Experimental Study on Stabilization of Soil By Using Shredded Rubber Tyres

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Abstract- *Soil is the basic foundation for any civil engineering structures. It is required to bear the loads without failures. In some places Soil may be weak which cannot resist the oncoming loads in such cases soil stabilization is needed, the clay often is weak has no enough stability in heavy loading.*

In this project we used shredded rubber tyres to improve properties of soil. With ongoing rise in use of motor vehicles hundreds of millions of tyres discarded each year throughout the world. Use of tyres in geotechnical engineering for improvement of bearing capacity of clayey soil has received great attention in recent times.

Shredded rubber tyre having sizes ranges from 10mm to 15mm (Width) and 20mm to 30mm (Length)and the steel belting was removed are used extensively. Added amount of rubber tyre had been varied in proportions of 4%, 6%, 8% and 10%. Use of shredded rubber tyres in geotechnical engineering for enhancing the soil properties has received great attention in the recent times. The main objective is to increase the strength or stability of soil and to reduce the construction cost by using local available materials.

Keywords- Soil Stabilization, Clayey Soil, Shredded Rubber Tyre, OMC and MDD etc….

I. INTRODUCTION

Soil stabilization is a way of improving the weight bearing capabilities and performance of in situ sub soils, sands, and other waste materials in order to strengthen road surfaces.Solid waste management is one of the major environmental concerns worldwide. In India, the scrap tires are being generated and accumulated in large volumes causing an increasing threat to the environment. With globalization of Indian economy and emphasis on development of infrastructure, the number of vehicles on road is increasing day by day. This increase in growth apart from causing noise and air pollution has begun to cause pollution in terms of stock piles of discarded tyres. Many countries already banned the disposal of the waste tyres in sanitary landfills. From the study, it has been found that the use of waste tyre rubber in clay soil is found to increase the bearing capacity and reduce the settlement. Generally, with the introduction of waste rubber tyre in the soil, its capacity to absorb and dissipate energy will be enhanced drastically. The objective of this study is to study the improvement of bearing capacities of the clay soil using waste tyre rubber. To examine the optimum moisture content present in the soil by using waste tyre rubber. To study the improvement of settlement of clay soil by using waste tyre rubber.

II. OBJECTIVES

1. Reduce the settlement of the structure on the soil.
2. Improve the shear strength of the soil and thus increase the bearing capacity.
3. Reduce the shrinkage and swelling characteristics of soils
4. Good disposal of waste (Shredded Rubber Tyres).

III. LITERATURE REVIEW

Several authors have reported various successful improvement techniques of soil using shredded rubber tyre.

Soil stabilization means alteration of soil properties to meet the specified engineering requirements. Disposal of tyres wastes are essential since it cause various hazardous to the environment. With the same intention literature review is undertaken on utilization of solid waste materials for stabilization of soil and their performance.

- **Baykal et al., (1992)** mixed clay and fly ash samples with used tire obtained from retarding industry and hydraulic conductivity test were conducted and he observed that strength decrease once tyre percentage exceeds 30%
- **Foose, (1996)** falling head permeability test were conducted on rubber mixed soil sample and it was observed that when water permeated through samples, slight increases in hydraulic conductivity.
- **Papp et al., (1997)** conducted research on shredded scrap tires blended with subbase soils under flexible pavements. Resilient modulus (Mr) testing was used to determine the plastic and elastic strains. Tests were conducted on cohesionless soils blended with varying amounts of

shredded tire chips. Blend ratios ranged from 0.1 to 0.5 tire chips to soil by dry weight.

- **Lee et al., (1999)** determined the shear strength and stress strain relationship of tyre chip and a mixture of sand and tyre chips. They found out the stiffness and strength properties for tyre sheds and rubber sand mixture.
- **Rao and Dutta, (2001)** conducted studies on sand mixed with rubber chips. Compressibility tests and triaxial tests were conducted. The stress strain relations and strength parameters were studied. It was found that the value of internal friction and effective cohesion of sand increased with increase in percentage of rubber up to 15%.

The performance of the shredded tire blends was compared to that of the naturally occurring virgin soil used in subbase applications in New Jersey. He concluded that physically mixing tire chips with the soil did not present any problems except when excessive steel wires were protruding from the chips. The addition of the tire chips to the soil reduced both density and strength of the soil. The 50-mm (1.96-inch) tire chips were most economical and had the least negative strength impact.

Rubber was blended with each type of sand at 5, 10, 20, and 50% by weight.. Each blend was subjected to direct shear tests and observed that the shear stress and internal friction angle of the two mixtures decreased at about 10% rubber concentration and then leveled off.

Rao and Dutta concluded that the blends were useful as lightweight embankment fill on weak foundation soils and retaining wall backfill material since the sand rubber mixtures were significantly lighter than 100% sand mixtures

IV. MATERIALS USED

4.1 CLAY SOIL-Clay soil has poor aeration compared to sandy soil. It holds water much better than sand, though is prone to water logging which results in settlement to structures.

4.2 RUBBER- The soil used in this study collected from Keesara village, Andhra Pradesh, India. Classification of soil as per BIS is CI which is clay with intermediate compressibility.

Fig. 1: Shredded Rubber Tyre

Fig. 2: Soil-Shredded Rubber Tyre Mixture

Table-4.1: Chemical properties of Crumb Rubber

Sr. No.	Chemical Properties	Percentage (%)
1.	SBR	48.0
2.	Carbon Black	47.0
3.	Extender Oil	1.9
4.	Stearic Acid	0.5
5.	Accelerator	0.7
6.	Sulphur	0.8
7.	Zinc Oxide	1.1

Table-5.1: Show the MDD and OMC of Virgin Soil

Soil Tyre	OMC (%)	MDD (g/cc)
Virgin Soil	22.93	1.63

Shredded rubber tyre was cut into different sizes ranges from 15mm to 25mm (Width) and 30mm to 50mm (Length). Added amount of rubber tyre had been varied in proportions of 4%, 6%, 8% and 10%. The view of shredded rubber tyre used in the study is shown in Fig.1 and Fig.2.

V. COMPACTION CHARACTERISTICS

Modified Proctor test is conducted on soil and shredded rubber tyre mixtures to determine its compaction characteristics, namely, the Optimum Moisture Content (OMC) and Maximum Dry Density (MDD). The soil is mixed with tyre shreds of 4%, 6%, 8% and 10% by weight of soil. The OMC and MDD virgin values obtained are shown below in the table.

Table-5.1: Show the MDD and OMC of virgin soil

Soil Tyre	OMC (%)	MDD (g/cc)
Virgin Soil	22.93	1.63

And the optimum moisture content and maximum dry density of soil when mixed with shredded tyre are shown below in table.

Table-5.2: OMC and MDD table for size $15^{\times 30}$ mm

% of shredded rubber tyre	$15^{\times 30}$ mm	
	OMC (%)	MDD (g/cc)
4	33.33	1.533
6	36.11	1.475
8	22.22	1.53
10	23.61	1.505

It can be seen from the above tables that the MDD of soil tyre mixtures reduces significantly with an increase in the percentage of shredded rubber tyre. This is due to the light weight nature of shredded rubber tyre. On the other hand, the value of OMC also decreasing with an enhancement of percentage of shredded rubber tyre. This is due to the fact that the shredded rubber tyre has more water absorption capacity.

VI. CONCLUSIONS

Based on the experiments carried out on soil and soil-tyre mixtures, the following observation and conclusion are drawn:

i. The optimum moisture content as well as maximum dry density is found to decrease with the increase of the percentage of rubber tyre content. This might be due to light weight nature of tyre waste.

ii. The overall objective of this study is to determine the approximate percent of waste tyre rubber which is to be added in the studied soil sample to get the maximum shear strength and stability of soil because percentage of waste tire greater than this will cause further decrease in the strength of soil.

iii. The use of shredded rubber tire as a stabilization is a low cost method because due to tire rubber mix.

iv. This method of stabilization reduces the disposal of waste tyre disposal problem which exist currently.

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