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Improvement of Engineering Properties of clayey soil using shredded rubber tyre

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ABSTRACT: Soil properties play very important role in construction. some time the properties of soil are not favourable for construction and we used some method to improve properties of soil called soil stabilization. In this paper we used shredded rubber tyre to improve properties of soil. Shredded rubber tyres with different sizes (10mm, 20mm, 30mm) in width and (20mm,40mm,60mm) in length are used for experimental work. the percentage used is (5%, 10%, 15%) for the experimental work. Use of shredded rubber tyres in geotechnical engineering for enhancing the soil properties, has received great attention in the recent times. This paper presents the effect on the behavior of pavement subgrade when pavement subgrade soil is stabilized with shredded rubber tyre. It is found from the investigation that the optimum value of shredded rubber tyre is 5%.and size is 10mm × 20mm. It improve the value of CBR by 28.66% than in comparison of virgin soil.

Keywords: soil stabiliztion, CBR, shredded rubber tyre,

I. INTRODUCTION

Soil properties is very important for every construction work, because we can change the material if it hasn't good quality, but it is very difficult to replace the soil If the property of soil is not too good, because the transportation of soil and change of all existing soil is very difficult work. for such condition we use some admixture and material which improve some important property of soil. Method of using waste material and admixture to improve the property of soil is called soil stabilization. This paper aims at studying the appropriateness of shredded rubber tyres for its use in pavement engineering, i.e. to stabilize the subgrade of the pavements. It discusses about CBR value of soil-tyre mixture and the results are presented.

II. MATERIAL AND METHODS

The soil used in this study is collected from Banur near Chandigarh. Classification of soil as per BIS is CL which is clay with low compressibility. Compaction characteristics of virgin soil are given below:

Table 1: MDD and OMC of virgin soil.

Soil type	OMC%	MDD(g/cc)
Virgin soil	12.7	1.95

Shredded rubber tyre was cut into different sizes (10mm, 20mm, 30mm) in width and (20mm,40mm,60mm) in length. The percentage used for laboratory experiment was 5%, 10%, 15%.

III. COMPACTION CHARACTERISTICS

Modified proctor test was used to find the compaction characteristics *i.e* optimum moisture content and maximum dry density. optimum moisture content and maximum dry density was found of soil mixed with shredded tyre of percentage 5%, 10%, 15%. And size (10mm, 20mm, 30mm) in width and (20mm, 40mm, 60mm) in length and also optimum moisture content and maximum dry density was found by modified proctor test of virgin soil.

Table 2: MDD and OMC of virgin soil.

Soil type	OMC%	MDD(g/cc)
Virgin soil	12.7	1.95

Table 3: OMC and MDD Table for Size 10mm × 20mm.

S.NO	PERCENTAGE	MDD	OMC
1	5%	1.81	13.2
2	10%	1.77	14
3	15%	1.70	16

Table 4: OMC and MDD Table for Size 20mm × 40mm.

S.NO	PERCENTAGE	MDD	OMC
1	5%	1.80	13
2	10%	1.75	15.2
3	15%	1.69	16.2

Table 5: OMC and MDD table for size 30mm × 60mm.

S.NO	PERCENTAGE	MDD	OMC
1	5%	1.77	13.3
2	10%	1.73	14.6
3	15%	1.71	16.1

Table 6: Comparison of the OMC and MDD of virgin soil with reinforced soil.

S.No.	**Percentage of shredded rubber tyre = 0% Virgin Soil**		**Percentage of shredded rubber tyre 5%**		**Percentage of shredded rubber tyre 5%**		**Percentage of shredded rubber tyre 5%**	
	MDD $\gamma_{d(max)}$ g/cc	**OMC, w %**	**MDD $\gamma_{d(max)}$ g/cc**	**OMC, w %**	**MDD $\gamma_{d(max)}$ g/cc**	**OMC, w %**	**MDD $\gamma_{d(max)}$ g/cc**	**OMC, w %**
1.	1.95	12.7	**Size of shredded rubber tyre 10mm × 20mm**					
			1.81	13.2	1.77	14	1.70	16
2.			**Size of shredded rubber tyre 20mm × 40mm**					
			1.80	13	1.75	15.2	1.69	16.2
3.			**Size of shredded rubber tyre 30mm × 60mm**					
			1.77	13.3	1.73	14.6	1.71	16.1

Table 7: Comparison of the OMC and MDD of virgin soil with reinforced soil with percentage variation.

S.No.	**Percentage of shredded rubber tyre = 0% Virgin Soil**		**Percentage of shredded rubber tyre 5%**		**Percentage of shredded rubber tyre 5%**		**Percentage of shredded rubber tyre 5%**	
	MDD $\gamma_{d(max)}$ g/cc	**OMC, w %**	**MDD $\gamma_{d(max)}$ g/cc**	**OMC, w %**	**MDD $\gamma_{d(max)}$ g/cc**	**OMC, w %**	**MDD $\gamma_{d(max)}$ g/cc**	**OMC, w %**
1.	1.95	12.7	**Size of shredded rubber tyre 10mm × 20mm**					
			(-) 7.17%	13.2	(-) 9.23%	14	(-) 12.5%	16
2.			**Size of shredded rubber tyre 20mm × 40mm**					
			(-) 7.69%	13	(-) 10.2%	15.2	(-) 13.3%	16.2
3.			**Size of shredded rubber tyre 30mm × 60mm**					
			(-) 9.23%	13.3	(-) 1128%	14.6	(-) 12.3%	16.1

And the optimum moisture content and maximum dry density of soil when mixed with shredded tyre are shown in table. 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 optimum moisture content is increased with increase in percentage of shredded tyre. This is due to the fact that shredded tyre has some value of water absorption.

IV. CBR VALUE OF THE SOIL

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 5%, 10% and 15% by weight of soil. The CBR values of the soil and soil-tyre mixtures are summarized in the respective tables. the variation of CBR value with percentage variation of shredded tyre is shown in Fig.1, Fig. 2, and Fig. 3.

CBR value of virgin soil =1.50

Table 8: CBR Value of soil tyre mixture (10mm × 20mm).

S. no	Percentage	Soaked CBR value
1	5%	1.93
2	10%	1.83
3	15%	1.40

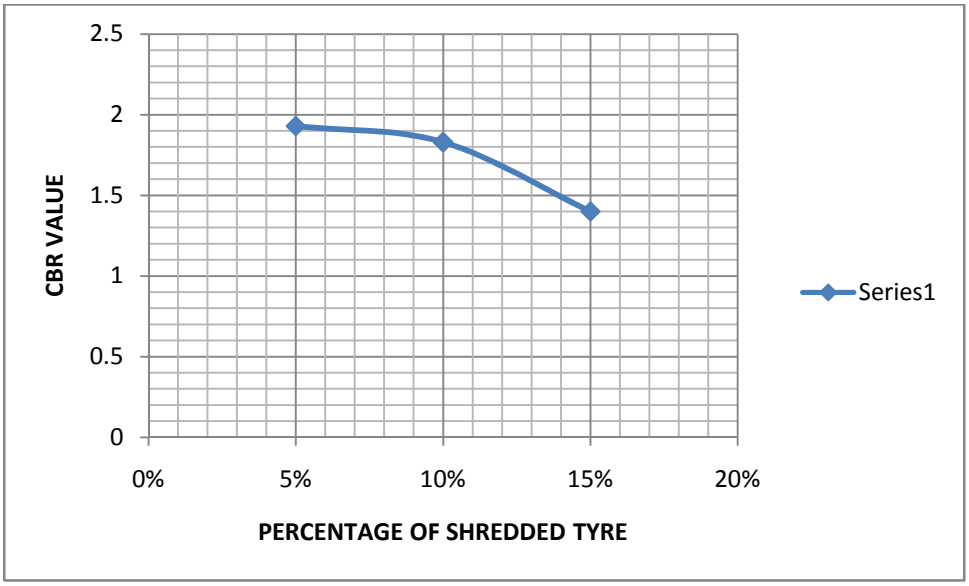

Fig. 1. Soaked CBR Value of Soil-Tyre Mixture (10mm×20mm).

Table 9: CBR Value of soil tyre mixture (20mm × 40mm).

S. no	**Percentage**	**Soaked CBR value**
1	5%	1.89
2	10%	1.81
3	15%	1.35

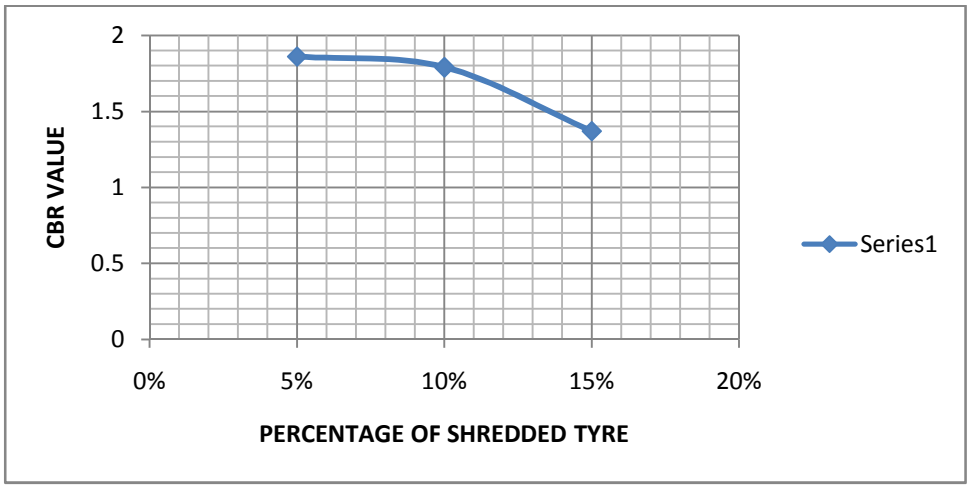

Fig. 2. Soaked CBR Value of Soil-Tyre Mixture (20mm × 40mm).

Table 10: CBR Value of soil tyre mixture (30mm × 60mm).

s.no	Percentage	Soaked CBR value
1	5%	1.86
2	10%	1.79
3	15%	1.37

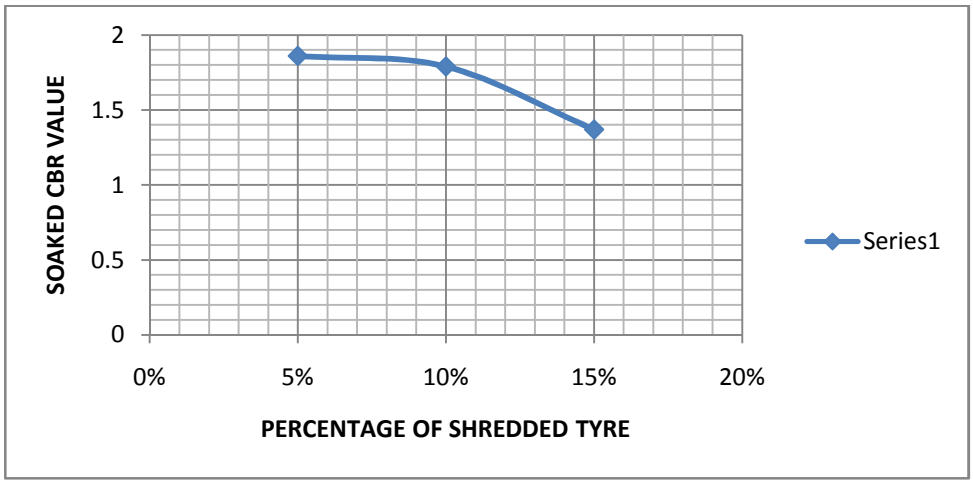

Fig. 3. Soaked CBR Value of Soil-Tyre Mixture (30mm × 60mm).

Table 11: Comparison of California Bearing Ratio of virgin soil with reinforced soil.

S.No.	**CBR value of Virgin Soil (kg/cm^2)**	**Percentage of shredded rubber tyre**	**Size of shredded rubber tyre**		
			10mm × 20mm	**20mm × 40mm**	**30mm × 60mm**
			CBR of reinforced soil, (kg/cm^2)		
1.	1.5	5%	1.93	1.89	1.86
2.		10%	1.83	1.81	1.79
3.		15%	1.40	1.35	1.37

Table 12: Comparison of California Bearing Ratio of virgin soil with reinforced soil with percentage variation.

S. No.	CBR value of Virgin Soil (kg/cm^2)	Percentage of shredded rubber tyre	Size of shredded rubber tyre		
			10mm × 20mm	20mm × 40mm	30mm × 60mm
			CBR of reinforced soil, (kg/cm^2)		
1.	1.5	5%	(+)28.66%	(+) 26%	(+) 24%
2.		10%	(+) 22%	(+) 20.66%	(+) 19.33%
3.		15%	(-) 6.66%	(-) 10%	(-) 8.66%

It is inferred from Tables and Fig. 1, Fig. 2 and Fig. 3 that the 5% of size 10 mm × 20 mm of tyre content is the specific value.CBR value at 5% shredded tyre with size 10mm × 20mm is 1.93 and the CBR value of virgin soil is 1.50, and improvement in CBR value from the experimental study was 28.66% than from virgin soil. An improvement in CBR value of 28.66% can considerably trim down the overall thickness of the pavement and hence the total cost involved in the project.

V. CONCLUSION

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

i. The optimum moisture content is found to increase with increase in percentage of shredded tyre, because shredded tyres have some water absorption value.

ii. The maximum dry density of soil decrease with increase in percentage of soil. This is due to the light weight nature of tyre waste.

iii. When soil mixed with 5% of shredded tyre with size (10mm × 20mm) its CBR value increase to 28.66% than from virgin soil.

iv. The percentage increase in CBR value of stabilized soil is 28.66% in soaked condition an increase in CBR value can considerably decrease the thickness of pavement and also reduce the cost of the project.

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