Strengthening of Soil by using ECO-Friendly Plastic Reinforcement

Report of strengthening of soil by using eco-friendly plastic reinforcement

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Certificatetion

This is to certify that the dissertation entitled "**Strengthening of Soil by using ECO Friendly plastic reinforcement**" is a project of in Final Year completely done by **Anuraj Bose [26301319063]** under our guidance and supervision and this is the project is being submitted of the Regent Education and Research Foundation the partial fulfilment of the requirement of the degree Bachelor of Technology in Civil Engineering.

.....18.06.22.....

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I would like to express my special thanks of gratitude to my teacher Souvik Sarkar Department of civil engineering, REGENT EDUCATION AND RESEARCH FOUNDATION who give me the golden opportunity to do this project on the topic "**STRENGTHENING OF SOIL BY USING ECO-FRIENDLY PLASTIC REINFORCEMENT"**.It helped me to do a lot of research i came to know about a lot of things related to this topic.

Finally, I would like to thank my parents and friends who helped me a lot in finalizing this project within the limited time frame.

CERTIFICATE

It is certified that the work contained in this report titled " **STRENGTHENING OF SOIL BY USING ECO - FRIENDLY PLASTIC REINFORCEMENT** " is the original work done by Anuraj Bose [26301319063] and has been carried out under our supervision. Mr Souvik Sarkar

Abstract:

Expansive clay soils are the types of soils whose volume changes with the change in water content. They have a behaviour of swelling and shrinking that is a serious hazard to structures built over them. Expansive soils are a bun- dangly existing soil types in Ethiopia, particularly Addis Ababa. This paper shows the outcomes of an attempt to reinforce and stabilize expansive clay soil with plastic bottle strips. The plastic strips were prepared and added at three different mixing ratios (0.5%, 1% and 2%) by weight and in three different aspect ratios (5 mm × 7.5 mm, 10 mm × 15 mm, 15 mm × 20 mm). The experimental results showed that there was a significant improvement in shear strength parameters. The swelling and desiccation cracking behaviour of the soil were also expressively reduced. There was a substantial reduction in the optimum moisture content and slight increment in maximum dry density. The optimum plastic size (aspect ratio) and plastic content that results in optimum result can be selected based on the importance of the selection parameter for a specified engineering work. Stabilizing expansive clay soils with waste plastic bottles simultaneously solves the challenges of improper plastic waste recycling that is currently a teething problem in most developing countries. The results obtained from this study favourably suggest that inclusion of this material in expansive soils would be effective for ground improvement in geotechnical engineering.

Soil stabilization is any process which improves the physical properties of soil, such as increasing shear strength, bearing capacity, etc. which can be done by use of the controlled compaction or addition of suitable admixtures like cement, lime and waste materials like fly ash, phosphor gypsum etc. Using plastic bottles as a soil stabilizer is an economical utilization since there is a scarcity of good quality soil for embankments and pavements. This project involves the detailed study on the possible use of waste plastic bottles for soil stabilization. The analysis was done by conducting a CBR test on soil reinforced with layers of plastic bottles into different percentages such as 0.5%, 0.7%, 0.9%, for different soils. The CBR test is conducted for the red, loamy 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 2.5 for red soil and 3.3 for the black cotton soil. And by adding 0.7 % of plastic strips to loamy soil the strength of the soil is increased resulting the bearing ratio of 2.9. Index Terms – stabilization, admixtures, strength, plastic, soil.

Resilient modulus (Mr) is a representative property for characterize n unbound granular materials and sub grade soils. It exhibits the elastic behaviour as well as the load-bearing ability of pavement materials under cyclic traffic loads. This paper investigates the influence of using recycled plastic PolyethyleneTerephthalate (PET) as a soil reinforcement material on the Prof a clayey soil ; ordinary soil in the delta region in Egypt. A comprehensive laboratory testing was conducted at Mansour University Highway and Airport EngineeringLaboratory (H&AE-LAB). The conducted testing includes standard engineering tests and repeated-loading triaxial tests (RLTT). Laboratory specimens were prepared at four different percentages of the recycled PET (0%, 0.2%, 0.6%, and1.0%). RLTT results shows that the Mr of 0.6% PET-reinforced specimens increases by 58% compared to the Mr of the control specimen (0% PET).However, the Mr of the reinforced soil is found to decrease with the increase ofPET percentage. Moreover, the universal Mr model exhibits excellent Mr pre-dictions for the control and the PET-reinforced clay soil. Economically, the initial cost for constructing a 10-km road segment decreases by 8% using the0.6% PET-reinforced Sub grade compared to the control Sub grade. Finally, damage analysis using the KEN LAYER software is used to manifest the-enhancement of pavement performance by reinforcing the soil.

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1. Introduction

The performance of paved and unpaved roads is often poor after every monsoon and, in most cases; these pavements show cracking, potholes, and wheel path routing and serious differential settlement at various locations. Therefore, it is of utmost importance considering the design and construction methodology to maintain and improve the performance of such pavements. The proposed technique can be used to advantage in embankment/road construction. 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. Plastic is a non-renewable source and bio-degradable. The disposal of waste plastic bottles causes environmental pollution, it's a sustainable waste. Such wastes of plastics are used as additives for stabilized soil. Waste plastic materials are reused because it can be remedied /recycled by no. of times, thus wastage is reduced. Uses of these plastic wastes for improving the properties of soil, effective method of stabilization. Inversely the soils shear strength and load bearing capacity. 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.

Packaging waste reuse and recycling rates have not achieved desirable values, with 79.2% recovery rate and 65.3% recycling rate in Indian Standards. However, plastic recycling is lower, with a 41% recycling rate of the collected plastic waste in INDIA rest of the world, with highly uneven values between the countries. The rates of waste plastic that ends in landfills or goes to incineration are still very high. Efforts to improve the reuse and recycling rates are being developed. However, some plastic wastes have low interests in recycling and reuse and could benefit from more valorisation options. Soil properties have been improved through the historical backdrop of human civi- ligation. With the present high demand of more sustainable structures, soil improve- meant procedures have turned into an essential task in the geotechnical engineering projects. Such strategies have been produced as per progresses in current innovation and human resources that make numerous structural building projects more practical. Currently, different methods are used to enhance soil properties mechanically by compaction or by adding different types of materials that improve the characteristics of soils. Some of these materials that are being used as additives change the chemical composition of soils such as cement and lime as. Other reinforcing materials are nonreactive such as fibres, geotextiles, and geo-grids. Soil reinforcement enhances the bearing capacity of the soil by compaction, pro- portioning and/or adding a suitable admixture. Reinforcing the sub grade soil which is the most vulnerable layer in the pavement structure improves its performance against various defects. If soil enhancement gained such importance, recycling of plastics also is considered as one of the critical issues which has visibly aided in diverse parts of life. The widespread reuse of plastics in many areas of public life in tandem with being non-biodegradable material raises questions regarding its sustainability. Not to mention being one of the major problems for the environment. The global plastic waste increased dramatically in the past decades, while reports indicate that approximately 60 million tons of plastic water bottles are consumed every day in the United States, as well as 86% of plastic water bottles becoming garbage which ends up in landfills throughout the country. In this research, plastic water bottles were reused to improve soil stiffness.

Soil stabilisation with plastic waste can be used in embankments and road pavement layers to improve the soil strength values. Stabilisation with plastic waste showed interesting results with an increase in soil strength characteristics measured in different tests. However some researchers say that the results differ with the type of soil and some strength values may be decreased with waste plastic stabilisation. Plastic waste used comes from garbage, mainly bottles or packages, and is made from High Density Polyethylene (HDPE) or Polyethylene Terephthalate (PET). Some researchers used waste plastic cut into strips, generally with dimensions of 4 mm to 40 mm. However, plastic wastes can also be available as flakes or fibres, which are more prone to be offered from the recycling industries. However, the effect on the soil strength properties is different with the type of waste. Waste plastic fibres, strips or flakes interaction with the soil matrix is different and is also influenced by the properties of the soil.

Plastic waste stabilised soils generally show increases in CBR values. The percentages of plastic waste that offer the best results are below 2%, often in the 0.5% to 1.5% range. The CBR values increase until the optimum percentage of plastic waste, decreasing for higher contents. observed that optimum moisture content (OMC) for compaction does not exhibit significant variation with plastic waste content. However, some researchers refer there is a moderate decrease of the optimum moisture content with the increase in the waste plastic content. Maximum dry unit weight decreases with the increase in the plastic waste content. However, some researchers refer that dry unit weight can increase with plastic waste content until a maximum is achieved, decreasing subsequently for higher contents. The size and shape of plastic waste particles have an influence on the results achieved.

However, it should be mentioned that waste stabilised soil can have limitations for reuse and disposal at the end of the life of the infrastructure when compared to virgin soil.

2. Literature Reviews

2.1 An Overview on the Use of Waste Plastic Bottles and Fly Ash in Civil Engineering Applications by Sushovan Dutta*, M. B. Nadaf, J. N. Mandal

Abstract: *With rapid growth in population, it becomes difficult to control the huge amount of residual materials generated from enormous industrial activities. The residuals that are not recycled, reclaimed or reused constitute the waste only to get released to the environment. As some of the wastes cannot be assimilated by the environment, those can become hazardous for the environment quality and ensure pollution. This paper expresses the concern on two such industrial wastes, used plastic water bottles and fly ash. The present study emphasizes the reuse of used waste plastic water bottles in the Civil Engineering applications and in this regard, it discusses the previous work by Dutta and Mandal (2013). Two different type plastic water bottles, having different diameter and tensile stiffness, were chosen to prepare perforated cells of different heights wrapped with jute geotextile from the inner side so that fine infill materials cannot escape from the perforations. Laboratory strain controlled compression tests were carried out on the cells rested over a rigid base and filled with compacted fly ash or stone aggregates. Test results showed significant load carrying capacity of the composite cells with fly ash as infill material. Though fine fly ash appeared to be an effective infill material, use of coarse stone aggregates as infill material produced better load carrying capacity of the composite cells. It was also observed that with reduction in cell height over the rigid base, load carrying capacity of the composite cells got increased. The study confirmed that plastic bottles with suitable infill material can act as an ideal compression member.*

2.2 Experimental Review for Utilisation of Waste Plastic Bottles in Soil Improvement Techniques by Abhishek Patil, Girish Waghere , Niranjan Inamdar, Pranav Gavali, Roshan Dhore, Shreyash Shah.

Abstract *: Soil Improvement Technique is the technique which improves the physical properties of soil, such as increasing shear strength, bearing capacity etc. which can be done by use of controlled compaction or addition of suitable admixtures. The cost of introducing these additives has also increased in recent years which opened the door widely for the development of soil by using plastic. This new technique can be effectively used to meet the challenges of society, to reuse the waste materials. Use of plastic bottles is increasing day by day leading to various environmental concerns. Therefore the disposal of the plastic wastes without causing any ecological hazards has become a real challenge. Thus using plastic bottles to improve the strength parameters of soil is an economical utilisation since there is scarcity of good quality soil for embankments. This project involves the detailed study on the possible use of waste plastic bottles for soil improvement. The analysis was done by conducting a "Triaxial Test & Direct Shear Test" on soil reinforced with Plastic Bottles Strips of size 1cm x 1cm. The comparison of test results showed that the soil sample using plastic strips gives better results than soil without plastic. The size and content of strips of waste plastic bottles have significant effect on the enhancement of strength of the soil. In this review paper, we have taken Black Cotton Soil. The soil is tested with 1% plastic by weight & with naturally obtained soil. The test results are compared for above conditions and obtained the change in the strength parameters of soil.*

2.3 IMPROVING THE STRENGTH OF SOIL BY USING PLASTIC BOTTLES

by MOHD FURKHAN, SUFYAN SYED, MAROOF AHMED, MEHRAJ MOHIUDDIN

Abstract: *Soil stabilization is any process which improves the physical properties of soil, such as increasing shear strength, bearing capacity, etc. which can be done by use of the controlled compaction or addition of suitable admixtures like cement, lime and waste materials like fly ash, phosphogypsum etc. Using plastic bottles as a soil stabilizer is an economical utilization since there is a scarcity of good quality soil for embankments and pavements. This project involves the detailed study on the possible use of waste plastic bottles for soil stabilization. The analysis was done by conducting a CBR test on soil reinforced with layers of plastic bottles into different percentages such as 0.5%, 0.7%, 0.9%, for different soils. The CBR test is conducted for the red, loamy 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 2.5 for red soil and 3.3 for the black cotton soil. And by adding 0.7 % of plastic strips to loamy soil the strength of the soil is increased resulting the bearing ratio of 2.9.*

2.4 Soil Reinforcement Using Recycled Plastic Waste for Sustainable Pavements

byMuhammad Hafez, Rabah Mousa, Ahmed Awed, and Sherif El-Badawy

Abstract: *Resilient modulus (M_r) is a representative property for characterizing unbound granular materials and sub grade soils. It exhibits the elastic behaviour as well as the load-bearing ability of pavement materials under cyclic traffic loads. This paper investigates the influence of using recycled plastic Polyethylene Terephthalate (PET) as a soil reinforcement material on the M_r of a clayey soil; ordinary soil in the delta region in Egypt. A comprehensive laboratory testing was conducted at Mansour University Highway and ry (H&AE-LAB). The conducted testing includes stands Airport Engineering Laboratory engineering tests and repeated-loading triaxial tests (RLTT). Laboratory specimens were prepared at four different percentages of the recycled PET (0%, 0.2%, 0.6%, and 1.0%). RLTT results shows that the M_r of 0.6% PET-reinforced specimens increases by 58% compared to the M_r of the control specimen (0% PET). However, the M_r of the reinforced soil is found to decrease with the increase of PET percentage. Moreover, the universal M_r model exhibits excellent M_r pre- dictions for the control and the PET-reinforced clay soil. Economically, the initial cost for constructing a 10-km road segment decreases by 8% using the 0.6% PET-reinforced Sub grade compared to the control Sub grade. Finally, damage analysis using the KEN LAYER software is used to manifest the enhancement of pavement performance by reinforcing the Sub grade with PET.*

2.5 SOIL STABILISATION USING RAW PLASTIC BOTTLES

byS.Saravanan PRIST University, Thanjavur, B.Jose Ravindraraj PRIST University, Thanjavur

Abstract: *Soil stabilisation is any process which improves the physical properties of soil, such as increasing shear strength, bearing capacity etc. which can be done by use of controlled compaction or addition of suitable admixtures like cement, lime and waste materials like fly ash, phosphor gypsum etc. The cost of introducing these additives has also increased in recent years which opened the door widely for the development of other kinds of soil additives such as plastics, bamboo etc. This new technique of soil stabilisation can be effectively used to meet the challenges of society, to reduce the quantities of waste, producing useful material from non-useful waste materials. Use of plastic products such as polythene bags, bottles etc. is increasing day by day leading to various environmental*

concerns. Therefore the disposal of the plastic wastes without causing any ecological hazards has become a real challenge. Thus using plastic bottles as a soil stabiliser is an economical utilization since there is scarcity of good quality soil for embankments. This project involves the detailed study on the possible use of waste plastic bottles for soil stabilisation. The analysis was done by conducting plate load tests on soil reinforced with layers of plastic bottles filled with sand and bottles cut to halves placed at middle and one-third positions of tank. The comparison of test results showed that cut bottles placed at the middle position were the most efficient in increasing strength of soil. The optimum percentage of plastic strips in soil was found out by California Bearing Ratio Test and using this percentage of plastic, plate load test was also performed. The size and content of strips of waste plastic bottles have significant effect on the enhancement of strength of the soil.

2.6 Soil Stabilization Using Raw Plastic Bottle by P.R Kalyana Chakravarthy, S Banupriya, and T Ilango

Abstract: *The physical properties of soil easily improved by the process of soil stabilisation like bearing capacity and increasing shear strength that controlled by certain things like addition of suitable admixtures or compaction like lime, cement, and fly ash, phospho gypsum waste materials etc. The following years there is a drastic hike in the cost of additives to open door broad development particularly which deals with soil additives like bamboo, plastics so and so. It is easy to challenge the society using this soil stabilisation technique that can reduce the waste quantity, useful materials can be produced from non-useful waste materials leads to use the plastic products like bottles and polythene bags. This creates lot of environmental concerns that automatically increases day by day. The plastic waste's disposal becomes a challenge and it should not cause any ecological hazards. The main economical utilization is to use the plastic bottles as a soil stabilizer that mat have a quality soil for embankments. This paper is about a short study on the use of waste plastic bottles for soil stabilization. It is analysed as per by the process of conducting engineering property and index property.*

2.7 Soil Stabilization using Waste Plastic Powder by P. Mohan Kumar1 R. Purushothaman2 R. Sathish3 C Subasri 4 A. Arunraj Christa Doss5

Abstract*: In modern days, engineers have to face different kinds of problems like construct heavy structure and heavy mobility. But some places on earth soil have poor engineering properties like bad Workability, low bearing capacity and strong compressibility. So in order to improve the strength of soil, add some stabilizers. The aim of this study is to improve the engineering properties of soil using waste plastic powder. Clayey soils are poor in strength and they will result in poor pavement support and ultimately affects its life period. The soil stabilization is used to increase the strength of the soil by using the waste plastic material. The new technique of soil stabilization can be effectively used to meet the challenges of society, to reduce the quantities of waste, producing useful material from non-useful waste materials. Specimens are prepared to know the properties of soil with percentage of 0.6%, 0.8% and 1% of waste plastic powder. Some of the tests carried for the soil sample are Standard proctor test, unconfined compressive test, California bearing ratio and a tterbergs limit test are performed to analysis compressive strength, Maximum Dry Density (MDD) and optimum moisture content (OMC) of soil mixture.*

2.8 Soil Stabilization Using Waste Plastic Materials by Rebecca Belay Kassa1*, Tenaw Workie, Alyu Abdela, Mikiyas Fekade, Mubarek Saleh, Yonas Dejene

Abstract: *Expansive clay soils are the types of soils whose volume changes with the*

change in water content. They have a behaviour of swelling and shrinking that is a serious hazard to structures built over them. Expansive soils are abundantly existing soil types in Ethiopia, particularly Addis Ababa. This paper shows the outcomes of an attempt to reinforce and stabilise expansive clay soil with plastic bottle strips. The plastic strips were prepared and added at three different mixing ratios (0.5%, 1% and 2%) by weight and in three different aspect ratios (5 mm × 7.5 mm, 10 mm × 15 mm, 15 mm × 20 mm). The experimental results showed that there was a significant improvement in shear strength parameters. The swelling and desiccation cracking behaviour of the soil were also expressively reduced. There was a substantial reduction in the optimum moisture content and slight increment in maximum dry density. The optimum plastic size (aspect ratio) and plastic content that results in optimum result can be selected based on the importance of the selection parameter for a specified engineering work. Stabilising expansive clay soils with waste plastic bottles simultaneously solves the challenges of improper plastic waste recycling that is currently a teething problem in most developing countries. The results obtained from this study suggest that inclusion of this material in expansive soils would be effective for ground improvement in geotechnical engineering.

3. Aim and Objective

Aim:

1.Sub grade soil can be reinforced using recycled plastic bottles as an alternative method for improving the performance of the pavement structure.

2. Reinforcing sub-grade soil with plastic waste increases its Mr until certain content of PET then the material weakens while the PET content increases

3.The Mr values are well predicted with the universal model.

3. Objective

➢ Improving the strength of soil by using eco friendly material (Plastic)

3.1 Specification-Plastic—Proposed Size 10mm x 10mm

- Polyethylene Terephthalate (PET)
- Strong & Light material
- Product of Petroleum Hydrocarbons
- Polymerizes to form long molecular chains

3.2 Material Composition

Sl no.	Material(soil)	Admixture(plastic)
1	100%	0%
2	90%	10%
3	80%	20%
4	70%	30%
5	60%	40%
6	50%	50%

3.3 Tests to be performed

Natural property test—Soil

A. Liquid Limit Test
B. Plastic Limit Test
C. Specific gravity test
D. Sieve analysis

Load Test-Soil

A. Proctor test.
B. CBR (California bearing ratio test)

4.1 Natural property test—Soil

4.1.1 LIQUID LIMIT TEST:

Liquid limit is significant to know the stress history and general properties of the soil met with construction. From the results of liquid limit the compression index may be estimated. The compression index value will help us in settlement analysis. If the natural moisture content of soil is closer to liquid limit, the soil can be considered as soft if the moisture content is lesser than liquids limit, the soil can be considered as soft if the moisture content is lesser than liquid limit. The soil is brittle and stiffer.

S.NO.	OBSERVATIONS AND CALCULATIONS	Results
1.	MASS OF EMPTY CONTAINER(M1)	24.12 gm
2.	MASS OF CONTAINER +WET SOIL(M2)	31.28 gm
3.	MASS OF CONTAINER +DRY SOIL(M3)	30.23 gm
4.	MASS OF WATER= M2-M3	1.05 gm
5.	MASS OF DRY SOIL= M3-M1	6.11 gm
6.	WATER CONTENT W= (5)/(6)X100	17.1%

4.1.2 PLASTIC LIMIT TEST:

Plastic limit is the minimum water content at which soil can be rolled into a thread of 3 mm diameter without crumbling. In other words, it is the moisture content at which soil can be deformed plastically.

SL. No.	OBSERVATIONS AND CALCULATIONS	Results
1.	NO OF BLOWS(N)	39.00
2.	WATER CONTENT CAN NO.	5
3.	MASS OF EMPTY CONTAINER(M1)	10.19
4.	MASS OF CONTAINER +WET SOIL(M2)	21.92
5.	MASS OF CONTAINER +DRY SOIL(M3)	17.60
6.	MASS OF WATER= M2-M3	4.30
7.	MASS OF DRY SOIL= M3-M1	7.41
8.	WATER CONTENT W= (6)/(7)X100	58.02%

4.1.3 Specific Gravity Test :

This test is done for obtain the particle density of the soil. Specific gravity G is defined as the ratio of the weight of an equal volume of distilled water at that temperature both weights taken in air.

Trials	1st Trail	2nd Trial	3rd Trail
Mass of Pycnometer M1 (g)	95	95	95
Mass of pycnometer + Water M4 (g)	360	360	360
Mass of pycnometer + soil M2 (g	218.02	227.0	223.03
Mass of pycnometer + soil + water M3 (g)	330.0	344.02	344.0
Specific Gravity	0.80	0.89	0.83
Average Specific Gravity	0.84		

4.1.3 Sieve Analysis Test:

Sieve analysis helps to determine the particle size distribution of the coarse and fine aggregates. This is done by sieving the aggregates as per IS: 2386 (Part I) – 1963. In this we use different sieves as standardized by the IS code and then pass aggregates through them and thus collect different sized particles left over different sieves.

With the sieve Analysis test we have taken only passing through 4.75mm IS sieve to perform this test

4.2 Test & Test Results

4.2.1 Standard Proctor Compaction Test

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).

All strip sizes showed reduction in optimum moisture content as the percentage of plastic increased. A largest reduction is obtained at a strip size of 10 × 10 (mm) at a 2% addition which yielded a 31% decrease in the moisture content.

The reason for the decrement of the OMC might be because of zero absorption.

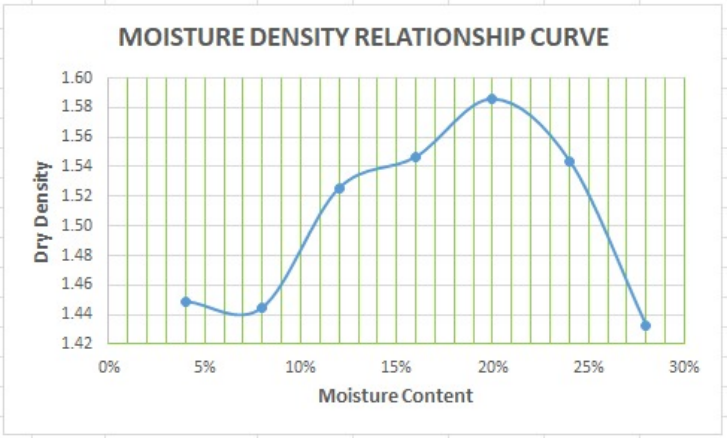
Figure 1: Kinley Bottles are cutting down into similar 10 x 10mm portions

Figure 2: Furniture it cut into major and similar shape

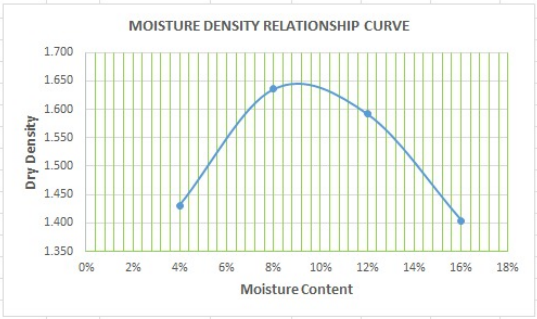
4.2.2 Test Results

Moisture Density :

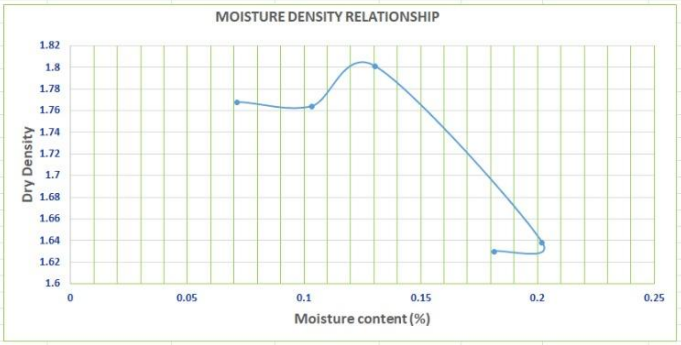
Experiment no.	1	MOISTURE DENSITY RELATIONSHIP					
Sl. No.	Empty wt. of Mould	Wt. of Mould + Compacted Soil	Wt. of Compacted Soil	Volume of Mould	Bulk Density	Water added	Dry Density
	gm	gm	gm	cc	gm/cm^3	%	
1	4246	5548	1302	863.96	1.507014	4%	1.45
2	4246	5594	1348	863.96	1.560257	8%	1.44
3	4246	5722	1476	863.96	1.708412	12%	1.53
4	4246	5796	1550	863.96	1.794065	16%	1.55
5	4246	5890	1644	863.96	1.902866	20%	1.59
6	4246	5900	1654	863.96	1.91444	24%	1.54
7	4246	5830	1584	863.96	1.833418	28%	1.43
		OMC	20%				
		MDD	1.59 g/cc				



Experiment no.	3	MOISTURE DENSITY RELATIONSHIP					
Sl. No.	Empty wt. of Mould	Wt. of Mould + Compacted Soil	Wt. of Compacted Soil	Volume of Mould	Bulk Density	Water added	Dry Density
	gm	gm	gm	cc	gm/cm^3	%	gm/cm^3
1	4246	5730	1484	997.3	1.488	4%	1.431
2	4246	6008	1762	997.3	1.767	8%	1.636
3	4246	6024	1778	997.3	1.783	12%	1.592
4	4246	5870	1624	997.3	1.628	16%	1.404
		OMC	8%				
		MDD	1.64 g/cc				



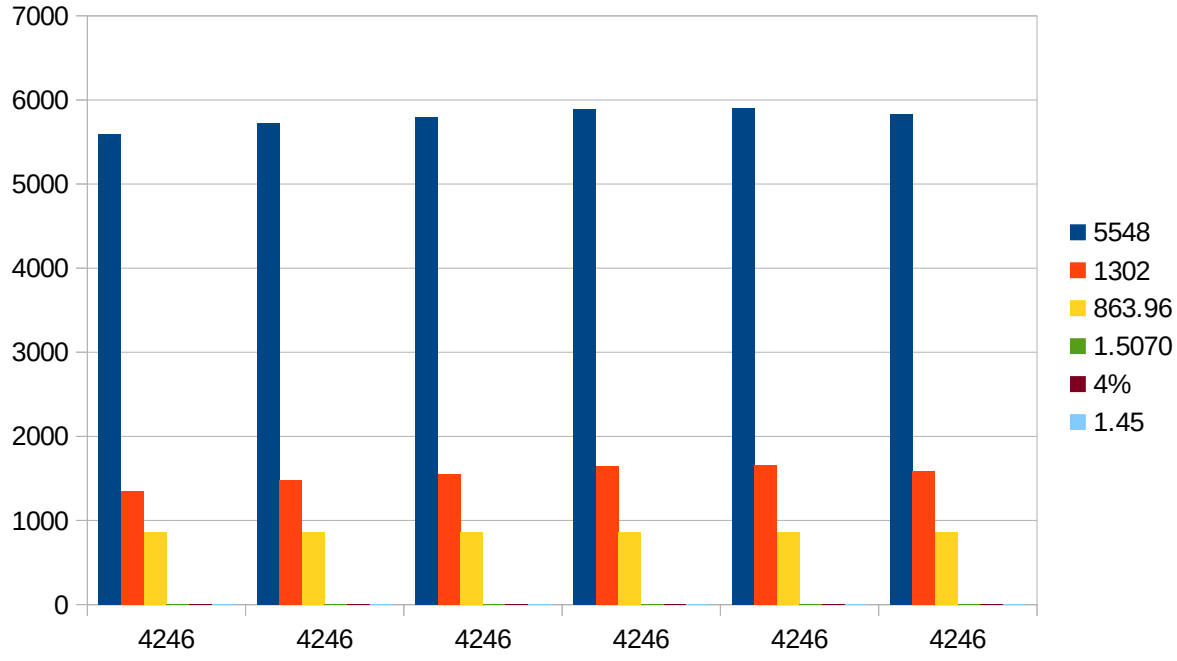
Experiment no.	2	MOISTURE DENSITY RELATIONSHIP							
Sl.No.	Wt. of mould+compacted Soil (gm)	Weight of mould (gm)	Weight of soil (gm)	Bulk density γ=M/v	Moisture test				water content/moisture content wc=(m2-m3)/(m3-m1)	Dry density $\gamma_d=\gamma/(1+w)$
					Container No.	wt. of empty container (m1)	wt. of container + wt. of soil (m2)	wt. of container + dry soil (m3)		
1	6144	4250	1894	1.894	0.2	23.61	24.96	24.87	0.07143	1.768
2	6196	4250	1946	1.946	403	21.36	27.13	26.59	0.1033	1.764
3	6286	4250	2036	2.036	404	12.65	14.73	14.49	0.1305	1.8009
4	6220	4250	1970	1.97	3	16.13	17.32	17.12	0.202	1.638
5	6176	4250	1926	1.926	1	16.39	22.12	21.24	0.1815	1.63
			OMC							
			MDD		g/cc					



Before this we got the scenario of Dry Density vs Moisture Content Graph with Three test

PROCTOR TEST OF SOIL RESULT – Natural Soil

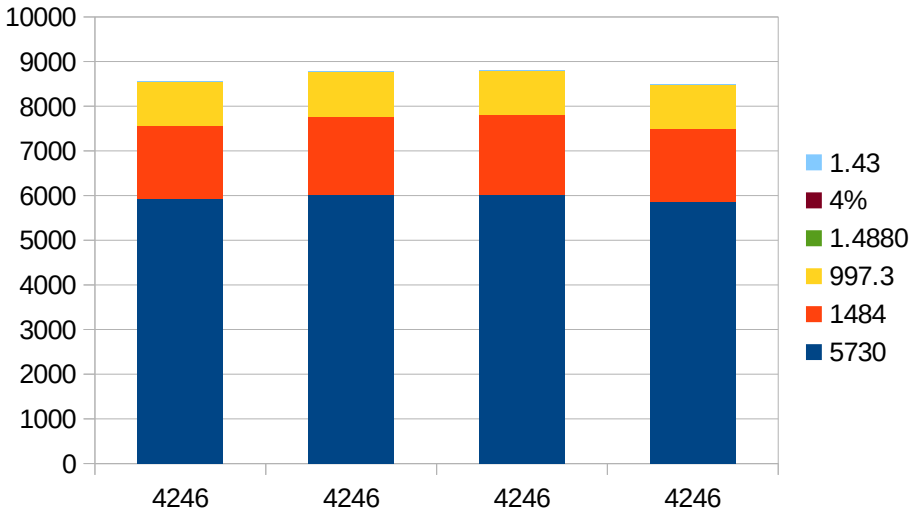
EMPTY MOULD WT. (gm)	WT. OF MOULD + COMPACT SOIL (gm)	WT. OF COMPACT SOIL (gm)	VOLUME OF MOULD (gm)	BULK DENSITY	WATER ADDED	DRY DENSITY
4246	5548	1302	863.96	1.5070	4%	1.45
4246	5594	1348	863.96	1.5603	8%	1.44
4246	5722	1476	863.96	1.7084	12%	1.53
4246	5796	1550	863.96	1.7941	16%	1.55
4246	5890	1644	863.96	1.9029	20%	1.59
4246	5900	1654	863.96	1.9144	24%	1.54
4246	5830	1584	863.96	1.8334	28%	1.43

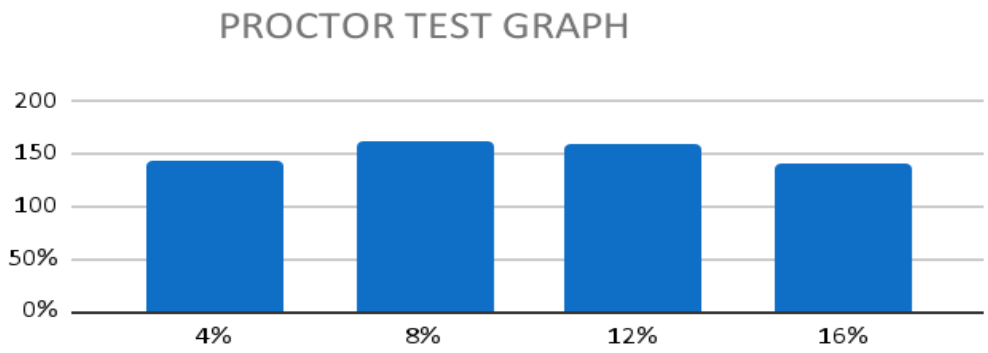


MDD	OMC	Plastic Used
1.59 gm/cc	20%	10%

PROCTOR TEST OF SOIL RESULT -2

EMPTY MOULD WT. (gm)	WT. OF MOULD + COMPACT SOIL (gm)	WT. OF COMPACT SOIL(gm)	VOLUME OF MOULD (gm)	BULK DENSITY (gm)	WATER ADDED (%)	DRY DENSITY
4246	5730	1484	997.3	1.4880	4%	1.43
4246	5940	1612	997.3	1.526	6%	1.52
4246	6008	1762	997.3	1.7668	8%	1.64
4246	6024	1778	997.3	1.7828	12%	1.59
4246	5870	1624	997.3	1.6284	16%	1.40





with the upper test charts we can get

MDD	OMC	Plastic Used
1.64 gm/cc	8%	8%

4.2.3 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 un- reinforced soil was found to be 1.64gm/cc which is small. The principal enhancement is attained at a strip size and content of 10 x 10 (mm)

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 improvement in CBR can attributed to the ability of the strips in resisting swelling prior to penetration and load exerted by the plunger during penetration. or to penetration and load exerted by the plunger during penetration.

Treatment Level	Value (%)
0	1.58
0.5	2.28
1	2.66
2	2.47

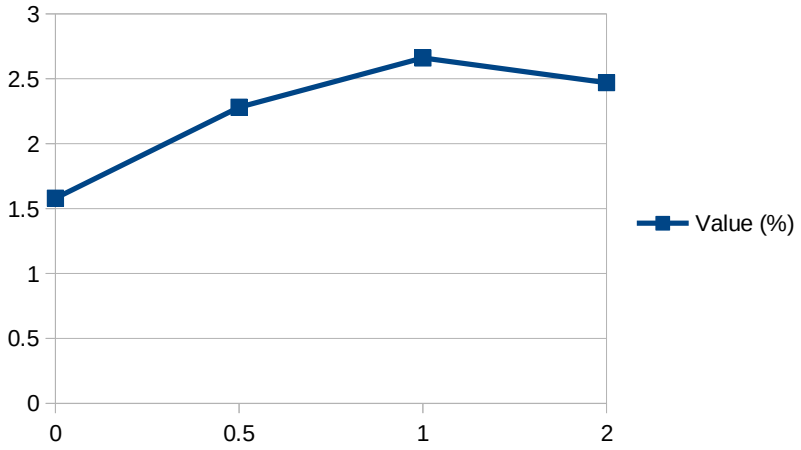


Figure 3: Treatment Level vs Value (%) Graph

5. CONCLUSION

By the test results we get the value of OMC < MDD was conducted for soil mixed with plastic strips. The test is conducted for the adding the 8% of plastic strips to the soil 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. From the above discussions it can be concluded that there is a dire need to utilize the waste plastic (PET)collect from various sources the waste all over the counter for the stabilization of soil which will help to the moisture content to decrease the requirement of valuable land for their disposal and also Reduce the hazardous environmental impacts. And by adding 8% of plastic strips to loamy soil the strength of the soil is increased, resulting the bearing ratio of 2.5. As it's 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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