iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 **Issue:** IV **Month of publication:** April 2025

DOI: https://doi.org/10.22214/ijraset.2025.68468

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue IV Apr 2025- Available at www.ijraset.com

Reuse of Non-Degradable Waste Pet Bottles for Ground Improvement

Prof. Dhumal M.S[1], Prof. Bedrekar A.Y[2], Pore Suhassantosh[3], Lokhande Swapnil Dadasaheb[4], Gavade Prakash Ajinath[5], Kale Sarthak Baburao[6]
Karmayogi institute of technology (Polytechnic), Shelve

Abstract: Due to the rapid progress in technology globally, the use of polystyx like polyethylene bags, bottles, etc. is also increasing. Disposal of discarded plastic waste is a serious challenge because most of the plastic harmful gases emissions are mostly non-biodigradeable and improper to consume. Soil stabilization improves engineering properties of weak soil by controlled compact or by adding stabilizers such as cement and lime. However, in recent years, these IIIths have become increasingly expensive.

This paper presents a detailed study of waste plastic behavior and application in the soil improvement. Experimental inspection on reinforced plastic soil shows that plastic can be used as an effective stabilizer to address the problem of waste disposal and to stabilize the weak soil. Plastic-reinforced soil displays the same features as fiber-reinforced soil.

This study examines the effect of plastic bottle straps on silt sand through a series of compacting, direct curry and California bearing ratio (CBR) tests. These tests were taken with different percentage and different aspects ratio in terms of size. The results indicate a significant increase in the CBR value with the maximum dry unit weight, the strength parameters and the reinforcement of the plastic in the soil. The degree of improvement in the soil properties depends on the type of soil, plastic material and the size of the bar. Studies have concluded that the optimal improvement in the engineering properties of Silte sand is achieved on 0.4% plastic material with a bar of 15 mm × 15 mm.

I. INTRODUCTION

In order to support the development of infrastructure, the ground improvement is important to enhance the properties of the soil. Due to the increasing environmental concerns of the plastic waste, the use of PET bottles as a durable measure to improve the ground can only take into account the problems of soil stabilityOtherwise, it can also contribute to the loss of waste.The purpose of this project is that the viability of PET bottles as a lightweight weight filling material and their impact on the properties of the soil.

In this study, pets (polyethylene terrifital) plastic is used as a reinforcement material in the soil that is commonly used to make plastic bottles, plastic carry bags, cold drink bottles, shopping bags. PET has been used in different proportions (2%, 4%, 6%and 8%.), And a series of CBR tests on clay patterns with different percentage of PET plastic. The results of CBR tests showed that the clay has improved the CBR value of the soil due to the connection of the pets in the soil. Pet content was taken by the weight of a dry pattern created for CBR testing. Using waste pets in the soil makes the soil stabilization technique economically and solves the problem of waste disposal

1) Pet Bottle:

The PET is commonly called polyethylene terrafathelette, and is produced by petroleum hydrocarbon by reactions between the ethylene glycol and terrafathalet acid Sid. Its excellent wearing resistance, low coefficient of friction and high modules, is considered a good additive to the stabilization of the soil to improve the engineering properties of the soil. The chemical formula of the PET is the C10H8O6). Bottles of pets are cut into strips using bottles of waste water (15 mm x 15 mm), (15 mm x 25 mm) and (15mm x 35 mm) scissors and ruler to measure. Standard proctors tests and California bearing ratio (CBR) tests are performed without plastic straps, and the same tests are performed on reinforced soil with a different percentage of 2%, 4%, 6% and 8%, respectively

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue IV Apr 2025- Available at www.ijraset.com

Fig4.3.1 Pet Bottle

II. LITERATURE SURVEY

According to a recent study, underlines the probability of using recycled materials in civil engineering. Research indicates that PET bottles can significantly reduce the weight of the material filled, improve compact efficiency and reduce construction costs. The main findings include this:

1. Lightweight Phil: PET bottles, if used in large quantities, can reduce the total density of filling, increase stability in weak soils (Smith at Al., 2021).

2 -Receiving benefits: The use of recycled plastic in construction reduces landfill waste and reduces carbon footprint (Jones and Wang, 2).

3.3 Soil Interaction: Examining the interaction between soil and pet bottles shows improvement in the energy and load distribution (Kumar and Sharma, 2022).

4.4 Video (69 69) to reduce the risk of slopes, increase the capacity of bearing capacity, and to reduce the deformity of the tensile resisting material (geo-synthetic, etc.) in weak soils. After a few years,

III. OBJECTIVE OF THE PROJECT

Theobjectiveofprojectincludes:

1) Soil stability: Earth volatility and low bearing capabilities are common problems in construction sites, especially in urban areas high traffic. Traditional ground improvement techniques are expensive and environmentally attacked.
2) To increase the soil density and California bearing ratio (CBR) using plastic as a mixture.
3) To provide alternative measures to dispose of plastic waste.
4) To provide economical satisfaction for stabilization of soil using plastic waste.
5) To fix the optimum plastic material for use.

IV. EVALUATING PROGRAMME:

Preparation and Testing of Soil with PET Bottle Strips for Ground Improvement:

1) The three natural earthen patterns used in this study are collected from the nearest region as well as even after the soil test before adding pet bottles cut strips

- Partial size analysis (sieve test)
- A specific gravity of the soil
- The liquid limit test
- Plastic limit test

2) Plastic bottles were collected from 2disposal point. The head and tail of the bottles were cut and a tool was used to convert the bottles into a rotation. These rotations were then cut into final strips of different sizes. Pets bottles were cut in 13x25 mm belt and 15x35 mm structure 2%, 4%, 6%and 8%. Stepwise.

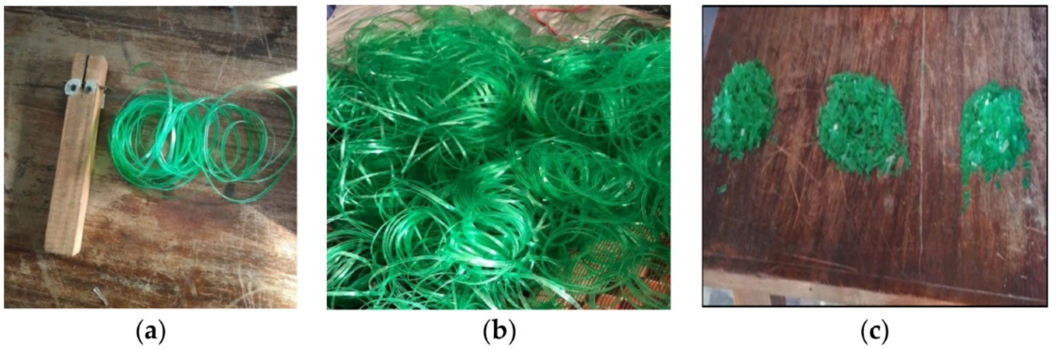


Figure 1. Waste PET bottle strip process: (**a**) strip cutting tool; (**b**) PET spiral; (**c**) plastic strips sizes.

Fig.5.1.1 Cutting PET bottles into strips is represented

- following test on soil also conducted After PET bottles cut strips added
- Compaction Test (Standard Proctor Test)
- CBR test.

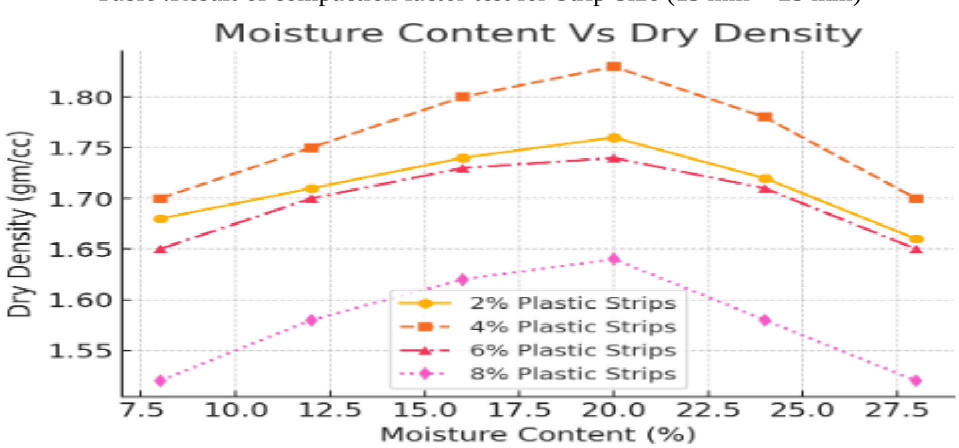
V. RESULTS AND DISCUSSIONS:

A. *Effect of Plastic Content for Strip Size (15 mm × 25 mm)*

In this section, detailed results for plastic reinforced soil for different plastic contents (%) of soil for (15 mm × 25 mm) strip size are presented. A series of compaction, direct shear, and CBR tests are performed, and their corresponding test results are shown in Table 6.2.1.1

Moisture Content (%)	Dry Density (gm/cc) (2% Plastic Strips)	Dry Density (gm/cc) (4% Plastic Strips)	Dry Density (gm/cc) (6% Plastic Strips)	Dry Density (gm/cc) (8% Plastic Strips)
8	1.68	1.70	1.65	1.52
12	1.71	1.75	1.70	1.58
16	1.74	1.80	1.73	1.62
20	1.76	1.83	1.74	1.64
24	1.72	1.78	1.71	1.58
28	1.66	1.70	1.65	1.52

Table .Result of compaction factor test for Strip Size (15 mm × 25 mm)



Load (Kgs) → Penetration (mm)	2% Plastic Strips	4% Plastic Strips	6% Plastic Strips	8% Plastic Strips
0	0	0	0	0
10	1	1	1	1
20	3	2	2	2
30	5	3	3	3
40	7	4	5	4
50	9	6	7	5
60	11	8	9	6
80	-	10	11	8
100	-	12	13	10
150	-	14	-	12
200	-	-	-	-
250	-	-	-	-

Table .Result of CBR test for Strip Size (15 mm × 25 mm)

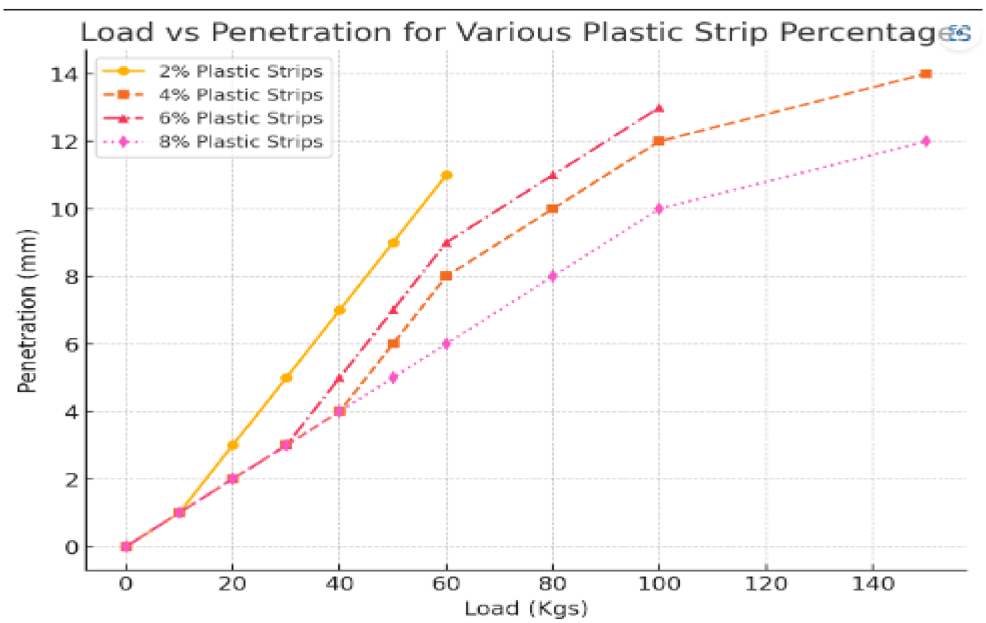


Fig. CBR test for Strip Size (15 mm × 25 mm)

Observations:

- The penetration increases as the load increases for all cases.
- Soil with 4% plastic bottle strips seems to withstand higher loads before significant penetration occurs.
- Soil with 2% plastic strips reaches maximum penetration at a lower load.
- Soil with 6% and 8% plastic strips show intermediate behavior, with 6% offering better resistance.

B. Effect of Plastic Content for Strip Size (15 mm × 35 mm)

In this section, detailed results for plastic-reinforced soil for different plastic contents (%) of soil using (15 mm × 35 mm) strip size are presented. A series of compaction, direct shear, and CBR tests are performed to analyze the effect of plastic reinforcement on soil properties.

Similar to the 15 mm × 25 mm strips, the maximum dry density (MDD), optimum moisture content (OMC), and California Bearing Ratio (CBR) were evaluated.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue IV Apr 2025- Available at www.ijraset.com

The results show that plastic reinforcement enhances soil strength, with 4% plastic content providing the highest CBR value, indicating an optimal reinforcement level. However, at higher plastic contents (6% and 8%), the CBR values begin to decline, likely due to excessive plastic disrupting soil cohesion.

The corresponding test results for the (15 mm × 35 mm) strip size are shown in Table

Moisture Content (%)	Dry Density (gm/cc) (2% Plastic Strips)	Dry Density (gm/cc) (4% Plastic Strips)	Dry Density (gm/cc) (6% Plastic Strips)	Dry Density (gm/cc) (8% Plastic Strips)
8	1.66	1.68	1.63	1.50
12	1.69	1.73	1.68	1.56
16	1.72	1.78	1.71	1.60
20	1.74	1.81	1.72	1.62
24	1.70	1.76	1.69	1.56
28	1.64	1.68	1.63	1.50

Table 6.2.2.2Result of compaction factor test for Strip Size (15 mm × 35 mm)

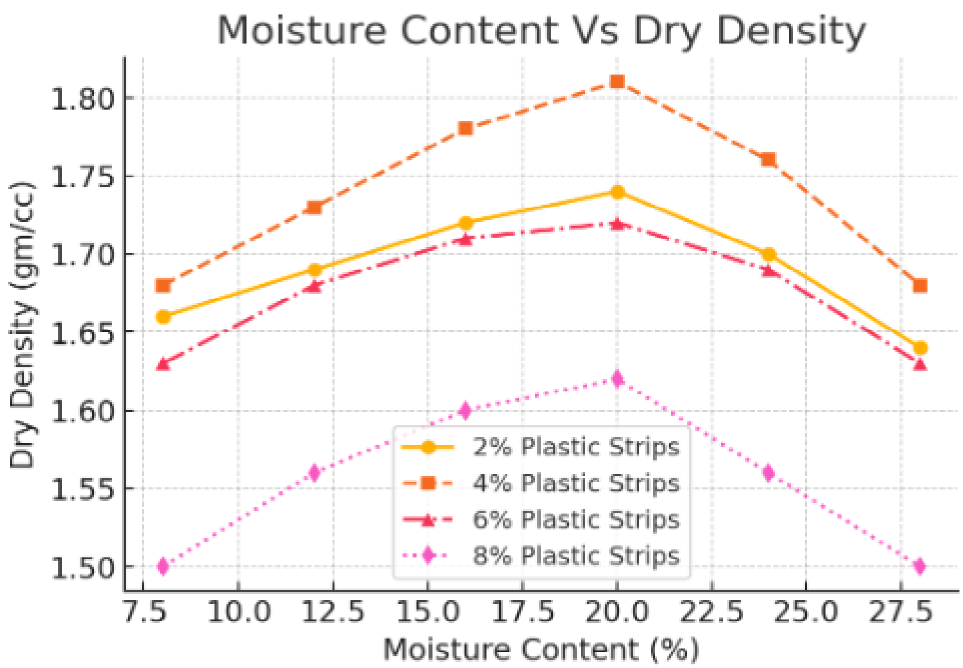


Fig. compaction factor test for Strip Size (15 mm × 35 mm)

Load (Kgs)	2% Strips	4% Strips	6% Strips	8% Strips
0	0.0	0.0	0.0	0.0
10	0.8	0.8	0.8	0.8
20	2.5	1.7	1.7	1.7
30	4.2	2.5	2.5	2.5
40	6.0	3.4	4.2	3.4
50	7.6	5.1	6.0	4.2
60	9.3	6.8	7.6	5.1
80	-	8.5	9.3	6.8
100	-	10.2	11.0	8.5
150	-	11.9	-	10.2
200	-	-	-	-
250	-	-	-	-

TableResult of CBR test for Strip Size (15 mm × 35 mm)

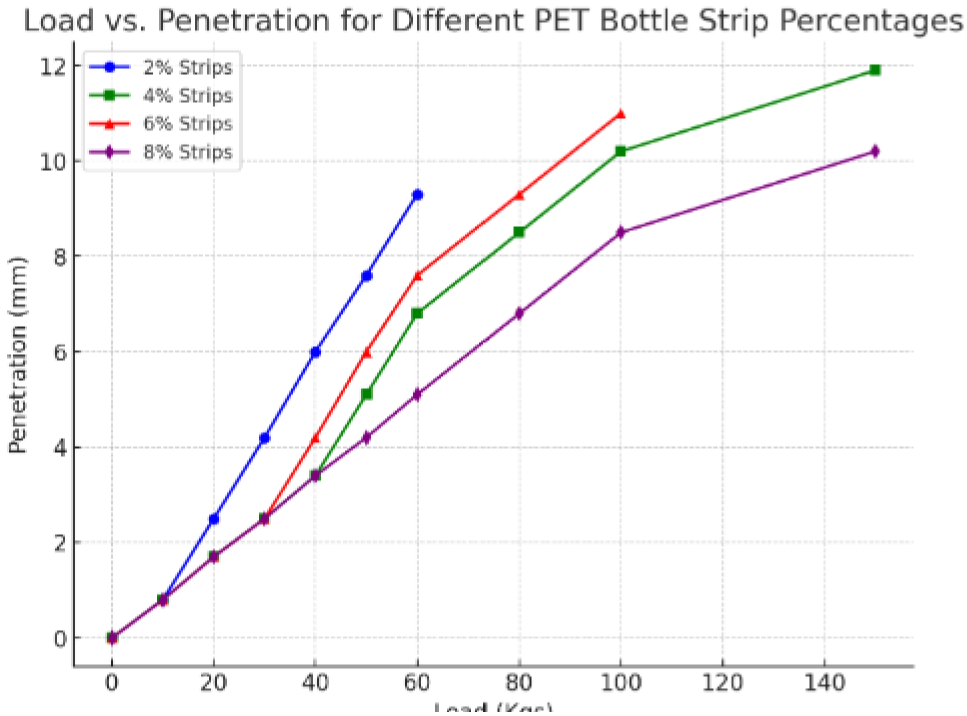


Fig. CBR test for Strip Size (15 mm × 35 mm)

Observations:

- The penetration increases as the load increases for all cases.
- Soil with 4% PET bottle strips shows better resistance, with lower penetration at higher loads.
- Soil with 2% PET bottle strips experiences the highest penetration, indicating lower resistance to load.
- Soil with 6% and 8% PET bottle strips exhibit intermediate behavior, with 6% offering better stability than 8%.
- The rate of penetration slows down for higher percentages of PET strips, indicating improved load-bearing capacity.
- The optimal percentage of PET bottle strips appears to be around 4% to 6%, as they provide balanced load resistance without excessive penetration.

VI. CONCLUSION

This study confirms that PET plastic bottle strips significantly enhance the engineering properties of silty sand. The optimal improvement occurs at 4% PET content, beyond which soil cohesion decreases. The use of PET bottle strips in soil stabilization provides a sustainable and economical solution for both waste disposal and ground improvement in civil engineering applications. This method offers an effective way to utilize plastic waste while improving soil properties, making it a viable option for construction and environmental management.

REFERENCES

[1] Mohd Furkhan, Sufyan Syed, Maroof Ahmed, Mehraj Mohiuddin, "Improving The Strength Of Soil By Using Plastic Bottles," 2020.
[2] Tariq Saeed, Muhammad Usman Arshid, "Soil Improvement Using Waste Polyethylene Terephthalate (PET)," 2019.
[3] S. Saravanan, B. Jose Ravindraraj, "Soil Stabilization Using Raw Plastic Bottles," 2018.
[4] Sumit Singh Sinwal, Ravishankar Rawat, Dikshant Bisht, Aryan Raj, "Analysis of CBR value of Soil Reinforced with PET Bottles," 2021.
[5] Murad Khan et al., "Reuse of Non-Degradable Waste Polyethylene Bottles for Ground Improvement," 2022.
[6] Improving The Strength Of Soil By Using Plastic Bottles
Author: Mohd Furkhan, Sufyan Syed, Maroof Ahmed, Mehraj Mohiuddin
[7] Soil Improvement Using Waste Polyethylene Terephthalate (PET)
Author: Tariq Saeed andMuhammadUsmanArshid
[8] Soil Stabiliisation Using Raw Plastic Bottles
Author: S.Saravanan and B.JoseRavindraraj.