

# Experimental Study on the Stabilization of Soil by Using Plastic Wastes

S. Saravananesh<sup>1</sup>, R. Priyanka<sup>2</sup>, S. Sinduja<sup>3</sup>, K. Balakumar<sup>4</sup>, A. Chellaiah<sup>5</sup>

<sup>1</sup>Assistant professor, <sup>2,3,4,5</sup>UG Students

Department of Civil Engineering, KSR College of Engineering, K.S.R Kalvi Nagar, Tiruchengode, Tamil Nadu, India

## ABSTRACT

The road pavements and sub-grades are severely affected during the rainy season, which results in the failure of the road. The rain water will penetrate the surface of the sub grade and weaken their stability. It will also result in heave frosting. To prevent the road from failure, the nature of the onsite materials are improved along with their stability by the process of stabilization. Many roads agencies have been experiencing problem of premature failure of pavements like potholes, roughness, cracks etc. which leads to poor performance of roads and its life. On the other hand, plastics, rubbers, etc. are increasing day by day. There are many ground improvement techniques to improve the strength of the soil. One of them was Stabilization of the soil by using plastic wastes. India nearly pumps 0.6 million tons of plastic per year. According to central pollution control board [CPCB] the plastic wastes generated will be about 15,342.6 tonnes per day. These plastic wastes cause a great harm to the environment and their surroundings. So it is very important to dispose of these wastes. The disposal of these wastes by the stabilization technique was cost effective and economical. This paper presents the stabilization of the sub grade soil by using plastic granules made from the plastic wastes. The plastic materials used for the stabilization are made by recycling the polypropylene plastic bags. Soil acts as a reinforcing material and resists the entry of water when mixed with varying proportions of plastic granules. As a result when the percentage of plastic increases, then the strength of the soil also gets increased with increase in plastic content.

**Keywords :** Pavement, Plastic Wastes, Soil Stabilization, Pollution, Sub Grade.

## I. INTRODUCTION

In India, the modern era of soil stabilization began in early 1970's with a universal shortfall of petroleum and aggregates; it became necessary for the technologists to look at means to improve soil other than replacing the poor soil at the construction site. Soil stabilization had lost its favour due to the absence of proper technique and obsolete methods. In recent times, with the growth in the demand for infrastructure, sensitive materials and fuel, soil stabilization has begun to call for a fresh form. With the availability of better research, materials and equipment, it is emerging as a popular and cost effective method for land improvement[1]. Soil stabilization is a method of improving the soil properties by blending and mixing other materials. The main objective of soil stabilization is done to improve the California bearing ratio of in situ soils by 4-6 times. The process of soil

stabilization refers to the changing of physical properties of soil in order to improve its strength, durability and stability of the soil. Soil that has been stabilized will have a vastly improved weight bearing capacity and water resisting capability. There are many ground improvement techniques to improve the strength of the soil. In the past, soil stabilization was done by utilizing the binding properties of clay soils, cement based products such as soil cement, or utilizing the rammed earth techniques and lime. The stabilization process also includes the stabilization of pavements, soils etc. There are different products used for stabilization like rice husk, cement, lime, fly ash, waste rubber tyres, rubber, coir ash, plastic wastes etc.. There are many different types of stabilization techniques available for stabilizing the soil. But the stabilization of soil by plastic wastes method is adopted. Because the usage of Plastic materials is keep on

increasing day by day. These materials are non-degradable and non-decomposable. These materials will even take a century time to degrade and decompose. So these wastes should be reduced effectively. So these waste materials are adopted for stabilization of sub grade soils, bitumen, base course and sub base courses. There are many types of plastic materials available, from which polypropylene [pp] type of plastic is adopted. The stabilization done by using plastic is very economical and effectively reduces solid wastes. The stabilization done by using plastic wastes or plastic materials are similar to aggregate bind soil stabilization. [Aggregate bind soil stabilization is a unique, environmentally friendly, cross linked, water based, styrene acrylic polymer with proprietary tracers. aggregate bind soil stabilizer is used to produce the roads from in-situ materials and for manufacturing soil stabilized blocks, bricks and pavers for buildings, homes without using any cement]. The plastic granules are used as an stabilizing agent. The soil behaves as a Reinforcing material when blended with the plastic granules. The soil fill will be strengthened by relatively stiff high strength plastic metallic inclusions. The soil will be mixed with various proportions of plastic granules ranging from 5%, 10%, 15%, 20%, 25% and 30%. The plastic materials are reduced effectively in an ecofriendly way. So the rate of pollution is decreased and the environment is clean.

## Literature Review

**Dr. Abhaykumar S Wayal (2013)** described that use of plastics & rubber reduces the porosity, absorption of moisture and improves soundness. The use of waste plastics & rubber tyres in the form of powder for flexible pavement material is one of the best methods for easy disposal of wastes [2].

## II. METHODS AND MATERIAL

### A. General

The selected soil sample is Red Soil and its behavioral nature is studied when it is blended with the plastic and it is experimented to find whether it is suitable for using it as a sub grade soil.

**Table: 1** Engineering properties of the Coarse grained soil sample

Index Properties	Soil Sample
Classification of soil	CL
Sample type	Coarse grained soil
Liquid limit	41.67 %
Plastic limit	20 %
Plasticity index	21.67 %
Specific gravity	2.75

### B. Plastics

Plastics are made by linking many monomers together to form a polymer. The collected samples are granules made up of polypropylene plastic which is 300 mm to 500 mm. The waste polythene bags are collected and recycled to form plastic granules.

### C. Characteristics

Plastics can be very resistant to chemicals, can be both thermal and electrical insulators, very light in weight with varying degrees of strength, can be processed in various ways to produce thin fibers or very intricate parts, durable, non-decomposable & degradable,

### D. Methods of testing

Liquid limit is a very important property of the fine grained soil & its value is used to classify the fine grained soil. Plastic limit is used to determine the plastic limit of soils. This is also the moisture content of a solid at which a soil changes from a plastic state to a semisolid state.

Specific gravity test is carried on to find out the void ratio of the soil & for determining the grain size distribution of the soil. This test is used to find out the grain size distribution of the coarse grained soils. Soil particles smaller than 0.075 mm sieve are termed as fine grained soils & greater than 0.075 mm sieve are termed as coarse grained soils.

Standard proctor Compaction is defined as the process of increasing the density of an aggregate/soil by driving out the air voids from the soil. The density depends upon the moisture content, at very high moisture content the maximum dry density is achieved.

California bearing ratio is a penetration test mainly done for the evaluating the mechanical strength of the road

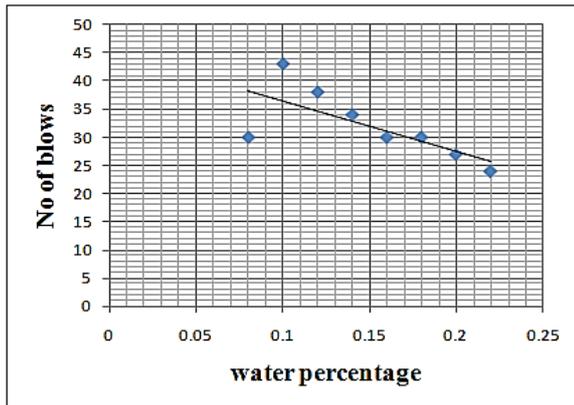
sub grades and base courses. Sub grade is defined as the foundation of the pavement structure, which lies below the constructed road, on which the sub base is laid.

### III. RESULTS AND DISCUSSION

#### A. Liquid Limit

**Graph 1:** No of blows Vs Water percentage

The consistency of the soil sample is found out from the graph as follows.



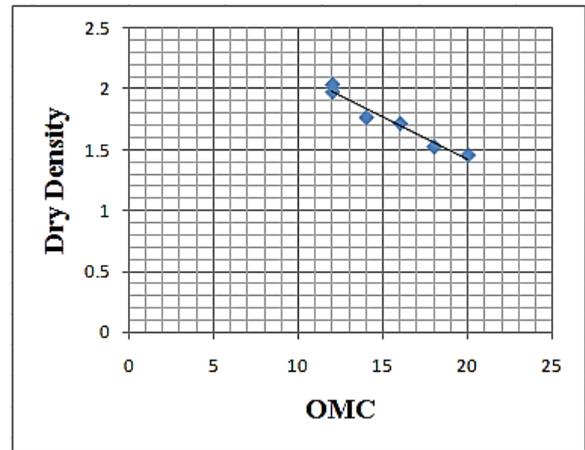
#### B. Standard Proctor Compaction

The optimum moisture content is obtained along with its maximum dry density. There is a decrease in the dry density with an simultaneous increase in the moisture content, [plotted in the graph shown below] when the plastic granules are added with the soil sample.

**Table: 1** standard proctor compaction with varying percentages of plastic

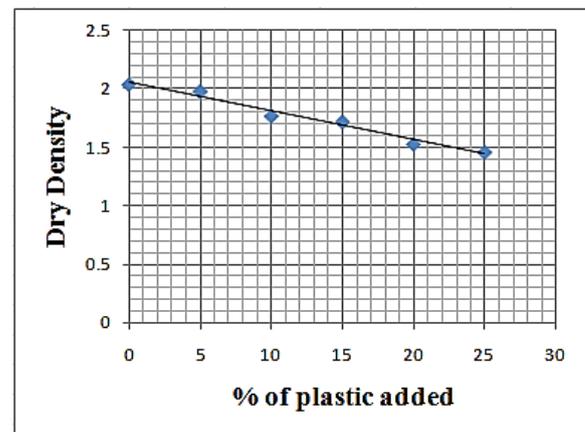
S.no	Plastic added (%)	Sample	
		OMC (%)	Dry Density(g/cc)
1	0	12	2.04
2	5	12	1.98
3	10	14	1.77
4	15	16	1.72
5	20	18	1.53
6	25	20	1.46

**Graph: 2** Maximum dry density Vs Optimum Moisture Content



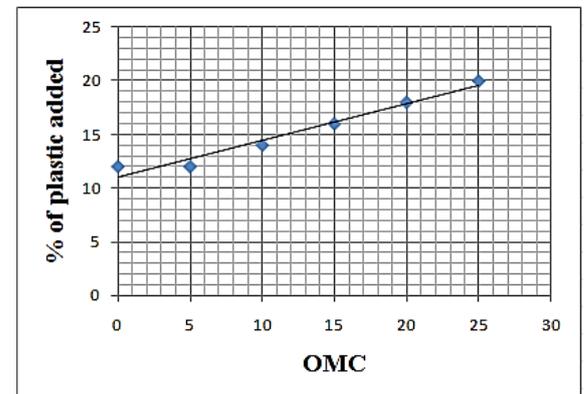
From the above graph, it is clearly known that there is an decrease in the dry density with an simultaneous increase in the moisture content.

**Graph: 3** Dry density Vs % of plastic added



From the above graph, it is clear that there is an decrease in the dry density when the plastic granules are added to the soil in varying proportions.

**Graph: 4** Optimum moisture content Vs % of plastic added

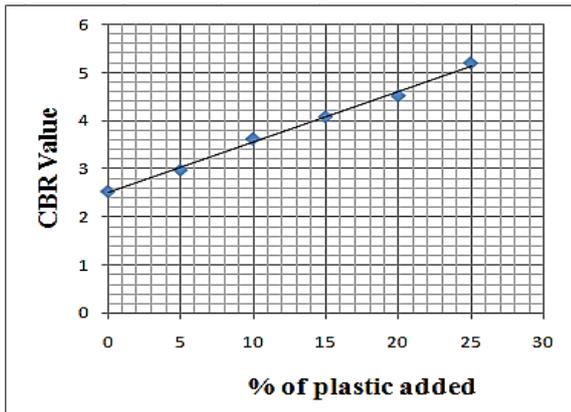


From the graph it is clearly known that when the plastic granules are added to the soil in Varying proportions ranging from 0%, 5%, 10%, 15%, 20%, and 25%, the strength also gets increased.

### C. California Bearing Ratio [CBR]

S.no	% of Plastic added	CBR Value
1	0	2.532
2	5	2.98
3	10	3.628
4	15	4.089
5	20	4.528
6	25	5.209

**Graph: 5** % of Plastic added Vs California Bearing Ratio value



From the CBR graph also it is proved that there is an increase in the bearing capacity and strength of the soil with the inclusion of plastic.

### IV. CONCLUSION

- From the liquid limit graph the toughness index, consistency, plasticity and the classification of the soil along with the dilatancy was identified.
- It is also used to predict the consolidation properties of the soil while calculating allowable bearing capacity & settlement of foundation.
- From the standard proctor compaction graph, when the varying proportions of plastic granules are added, the optimum moisture increases with increase in addition of plastic granules.
- The maximum optimum moisture content obtained is 16 % for 15 % of plastic granules with 1.72 dry weight.
- From the CBR graph it is clear that there is an maximum increase in the bearing capacity of the soil with the inclusion of plastic
- The CBR value gets increased with the addition of plastic granules in the soil
- On the whole the study reveals that Red Soil can also be used as a sub grade soil.

- The soil sample selected should be stabilized with suitable additives i.e., with suitable stabilizing agents.
- This method is cost wise economical and ecofriendly.

### V. ACKNOWLEDGEMENT

It is great pleasure to express our deep sense of gratitude to our project guide **Mr. S. Saravanaganesh, M. E.**, Assistant professor, and our other staff members for guidance and suggestions, which helped us in smooth traverse journey of Project work.

### VI. REFERENCES

- [1]. Shish Pal, Vinod Kumar Sonthwal, Jarvis S Rattan, 'Review on Stabilization of Soil Using Polypropylene as Waste Fiber Material', International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET) (An ISO 3297: 2007 Certified Organization) Vol. 4, Issue 11 ,ISSN(Online): 2319-8753, ISSN (Print): 2347-6710, November 2015 .
- [2]. Dr. Abhaykumar S Wayal, Mudassir. D. Wagle, Use of Waste Plastic and Waste Rubber in Aggregate and Bitumen for Road Materials, International Journal of Emerging Technology and Advanced Engineering (ISSN: 2250-2459, ISO 9001:2008 Certified Journal, Volume 3, Issue 7, July 2013) Pg No: 301
- [3]. Rajkumar Nagle, Prof. R.Jain, Prof. A.K.Shinghi, 'comparative study of CBR soil, reinforced with natural waste plastic material', International Journal of Engineering & Science Research(ISER),Vol – 4 , issue -6 pp 304-308,June 2014.
- [4]. A.K. Choudhary, J.N. Jha and K.S. Gill, 'A Study on CBR Behavior of Waste Plastic Strip Reinforced Soil', Emirates Journal for Engineering Research, 15(1), pp-51-57, (2010).
- [5]. Pragyan Bhattarai, A.V.A Bharat Kumar, K.Santosh, T.C. Manikanta & k. Tejeswini, 'Engineering Behavior of Soil Reinforced With Plastic Strips', International Journal Of Civil, Structural ,Environmental and Infrastructure Engineering Research And Development (IJCSEIERD) ISSN 2249-6866 Vol. 3, Issue 2, pp-83-88,June 2013.

- [6]. Raja.K, Sivaraja.M, Kathirvel.M, 'Stabilization of Waste Soil at Karur Dump Yard by using Polypropylene Fiber', International Open Access Journal of Modern Engineering Research (IJMER), ISSN: 2249-6645, Vol. 5 Issue. Pp - 38-42, 8 August 2015.
- [7]. Priti Mishra, Jha Ajachi R.B., Monish Satrawala, Harsh Amin, 'Experimental Study on Waste Recycled Product (W.R.P) and Waste Plastic Strips (W.P.S) as Pavement Sub Base Material', International Journal of Scientific & Technology Research , Volume 2, Issue 12, ISSN 2277-8616, December 2013.
- [8]. IS 2720-3-2 (1980): Methods of test for soils, Part 3: Determination of specific gravity, Section 2: Fine, medium and coarse grained soils [CED 43: Soil and Foundation Engineering].
- [9]. IS: 2720-16 (1979): Methods of test for soils, Part 16: California bearing ratio test [CED 43: Soil and Foundation Engineering].