

Strength Improvement of Sub-grade Soil by mixing Shredded Rubber Tyres

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ABSTRACT: The uses of automobiles are increasing day by day because of that the waste of tyres increases. In India, the waste tyres are classified as solid waste. Due to manufacturing of tyres with synthetic rubber, proper disposal of these waste tyres has become difficult. It is approximately estimated as 60 to 70% of waste tyres are disposed in improper way in various areas. As a result of this, there is a great damage to eco-system like air pollution and aesthetic pollution. To avoid this damage we can utilize these tyre wastes with technical development in different fields like using tyre wastes in construction of flexible pavements. It is not only to decrease the pollution but also to decrease the use of aggregates which are in low quantity. In this investigation, we put our effort to make an effective use of waste tyres to stabilize the sub grade of highway pavement.

KEYWORDS: Stabilization of Soil, CBR Test, Los Angeles Abrasion test, Crushing Value test, Impact Value test, Waste tyre Pieces.

I. INTRODUCTION

The soil often is weak and has no enough stability in heavy loading. The aim of the study was to use the waste material for stabilization of soil in order to reduce the environmental impact. Several reinforcement methods are available for stabilizing soils. Scrap tyre generations is always on the increasing trend everywhere in the world. Majority of them end up in the already congested landfill or becoming mosquito breeding places. Worst when they are burned. This paper aims at studying the appropriateness of shredded rubber tyres for its use in pavement engineering, i.e. to stabilize the sub grade of the pavements. It discusses about CBR value of soil-tyre mixture and the results are presented.

II. MATERIALS USED

The soil used in this study collected from Tirupati India. Classification of soil as per BIS is sandy soil which is clay with intermediate compressibility. 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 2.5%, 5%, 7.5% and 10%. The view of shredded rubber tyre used in the study is shown in Fig.1 and Fig.2.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

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Fig. 1: Shredded Rubber Tyre



Fig. 2: Soil-Shredded Rubber Tyre Mixture

III. COMPACTION CHARACTERISTICS

Modified Proctor test is conducted on soil and soil-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 0%, 2.5%, 5%, 7.5% and 10% by weight of soil. The OMC and MDD values obtained are shown below in the tables.

Table :1 OMC and MDD table for size 15 X 30mm

% of shredded rubber tyre	15 X 30mm	
	OMC (%)	MDD (g/cc)
0	15.3	2.1
2.5	11.5	1.9
5	10.7	1.8
7.5	9.2	1.6
10	7.8	1.5

Table :2 OMC and MDD table for size 20 X 40mm

% of shredded rubber tyre	20 X 40mm	
	OMC (%)	MDD (g/cc)
0	15.9	2.2
2.5	12.4	2
5	11.5	1.8
7.5	10.2	1.7
10	8.3	1.5

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Vol. 5, Issue 10, October 2016

Table :3 OMC and MDD table for size 25 X 50mm

% of shredded rubber tyre	25 X 50mm	
	OMC (%)	MDD (g/cc)
0	16.5	2.3
2.5	13.7	2.1
5	12.8	1.9
7.5	11.4	1.7
10	9.6	1.6

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.

IV. CBR VALUES OF SOIL-TYRES CHIPS

CBR tests were conducted on soil and soil-shredded rubber tyre mixtures to determine the CBR value from which the suitability of soil stabilized with shredded tyres can be assessed. In addition to that the thickness of the pavement can also be determined from the CBR value. The tests were conducted a corresponding OMC and MDD of the soil, soil-tyre mixtures. The soil is mixed with tyre shreds of 0%, 2.5%, 5%, 7.5% and 10% by weight of soil and modified proctor test were conducted on soil-shredded rubber tyre mixtures. The CBR values of the soil and soil-tyre mixtures are summarized in the respective tables. The variation of CBR value with percentage of tyre is shown in Fig. 3, Fig.4 and Fig.5

Table 4: CBR value of Soil-Tyre mixture (15 X 30 mm)

% of shredded rubber tyre	Unsoaked CBR 15 X 30mm
	5 mm thickness
0	7.1
2.5	8.3
5	8.7
7.5	8.1
10	7.7

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Table 5: CBR value of Soil-Tyre mixture (20 X 40 mm)

% of shredded rubber tyre	Unsoaked CBR 20 X 40mm
	5 mm thickness
0	7.2
2.5	8.4
5	8.8
7.5	8.2
10	7.8

Table 6: CBR value of Soil-Tyre mixture (25 X 50 mm)

% of shredded rubber tyre	Unsoaked CBR 25 X 50mm
	5 mm thickness
0	7.3
2.5	8.5
5	8.9
7.5	8.3
10	7.9

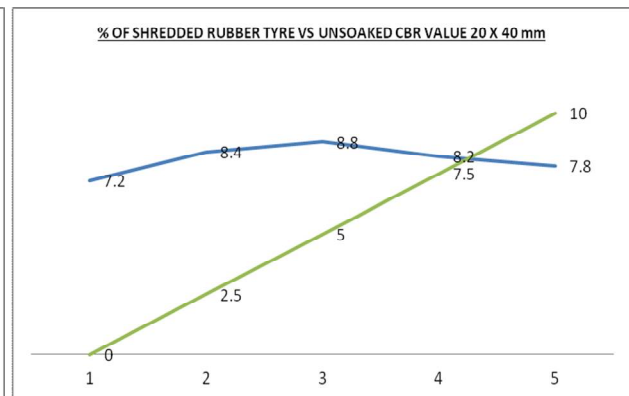
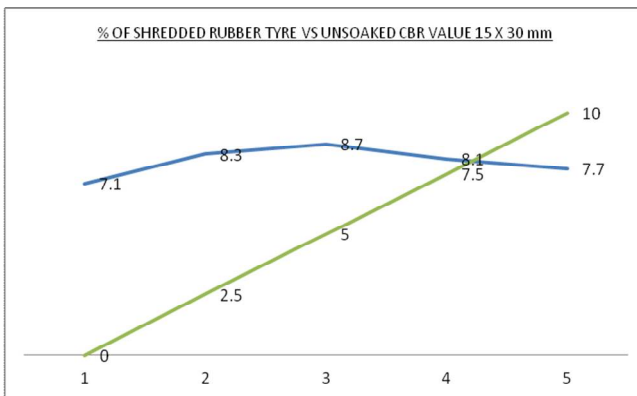


Fig. 3: CBR values of Soil-Tyre mixture (15 X 30 mm) Fig. 4: CBR values of Soil-Tyre mixture (20 X 40 mm)

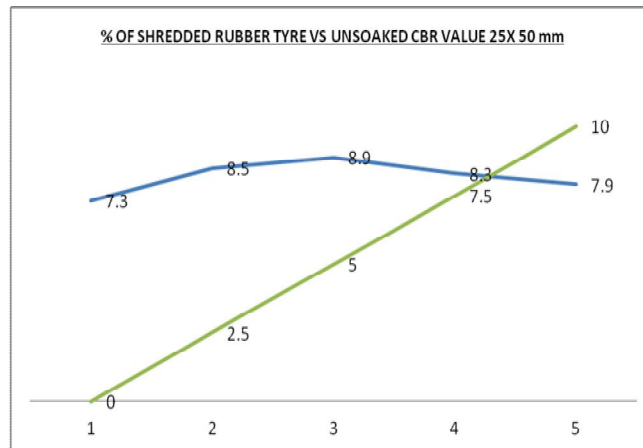


Fig. 5: CBR values of Soil-Tyre mixture (25 X 50 mm)

It is inferred from Tables and Fig.1, Fig.2 and Fig.3 that the 5% of size 25 mm×50 mm of tyre content is the specific value where the CBR has got the improvement of 66.28% than in comparison of the plain soil (26.01%). An improvement in CBR value of 8.9% can considerably trim down the overall thickness of the pavement and hence the total cost involved in the project.

V. CONCLUSION

The rapid growth in automobiles causes generation of large quantities of waste tyres. Use of waste tyres in subgrade stabilization is one of the methods of safe disposal. With all these, it is a good saving too. No toxic gas is produced. Disposal of waste tyres will no longer be a problem. The use of waste tyres on the road helps to provide better place for buying the used tyres waste without causing disposal problem. At the same time, a better road is also constructed. It also helps to avoid the general disposal technique of waste tyres namely land-filling and open burning, which have certain burden on ecology.

- Soil reinforced with Waste tyre pieces showing improvement in CBR value with its addition upto 5% and thereonwards decreased with further increase in tyre content in unsoaked conditions.
- 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.
- Shredded rubber tyre mixed with soil showed enhancement in CBR value with adding up to 8 % and there beyond decreased with additional increment in tyre content in unsoaked condition. Hence the optimal value of shredded rubber tyre is 5 % of size 25 mm×50 mm in unsoaked conditions.
- The percentage enhancement in CBR value of stabilized soil is 8.9 % in unsoaked condition whereas an increase in CBR value can considerably trim down the total thickness of the pavement and hence the total cost concerned in the project.

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