

Soil Stabilization by using Plastic Waste

Sagar Mali¹, Sachin Kadam², Sagar Mane³, Krushna Panchal⁴, Swati Kale⁵, Yogesh Navkar⁶

¹Under Graduation Student, Department of Civil Engineering DYPSOET Pune, Maharashtra, India

^{5,6}Professor, Department of Civil Engineering, DYPSOET Pune, Maharashtra, India⁵

Abstract: Soil stabilization is a process which improves the physical properties of soil, such as increasing shear strength, bearing capacity, etc. The foundation is very important for any structure & it has to be strongly enough to support the structure. Expansive soils such as black cotton soil have always problem of swelling, shrinkage, & unequal settlement. Plastic waste is become one of the major problems for the world. So, recommended that use of plastic waste for stabilization of soils and using plastic as soil stabilizer would reduce the problem of disposing plastic waste & also reduce facing environmental problems. These reviews the researches on stabilization of soil using waste plastic material in improving its strength.

Keywords: CBR, Plastic bottles, Soil Stabilization

1. INTRODUCTION

Nowadays, plastic industry is booming with more developments in technology and research fields. The plastic products are produced in agriculture industries, automobile, electronic and electric materials, household appliances, etc. The use of plastic bags is also on a rise. The recycling of plastic is expensive and labor intensive. The incineration of plastics produces harmful gases also produces gases which trap heat leading to global warming. The decomposition of plastic is not possible as it is not a putrescible substance. Landfill methods of plastic disposal affect the environment. The leaching of plastic due to acidic environment of soil affects the organisms. So, there is a need to develop new methods to dispose the plastic materials. The plastic has many characteristics properties like strength, brittle, durability, corrosion resistant, resistance to chemical attacks, insect attacks, abrasion resistant, insulating properties, heat resistant. For disposing of plastic waste, we can use plastic waste for stabilization of soil. This new technique of using plastic as soil stabilization reduce the environmental pollution and improves the properties of soil.

Stabilization of soil done in various way such that mechanical stabilization, chemical stabilization and by using other improvement techniques. Because of use and throw policy of plastic by the user it become serious issue as it develops man made hazards, one of the example was in Mumbai city flood was cited due to choking of drains by plastic waste products. The other issue is that plastic will last in environment for number of years and hence pollution is remain as a problem. When we use the plastic drinking straw which is used once for a minute and then thrown which remain in existence for 100s of years, that's why the new techniques are required for disposal of plastics. Some new techniques used for stabilization of soil by using steel and other admixtures will be more costly and hence for both economical and pollution reduction of plastic waste the best way is that use such wastes is for improving engineering properties.

Therefore, in present study stabilization of soil is reviewed by using locally available plastic waste products of plastic bottles are used in stabilization of soil in the form of strips of suitable dimensions. The objective of this study was improving properties of soil in economical way and reducing environmental pollution, and minimize the problems of plastic waste disposal.

1.1 MATERIALS:

1. SOIL

Soil samples collected from nearby our college campus is and tested their geotechnical properties and strength characteristics. The soil type in study is black cotton soil and also known as Expansive soils. It is one of the major soil deposits of India which covers an area of approximately 3,00,500 Sq. Km. BC soil is clayey soil seen grayish and black in color. It Contains montmorillonite clay mineral which contains very high expansive characteristics. They exhibit high rate of swelling and shrinkage when exposed to changes in moisture content. Because of high rate of montmorillonite in this soil which leads to form cracks in soil without any warning which is too dangerous for any construction structures, as this soil is directly connected to engineering structures.

2. PLASTIC MATERIAL

A word plastic is a material which is used to describe the wide range of synthetic or semi-synthetic materials that are used in a huge amount and in growing range of applications. We can separate plastics according to the structure of the

monomers that their polymer is made from. The waste produced from the plastic cannot be easily recycled because of their difficult chemical composition. Plastic is also not biodegradable which mean that it cannot be broken down into smaller molecules by mother nature rather it can survive for hundreds of years. Using of plastic waste bottle in geotechnical construction may reduce the problems faced for its disposal as their properties are mostly related to natural material. In this chapter we had mention about how we are using plastic waste bottles, as by the using of this plastic bottle stabilization of soil is obtained. For this we had cut bottles of plain surface whose dimension is almost length 20mm and width 4mm.

2. METHODOLOGY AND EXPERIMENTAL INVESTIGATION

There was some procedure which was taken into consideration during the undertaking of the project. The process and the use of the materials for the investigation is listed below:

1. Specific Gravity

2. Sieve Analysis

3. Moisture Content

4. OMC-MDD

1. SIEVE ANALYSIS: A sieve analysis is a practice or procedure used for assessing the practice size distribution of a granular material.

2. SPECIFIC GRAVITY: Specific gravity is defined as the ratio of the unit of soil solids to the unit of water. The specific gravity is needed for various calculation purposes in soil mechanics, e.g. void ratio, degree of saturation.

3. STANDARD PROCTOR COMACTION TEST: Compaction is the process of densification of soil mass by reducing air voids under dynamic loading. This test is conducted in order and maximum dry density of the soil.

Table 1: Properties of Sample Soil

S.No	Properties of Soil Sample	Values
1	Specific Gravity	2.12
2	Moisture content	6.52
3	Optimum moisture content	23.77
4	Maximum Dry Density	1.64

In order to conduct this study, various materials as black cotton soil, plastic bottles were used. The standard proctor compaction tests were done to assess the amount of compaction.

The CBR test will be conduct to determine the optimum amount of plastic strips in soil sample is required. We had cut bottles which dimensions are almost 20mm and width 4mm. The California Bearing Ratio test is will be conducted by adding plastic strips with varying percentage and determines the strength of soil until the strength of soil reaches the highest level and stop at the interval when the strength decreasing from the highest and then obtained CBR value corresponds to percentage of plastic content.

3. LITERATURE REVIEW

3.1 Literature Survey No. 1

Tarun Kumar, Suryaketan "Behaviour of Soil By Mixing Of Plastic Strips", International Research Journal Of Engineering & Technology e-ISSN: 2395-0056, Vol. 5, Issue 05, May 2018

This study is carried out on the development of the roadways which is very important and required to be strong enough to support different loads. To meet these challenges plastic wastes are used in the forms of strips of various sizes for identifying the required percentage amount of plastic strips and providing the alternative way for disposing the plastic wastes. To study this reinforcing effect of mixed plastic strips in soil, a series of standard proctor and unsoaked CBR tests have been conducted and based on this it is observed that the maximum dry density of plastic mix soil decreases with

increase of percentage of plastic strips, and for CBR increases with increase of percentage of plastic strips within a certain limit.

Based on this conclusion should be drawn is that by increasing the amount of plastic contents, the value of the MDD decreases whereas the value of OMC increases. There is increase in CBR value for soil with increasing the percentage of plastic strips. The maximum CBR value is obtained when the percentage of the plastic strips is 0.8% of dry weight of soil. Hence 0.8% of strips having length of 2cm is considered as required amount.

3.2 Literature Survey No. 2

Kiran kumar Patil, Shruti Neeralagi "Soil Stabilization Using Plastic Waste", International Journal of Advanced Technology in Engineering & Science, ISSN 2348-7550, Vol. 5, Issue No. 07, July 2017

Stabilization of soils is an effective method for improving the properties of soil. The main objective of any stabilization technique used for increasing the strength and stiffness of soil, workability and constructability of the soil. Plastic such as shopping bags is used for reinforcing the soil for improving the various properties of soil. Applications of stabilizing of soil are increasing the shear strength of soil, bearing capacity of foundations and for improving the natural soil subgrade for construction of highways and airfields. In this they are used plastic bottle strips and plastic bag strips for stabilization. From this study conclusion made is there is increase in CBR value of a soil and maximum CBR is achieved when 0.75% amount of plastic bottle strips are added to the soil after further addition of the strips there is decrease in the CBR value. In case of plastic bag strips, it has been observed that 2% of the total weight of the soil is the optimum proportion of the strips, we can also state from this study that strips cut out of plastic bottles are better option than strips of soil bags, to increase the CBR value of the soil.

3.3 Literature Survey No. 3

Sayli D. Madavi, Divya Patel "Soil Stabilization Using Plastic Waste" International Journal of Research in Science & Engineering, Vol. 3, Issue 2, March-April 2017

For the construction of any civil engineering structure the foundation is very important as it supports the structure and to achieve this strength stabilization of soil is required. Soil stabilization is done by addition of suitable admixtures like cement, lime, sand, fly ash. It is required to incorporate the new techniques of soil stabilization which can be effectively used to meet the challenges of society, to reduce the quantities of the waste and producing useful material from the non-useful material which cannot easily be recycled. This study reviews the experimental program conducted for stabilization of black cotton soil in the Amravati, a Capital of newly formed Andhra Pradesh state. They performed series of CBR testings to find out optimum amount of plastic content is required for obtaining maximum CBR value. It can be concluded that CBR percentage goes on increasing up to 4% plastic content in the soil and thereon it decreases with increasing the plastic content. Hence, we can say that 4% of plastic content is the optimum content of plastic waste in the soil.

Thus, using plastic as a soil stabilizer is an economical and gainful usage because there is lack of good quality soil for various constructions. These techniques can be serves the purpose of reducing pollution and meet the challenges of Amravati, and also to the whole society, producing useful material from non-useful waste materials.

3.4 Literature Survey No. 4

Sharan Veer Singh, Mahabir Dixit, "Stabilization of Soil by Using Waste Plastic Material: A Review", International Journal of Innovative Research in Science, Engineering & Technology, ISSN(Online) 2319-8753, Vol. 6, Issue 2, February 2017

Infrastructure is a major sector that propels overall development of Indian economy. For any Structure foundation has the prime importance, the strong foundation plays very important role. Expansive soils such as black cotton soil creates problems in foundation and for this stabilization of soil is required. This paper focus on the soil stabilization by using plastic waste products. The plastic inclusion can improve the strength thus increasing the soil bearing capacity of the soil. Use of plastic waste as reinforcement which reduces the disposal problem of the waste materials. Research has been done in India to determine the suitability of these waste materials for Indian roads. Based on these the further study is required to find out the optimum amount of the percentage of plastic waste content.

3.5 Literature Survey No. 5

A. K. Choudhary, J.N. Jha and K.S. Gill, "A Study on Behaviour of Waste Plastic Strip Reinforced Soil" Emirates Journal for Engineering Research, 15 (1), 51-57 (2010)

IN the present time the performance of paved and unpaved roads is often poor after every monsoon. Attempts have been made in this study to demonstrate the potential of reclaimed HDPE as soil reinforcement for improving engineering properties of the subgrade soil. Strips obtained from waste plastic with various dimensions were mix randomly with soil and find out appropriate amount of HDPE strips. They performed tests and interpreted the data based on the ratio of length to width of the strip. He also mentioned that as most of the plastic bags are made of high-density polyethylene material, hence there is a rapid increase in the amount of the plastic material in the environment.

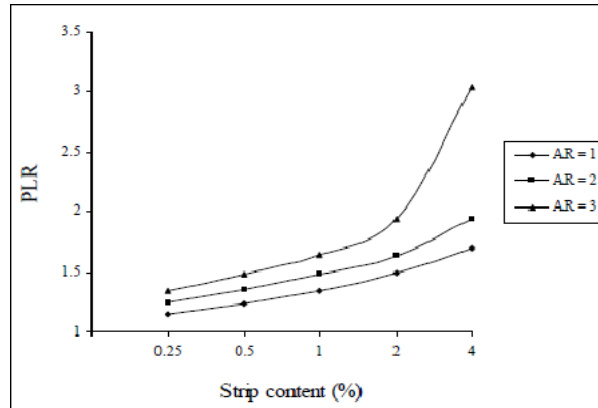


Fig. 1. Variation of Piston Load Ratio (PLR) with strip content at different Aspect ratio

It is seen from the curve that the maximum CBR and the secant modulus is obtained at the aspect ratio of 3 and strip content of 4%. The reinforcement benefit is directly proportional to the length of the strip content. The maximum CBR value of reinforced system is equal to the 3 times of unreinforced system. It is seen from the curve that the thickness of the base course is reduced by adding the strip content of particular aspect ratio and CBR value. Thus, from this study the feasibility of reinforcing soil with strips of HDPE is investigated and the results of this study proves useful as soil reinforcement in highway application.

4. CONCLUSION

Based on the review of the various research paper we can conclude that plastic strips in optimum amount with suitable dimension is feasible for improving the engineering properties of soil. Plastic can be utilized as one of the materials that can be used as soil stabilizing agent in proper proportion of plastic must be there, which helps in increasing the CBR of the soil. Thus, using plastic as a soil stabilizer is economical and gainful use in construction as there is lack of good quality soil for various construction. Reducing the amount of plastic waste and producing useful product from non useful waste materials for sustainable foundation and subgrade improvement. This new technique of soil stabilization can be effectively used to meet the challenges of society and it can significantly enhance the properties of soil used in construction of road infrastructure, foundation, stabilization of embankment, pavement sub grade and other different fields as per the needs and flexibility. Further large-scale research is advisable to determine the boundary effects influence on test and for its more effectiveness.

ACKNOWLEDGEMENT

We have a great pleasure to express our deep sense of gratitude and sincere regards to our Guide Prof. Swati Kale and Co-Guide Prof. Yogesh Navkar for their guidance and friendly discussion which helped immensely in selecting this topic and their generous encouragement throughout our dissertation work helped in completing this project work. We would like to thank our Head of Civil Engineering Department Dr. Nagesh shelke for allowing to do this project. He has immensely helped in providing all opportunities and facilities for the project work. I would also like to thank Dr. Ashok Kasnale, Principal, Dr D Y Patil School of Engineering and Technology, for providing all facilities at the right period of time. I am thankful to all the faculty members of Civil Engineering and library staff for helping me in this work. Finally, I would like to thank all those who directly or indirectly helped me during my work.

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