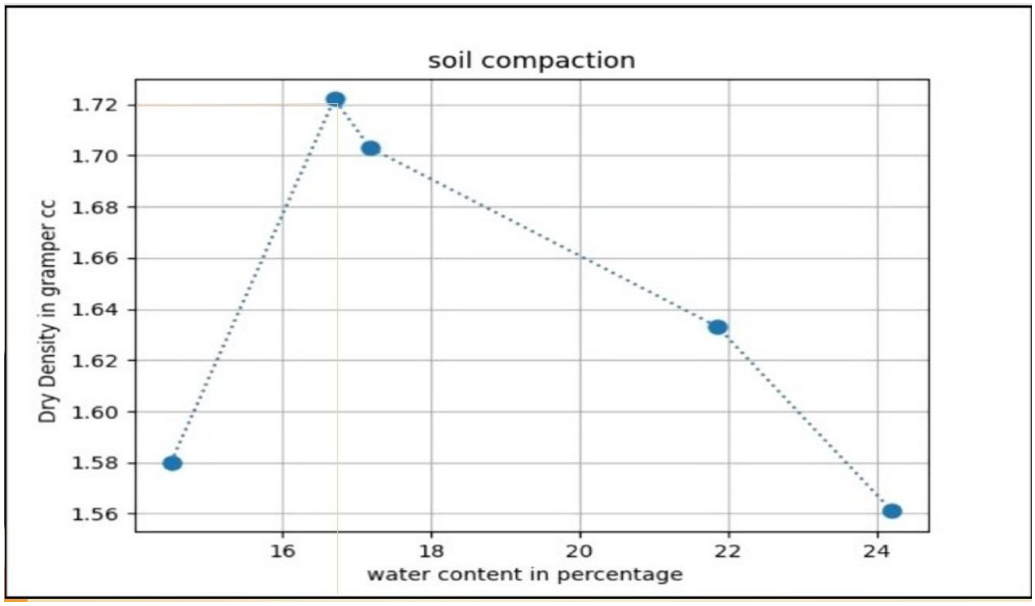



Figure: compaction graph

RESULT
MDD =1.72 g/cc
OMC= 16.35%

*D. CBR Test*

*1)* Prepare the test specimen as IS 2720 (Part 10). Perform the swelling test if desired.
*2)* Perform the Penetration test.
*3)* The mould containing the specimen with the base plate in position but the top exposed shall be placed on the lower plate of the testing machine.
*4)* Surcharge weights, sufficient to produce an integrity of loading equal to the weight of the base material and pavement shall be placed on the specimen If the specimen has been soaked previously, the surcharge shall be equal to that used during the soaking period.

5) To prevent the upheaval of soil into the hole of the surcharge weights, 25 kan-nalar weight shall be placed on the soil surface prior to scatting the penetration plunger after which the remainder of surcharge weights shall be placed.
6) The plunger shall be seated under a load of 4 kg so that full contact is established between the surface of the specimen and plunger.
7) The stress and strain gauges shall then be set to zero.
8) Load shall be applied to the penetration plunger so that the penetration is approximately 125 mm/min.
9) Reading of the load shall be taken at penetrations of 00, 05, 10, 15, 20,25,40,50,75, 100, 12.5 4mm. hy About 20 to 50 g of soil shall be collected from the top 30 mm layer of the specimen and water content is determined The load penetration curve is plotted A correction curve is plotted if necessary
10) The CBR value is calculated and reported correct to the first decimal place.

| Plastic waste(%) | CBR Value(%) |
|---|---|
| 0 | 2.571 |
| 0.5 | 2.785 |
| 1 | 3.432 |
| 1.5 | 3.871 |
| 2 | 4.3 |

Figure: Percentage of CBR Values

## VI. RESULTS AND DISCUSSIONS

For the soil sample the Specific Gravity value is 2.76
For the soil sample the Optimum moisture content (OMC) is 16.35%
For the soil sample the CBR value is 4.3%

## VII. CONCLUSION

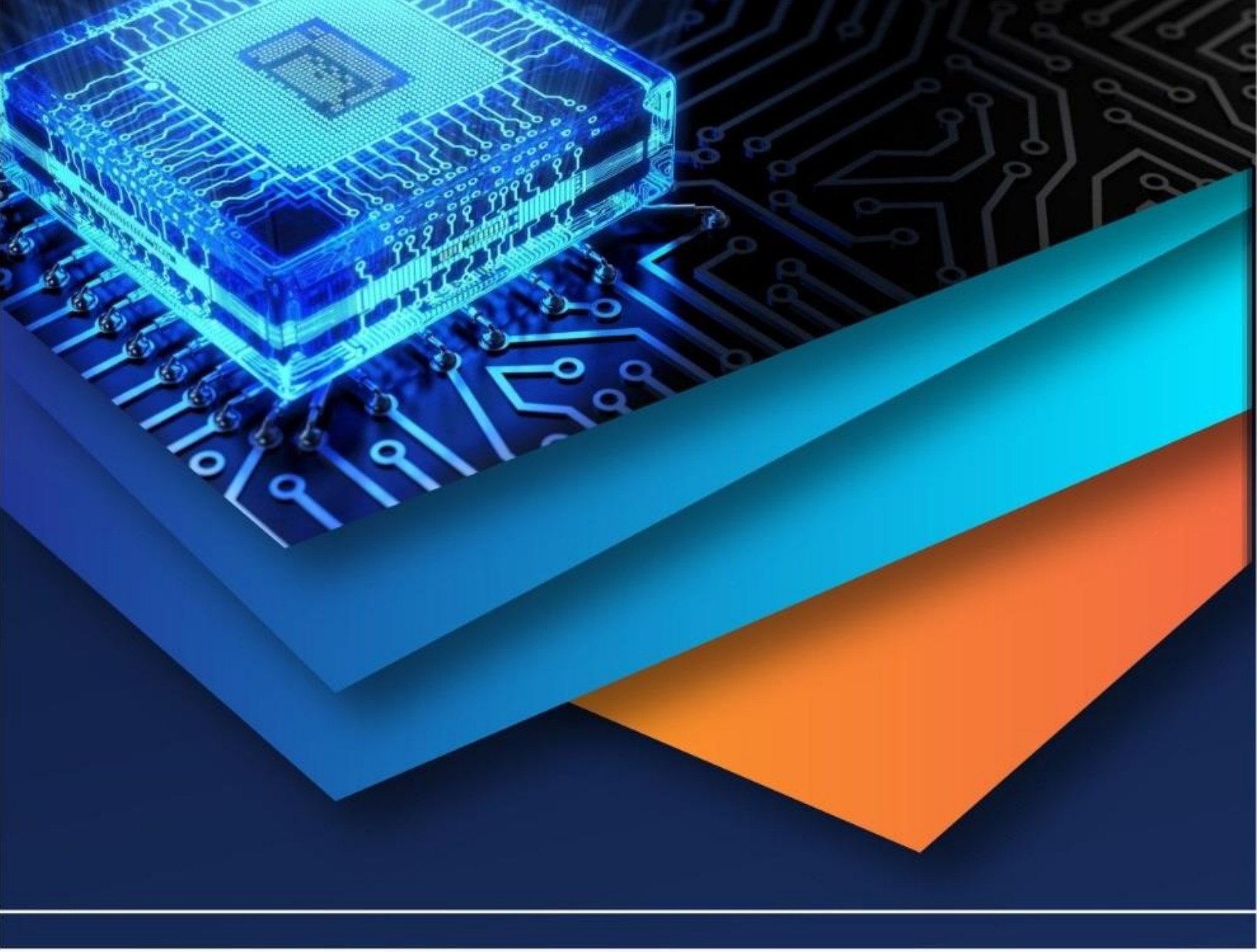
1) The results of the study concluded that insertion of plastic waste material in clayey soils would be productive for ground improvement and soil stabilization in geotechnical engineering.
2) In the present study, different content of plastic waste in % by weight varying from 0% to 2% were added into the soil.
3) The optimum moisture content (16.35%) and in the maximum dry density(1.72g/cc) results respectively.
4) The swelling of the soil was reduced significantly at high percentages of plastic content because of replacement in an equal mass of expansive soil by non expansive plastic. Reduction in swelling.
5) Properties of soil can be improved by using waste plastic as stabilizer:- CBR value(4.3%) and Increase the strength of soil.
6) Reduction in consolidation settlement.

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