

# “Soil Stabilization and Compaction Waste Plastic Material”

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## ABSTRACT:

A procedure of soil compaction techniques improvement which includes new authors' methodology is described. The significance of soil compaction for engineering functions is substantiated. Preconditions for Proctor compaction take a look at look are highlighted. Proctor's method and hints for the diploma of soil compaction assessing are analyzed. Soviet model of Proctor's tools and Modified Proctor compaction check are given. Principal variations between Proctor test, Standard compaction take a look at and Modified Proctor check are presented. The troubles and negative aspects of existent soil compaction checks are revealed. New authors' bodily scan methodology for patterns institution of water migration in subgrade embankment depth, in the potential elements of what it is accepted: clay soil kind (its wide variety plasticity); moisture, at what the soil used to be compacted; soil skeleton density; embankment height; «rest» time after sub grade erection and earlier than its operation is developed and realized. By laboratory and subject exams water migration patterns in compacted sub grade soils depth are established. As a end result of statistical processing of lookup results, the empirical dependence of compacted clay soil stabilized moisture is obtained. Empirical dependence parameter corresponds to most molecular moisture ability at what it is beneficial to do the sub grade clay soils multilayer consolidation for their long-term power ensuring.

## I. INTRODUCTION:

### Compaction:

Compaction of soils has been used to enhance its houses for as lengthy as mankind had the want to supply pathways for carrying significant visitors volumes irrespective of whether or not the site

visitors volumes had been pedestrians, animal or motorised vehicles. Although it can be typical that the early street builders did no longer recognize the concepts of soil mechanics, they knew intuitively (and empirically) that if a heavy load used to be utilized to the soil, its traits expanded in a way that it furnished a extra automatically steady pathway, greater appropriate for their purposes. Soil compaction is extensively utilized in geotechnical engineering practice. It is used to maximise the dry density of soils to decrease subsequent contract below working masses or to decrease the permeability of soils. The sturdiness and balance of constructions are fantastically associated to the terrific compaction achievement. The structural failure of roads and airfields, and the harm brought on by using basis contract can regularly be traced returned to the failure in accomplishing enough compaction. For that reason, soil compaction is vital for engineering activities involving earthworks. The want for appropriate compaction grew to be necessary for the duration of the early 20 th century, as a end result of multiplied visitors and axle loads. A huge vary of exceptional kinds of compaction gear was once developed in the course of the 20 th century, with vibratory compaction that used to be gaining hastily due to avenue pavement layers compaction significance [1]. The improvement of compaction gear and methods is nevertheless persevering with nowadays in order to similarly enhance compaction, as it is one of the most vital elements figuring out the overall performance of street pavement structures.

### Stabilization:

Now a days, Plastic enterprise is booming with extra trends in technological know-how fields. The plastic merchandise is produced in automobile, digital and electrical substances etc. The use of

plastic luggage is additionally on a boom. The recycling of plastic is expensive. The burning of plastics produces hazardous gases like dioxins, mercury, Polychlorinated biphenyls (BC Ps) additionally produces gases which lure warmth main to international warming. The decomposition of plastic is additionally now not possible. Landfill techniques of plastic disposal have an effect on the atmosphere. The leaching of plastic due to acidic surroundings of soil impacts the organisms. So, there is a want to boost new strategies to dispose the plastic materials. For disposing of plastic waste, we can use plastic waste for stabilization of soil. Soil stabilization is any system which improves the engineering residences of soil, such as growing shear strength, bearing capability etc. Soil stabilization methods can largely be labelled into three kinds namely: - Mechanical: The oldest kinds of soil stabilization are mechanical in nature. It entails bodily altering the property of the soil. Dynamic compaction is one of the essential sorts of soil stabilization, in this system a heavy weight is dropped again and again onto the floor at normal intervals to pretty actually pound out deformities and make sure a uniformly packed surface. Vibro compaction is any other method that works on comparable principles, even though it depends on vibration as an alternative than deformation thru kinetic pressure. To acquire its goals. Chemical: chemical methods consider on including an extra fabric to the soil that will bodily engage with it and exchange its properties. There are a range of one of a kind sorts of soil stabilization that consider on chemical components of one variety or another, regularly encountered compounds are utilization of cement, lime, fly ash, or kiln dust. Most of the reactions sought are both cementitious and pozzolanic in nature, relying on the nature of the soil. Polymer/Alternative: Most of the more recent discoveries and methods developed consequently a long way are polymer primarily based in nature such as processed polymer fibre or wastage substances such as polythene bags, plastic bottles, recycled plastic pins. These new polymers and resources have a variety of big Soil Stabilization the use of Plastic; they are more cost-effective and greater positive in customary than mechanical solutions, and substantially much less unsafe for the surroundings than many chemical solutions. In this undertaking stabilization is accomplished via polymer method, with the aid of the usage of plastic covers.

## II. LITERATURE VIEW:

Michael(1993)had cautioned about Bench-Scale Evaluation of Asphalt Emulsion Stabilization of Dirtied Soils. In this study, it used to be conversed about the use are mentioned to the environmental fixation of soils contaminated via natural contaminants.

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This find out about is carried out on the improvement of the roadways which is very necessary and required to be sturdy sufficient to assist distinct loads. To meet these challenges plastic wastes are used in the varieties of strips of a number sizes for figuring out the required share quantity of plastic strips and offering the choice way for disposing the plastic wastes. To learn about this reinforcing impact of blended plastic strips in soil, a sequence of wellknown proctor and unsoaked.

CBR checks have been carried out and primarily based on this it is determined that the most dry density of plastic combine soil decreases with extend of share of plastic strips, and for CBR will increase with expand of share of plastic strips inside a sure limit. Based on this conclusion must be drawn is that with the aid of growing the quantity of plastic contents, the cost of the MDD decreases whereas the cost of OMC increases. There is expanding in CBR price for soil with growing the share of plastic strips. The most CBR cost is received when the proportion of the plastic strips is 0.8% of dry weight of soil. Hence 0.8% of strips having size of 2cm is viewed as required amount.

Prof.Harish C, Ashwini HM additionally researched on soil stabilization the use of plastic waste. The waste plastic fabric i.e. plastic bottles are used in this project. The waste plastic bottles are taken and reduce into small strips. The addition of these small strips in the soil through unique share and behavior assessments such as liquid limit, plastic limit, compaction test, CBR take a look at etc. Then soil turns into stabilized i.e. growing the load bearing potential of the soil and additionally electricity homes such as shear power with a managed compaction. Soil stabilization with the aid of the usage of waste plastic bottles which considerably beautify the energy houses of the soil.

K. Geetha Manjari et.al. (2011)presented paper onCompressibility and permeability conduct of plastic waste blended Sand’. According to their investigation, they furnished experimental outcomes on the one-dimensional compression check and permeability for plastic waste combined

sand. Based on experimental take a look at results, it used to be located that the compressibility and permeability decreased extensively with addition of a small share of plastic waste to the soil. In his analysis, to check out the results of plastic waste on the engineering houses of soils, a collection of exams have been carried out on sand. One-dimensional consolidation check was once carried out for one of a kind percentages of plastic waste blended sand. A.K. Choudhary, J.N. Jha and K.S. Gill, "A Study on Behavior of Waste Plastic Strip Reinforced Soil" Emirates Journal for Engineering Research, 15 (1), 51-57 (2010) IN the current time the overall performance of paved and unpaved roads is frequently negative after each and every monsoon. Attempts have been made in this learn about to exhibit the practicable of reclaimed HDPE as soil reinforcement for enhancing engineering residences of the subgrade soil. Strips received from waste plastic with a number of dimensions have been combine randomly with soil and locate out excellent quantity of HDPE strips. They carried out checks and interpreted the facts primarily based on the ratio of size to width of the strip. He additionally stated that as most of the plastic luggage are made of high-density polyethylene material, as a result there is a fast make bigger in the quantity of the plastic cloth in the environment.

#### **Objectives:**

##### **Compaction:**

- 1) As a building platform to dry very moist soils & facilitate compaction of the top layers for this case, the stabilized soil is generally no longer regarded as a structural layer in the pavement graph process
- 2) To reinforce a susceptible soil and avert the extent trade conceivable of a fairly plastic or compressible soil for this case, the modified soil is commonly given some structural fee or savings in the pavement layout process.
- 3) To minimize moisture susceptibility of pleasant grain soils

##### **Stabilization:**

- 1) To make bigger the density and California Bearing Ratio (CBR) of soil the use of plastic as an admixture.
- 2) To furnish an choice answer for the disposal of plastic waste.
- 3) To grant an good value answer for soil stabilization the usage of plastic waste.
- 4) To decide the optimal plastic content material to be used

#### **Methodology:**

##### **Compaction:**

1) Soil Material Black cotton clayey soil was once used in this find out about amassed from Ganur, Tal. Chandwad. Dist- Nashik, Maharashtra, India. The accrued soil is low plastic silt (ML). Then the soil was once screened via the sieve of 4.75 mm aperture earlier than making ready the specimen for testing. According to the Unified Soil Classification Systems soil is clay. Table NO. 1. Properties of Black Cotton Soil S.NO PROPERTY VALUE 1 Specific Gravity 2.39 two Liquid Limit 51% three Plastic Limit 40.41% four Shrinkage Limit 15.69% 5 Plasticity Index 10.59%

2) Plastic Shopping Bag The substances used in the find out about had been plastic baggage gathered from ragpicker who collects waste plastic bags. The cloth density used to be measured to common 798kg/m<sup>3</sup>, with the tensile energy ranging between 14 and 20 MPa. Plastic baggage of thickness 50 micron. The Three reinforcement plastic strip of width 10mm & 15mm and lengths 20 mm, 40 mm, 60 mm are undertake and their reinforcement awareness in 0.15%, 0.30%, 0.45% & 0.60% via mass of soil are adopt.

##### **l.ii. Experimental Work :**

Soil samples for the checks had been oven dried in order to put off any results of moisture and the plastic strips combined with the soil to shape a composite (Figure 2a). The plastic strips used have been of lengths 20mm, 40mm, 60mm and widths of 10mm and 15mm. The strips had been brought to the soil at concentrations of 0.15%, 0.30%, 0.45% and 0.60% by way of weight of soil.

##### **Stabilization:**

(1) Mechanical approach of Stabilization: In this procedure, soils of extraordinary gradations are blended collectively to attain the favored property in the soil. This may additionally be carried out at the website or at some different area from the place it can be transported easily. The closing combination is then compacted by means of the regular strategies to get the required density.

(2) Additive technique of stabilization: It refers to the addition of manufactured merchandise into the soil, which in applicable portions enhances the best of the soil. Materials such as cement, lime, bitumen, fly ash etc. are used as chemical additives. Sometimes one-of-a-kind fibers are additionally used as reinforcements in the soil. The addition of these fibres takes place by way of two methods;

a) Oriented fiber reinforcement: The fibers are organized in some order and all the fibers are positioned in the equal orientation. The fibers are laid layer through layer in this kind of orientation.  
 b) Random fiber reinforcement: This association has discrete fibers allotted randomly in the soil mass. The mixing is finished till the soil and the reinforcement structure a greater or much less homogeneous mixture. Materials used in this kind of reinforcements are normally derived from paper, nylon, metals or different substances having diverse bodily properties.

Facilities Available:

The following amenities are handy at Sahakar Maharshi Shankararao Mohite Patil Institute Of Research & Technology, Akluj to raise out dissertation work.

1. Material trying out Lab.
2. Online Journals and Library facility.

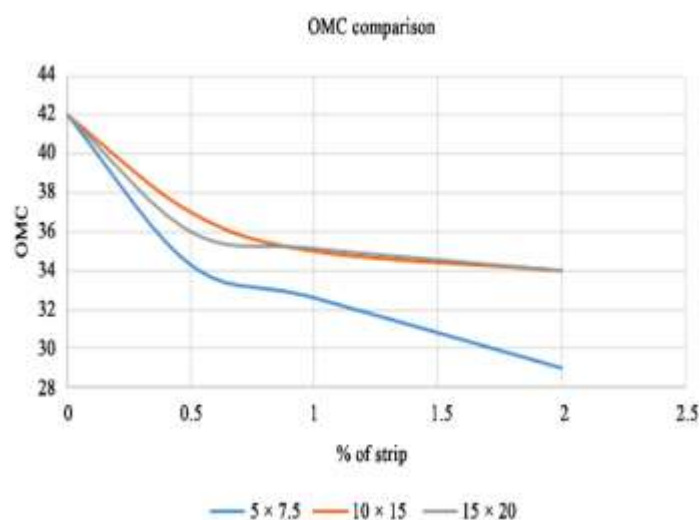
### III. RESULTS

#### A) Standard Proctor Compaction Test Results:

One of the ways the effect of adding plastic into the soil was checked was in terms of the soil's improvement during compaction. This improvement was expressed in the change in the maximum dry density (MDD) and optimum moisture content (OMC). The summary of the test results is given in Table 9.

**Table 09: MDD and OMC of soil with different treatment levels of plastic strips.**

Strip Size (mm)	Treatment Level (%)	MDD (KN/m <sup>3</sup> )	OMC (%)
None	0	12.81	41.99
	0.5	11.96	34.1
5*7.5	1	12.53	32.3
	2	12.5	28.95
	0.5	12.34	35.98
10*15	1	12.08	34.88
	2	11.90	33.98
	0.5	12.20	35.96
15*20	1	12.22	35.12
	2	12.15	34.97



#### B) Free Swell Test Results

The main problem of expansive soil is its volume change in different moisture conditions. When the moisture content increases, the soil swells and its volume increases in a wide range from the original.

This property happens at a particle level, when water particles break the bonds that connect the sandwich like chemical structure and penetrate between layers. This problem is particularly solved by altering the chemical characteristics of the soil using the application of different chemicals.

**Table 10: Free swell test results.**

Strip (mm)	Size	Treatment Level (%)	Swelling (%)
None		0	160
		0.5	136.1
5*7.5		1	126.1
		2	112.2
		0.5	133.8
10*15		1	120.9
		2	115.7
		0.5	134.8
15*20		1	127.2
		2	117.2

**C) Direct Shear Test Result.**

It was possible to conclude from the test results that the arrangement of the plastic strips in the soil affects the shear capacity of the reinforced soil. If the surface of the strip is parallel to the shear plane, the shearing will be enhanced and the

capacity will fail. But any other arrangement will improve the shear capacity of the soil. On the other hand, it was difficult to arrange the larger sizes of strips in on the direct shear machine, as their surface area was close to that of the shear box.

**Table 11: Direct shear test results**

Strip (mm)	Size	Treatment Level (%)	$\phi$	C (kPa)
None		0	5.67	49.80
		0.5	6.62	51.61
5*7.5		1	7.11	54.40
		2	7.59	56.85
		0.5	7.27	60.81
10*15		1	7.72	61.14
		2	8.32	61.84
		0.5	8.94	62.64
15*20		1	8.71	62.47
		2	8.24	61.97

**D) Unconfined Compressive Strength (UCS) Test Results**

The results found from the unconfined compressive strength (UCS) test, were different from the direct shear results. The UCS of unreinforced soil was found to be 151.8 kPa. The

largest improvement in the UCS is 316.4 kPa that is a net increase of 108% which is a tremendous growth. The rise in UCS is obtained at small strip contents and sizes. Increase in size generally reduces the UCS value.

**Table 12: UCS test results (kN).**

Treatment Level	Strip Sizes (mm)		
	5*7.5	10*15	15*20
0	151.5	151.5	151.5
0.5	256.9	316.1	173.1
1	273.4	287.2	153.1
2	307.1	246.0	134.2

**E) California Bearing Ratio (CBR) Test Results**

The bearing capacity of the soil was measured indirectly by conducting the CBR test.

The Soaked CBR is only tested in this study because it is only test that simulate actual site condition. Also, the study was focused in

investigating the effect of water on expansive soils CBR value. The load penetration curve has shown that there is an improvement in the CBR value. The soaked CBR of unreinforced soil was found to be 1.58 which is small. The principal enhancement is

attained at a strip size and content of 15 × 20 (mm) and 1% respectively and is of value 3.23. This is a total of 104% increment. The results are summarized in Table 8

**Table 13: CBR values (%)**

Treatment Level	Strip Sizes (mm)		
	5*7.5	10*15	15*20
0	1.56	1.56	1.56
0.5	1.68	2.26	2.83
1	2.07	2.64	3.21
2	1.94	2.45	3.02

#### IV. CONCLUSIONS.

This paper assessed the method of stabilizing clay soils using plastic bottle strips. The following conclusions are drawn based on the analysis and interpretation of the results obtained. A significant and marginal reduction was recorded in the optimum moisture content and in the maximum dry density results respectively. The angle of internal friction and the cohesion intercept increased significantly as the reinforcement percentages and sizes increased.

A huge improvement in UCS has been noted for smaller strip size and content. Any further increase in size and content has brought reduction in UCS because increase in size causes in un-compacted weak shear planes. The swelling of the soil was reduced significantly at high percentages of strip content because of replacement in an equal mass of expansive soil by non-expansive plastic.

Physical anchorage has also some effect in reducing the free swell. The swelling reduction is in some way similar for different sizes at the same percentage which shows that the dominant factor that contributes to reduction in swelling is percent by weight of plastic content.

Increase in plastic size for the same percentage has resulted in an increase in soaked CBR value but increase in plastic content for the same plastic size increases the soaked CBR then decreases. The optimum plastic size and plastic content that results in optimum result can be selected based on the importance of the selection parameter for a specified engineering work. In nutshell, stabilizing expansive clay soil with waste plastic bottle strips is a reliable alternative as it improves the volume fluctuation problems of the soil.

The strips were acting as reinforcements playing a role of arresting volume changes with change in water content. Incorporating waste

plastic bottles in the construction industry also is a crucial way to solve the issue of insufficient plastic waste disposal.

The laboratory results presented in the study favourably suggest the possibility of utilizing plastic material as tensile inclusions in expansive soil to increase the resistance to shear, CBR value and reduction in swelling. However, a better understanding of the interaction mechanism in soils reinforced with the plastic material would be essential to properly document the engineering behavior of the soil-plastic composite.

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