INCORPORATION OF RUBBER TYRE FOR SOIL STABILIZATION OF SUBGRADE

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Abstract: The rapid and extensive growth of automobiles due to globalization and growing technology has led to an exponential increase in heaps of discarded rubber tyres. In India, the waste tyres i.e., synthetic rubber mostly, are classified as solid waste and their proper disposal viz landfills resulting in leachate formation is quite difficult, leading to pollution of natural resources and other aesthetics. This paper examines how tyre waste can be utilized in subgrade soil alongside some technical development in the construction of flexible pavements. It is an effort not only to reduce the pollution levels but also an attempt to decrease the quantity of materials required in flexible pavement design. The series of tests conducted show that the waste tyre mixed upto a certain proportion with soil shows an improvement in the soil properties which play a pivotal role in various construction projects.

Index Terms: Landfill, Leachate, Flexible Pavement, Pollution, Rubber Tyre, Subgrade soil.

I. INTRODUCTION

With one of the largest road networks in the world, the transportation logistics of India suggest that most of the commute takes place through roadways. This shows a direct implication on the growth of number of vehicles; thereby causing a subsequent increase in tyre manufactures and discards. The domestic tyre industry margins continue to show a progression in the supply and demand which has led to amassing of generations of scrap tyre. Majority of them end up in landfills, mosquito breeding dumps or incineration sites. The conventional methods of disposal of the discarded synthetic rubber tyres don't provide a long-term solution and hence cause pollution of land, water and air.

In an attempt to make eco-friendly developments for the sustainability of the current and the future generations with respect to an economical pavement design, a series of engineered results regarding the improvement of subgrade soil by means of waste rubber tyres has been evaluated. Even though, wearing course of a pavement is the exposed surface, its success or failure is directly proportional to that of the underlying soil subgrade. The present paper involves the study of addition of shredded tyre discards in soil subgrade which is to be used in embankment fills. This will not only prove to be a method of disposing scrap rubber but the solution to technical issues like instability and settlement of pavement construction over ground can also be sought. Higher structural capacity of subgrade can result in comparatively thinner and more economical design of pavement. The tyre material being lightweight in nature induces low horizontal stresses and possesses relatively high shear strength. In addition to that, it is also comparatively cheaper. Moreover, the chances of pollution of natural resources can also be decreased consequently.

II. MATERIALS AND METHODS

The experimental tests with the corresponding equipments were conducted at the laboratory of Ramky Infrastructures Limited near the Srinagar-Jammu highway Nowgam, Srinagar. In this research, two basic materials were used for conducting various tests, i.e., subgrade soil and waste rubber tyres. Samples of soil subgrade were collected from the nearby

low lying borrow area. The rubber used in this study was crumb waste derived from tyres of motor vehicles. It was shredded so that it can pass through 4.75mm IS sieve. Three moulds with 3 trials each were tested upon to get the above results.

Laboratory tests were divided into two phases, i.e., without the inclusion of waste tyre and with the inclusion of waste tyre. The initial tests were performed on soil sample to ascertain their engineering properties like Grain Size Analysis, Free Swell Index and Atterberg's limits. In the second phase, crumb tyre was added to the soil in the proportions of 5, 7.5 and 10 percent by weight of the soil and compaction test viz Modified Proctor test was carried out to determine the respective optimum moisture content and compaction curve. Beginning with water content equal to 6%, water was continuously added to the sample until the point where there was a decrease in the weight of the sample was reached. After every set of tests, the sample was taken from the compacted mould to get the water content through oven dry method after 24 hours.CBR test was also performed on soil-crumb tyre mix with given percentages of crumb tyre in soaked and unsoaked condition to get the strength parameter of the soil.

III. RESULTS AND DISCUSSION

- This report contains the analyses and graphical representations of the results of the various tests conducted which will prove fruitful for the scholars in near future.
- The grain size analysis viz Sieve Analysis as per IS 2720, (Part 4) of the subgrade sample showed that the percentage of sand in the soil sample was found to be equal to 13.56 and silt and clay content was 86.44.
- The Free Swell Index as per IS 2720, (part 40) of the tested sample was taken out to be 13.64%. It is much lesser than 50% which is as per MORTH guidelines.
- Atterberg's limits as per IS 2720, (part 5) of the soil sample were found out to be as the following- the Liquid Limit was found out to be equal to 32.56%. The Plastic Limit and Plasticity Index came out to be 22.46% and 10.10 respectively.
- CBR, as per IS 2720, (Part 16) showed the following results at different proportions of rubber added to various soil specimen
- Modified Proctor Test as per IS-2720 (Part-8) done on the soil sample with weight of Rammer being equal to 4.89 kg showed the following values of OMC and MDD of the different soil samples. Refer to Figure 1 and 2.

The plotted graphs have been shown in the following figures, viz figure 1 to figure 3. Table 1 highlights the general summary of the geotechnical parameters of the specimen with and without the inclusion of waste rubber.

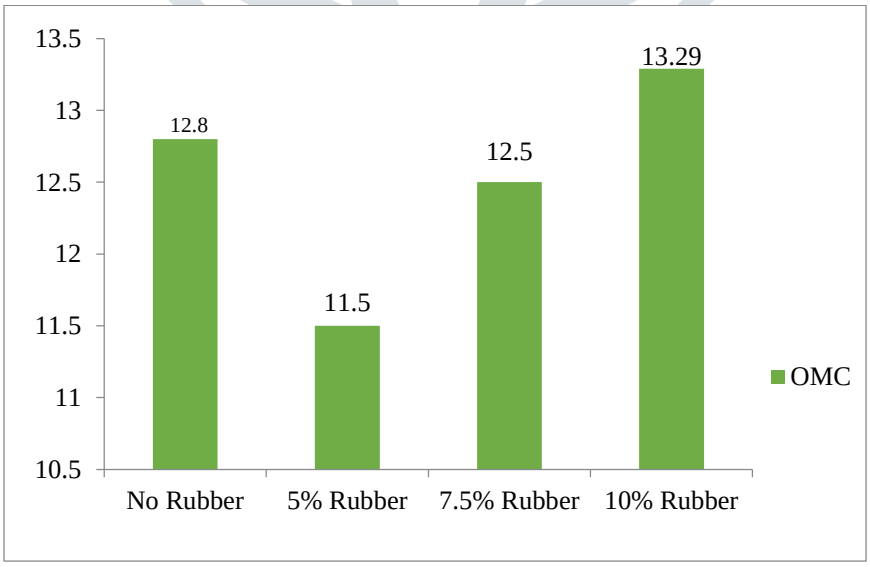

Fig. 1 OMC at different waste tyre content

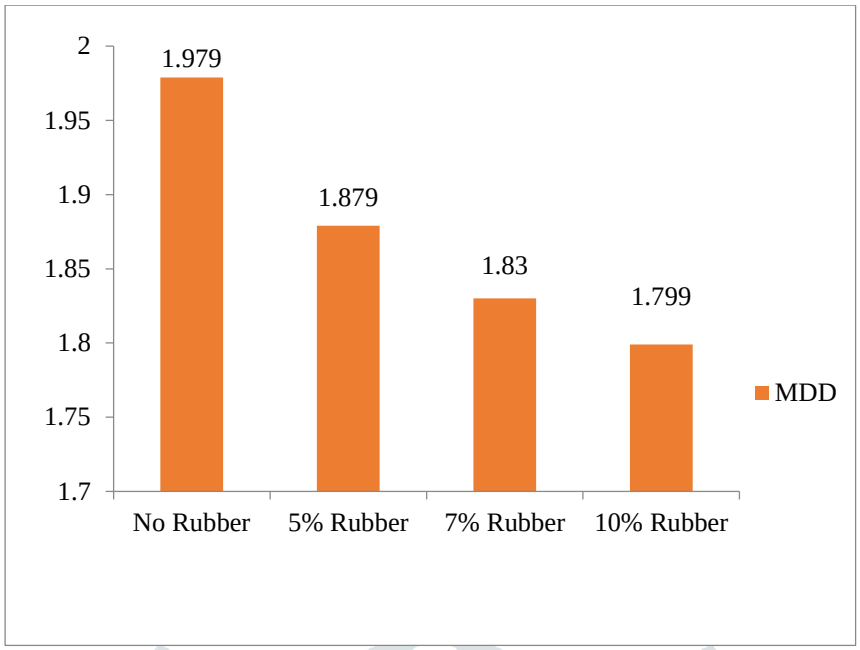

Fig. 2 MDD at different waste tyre content

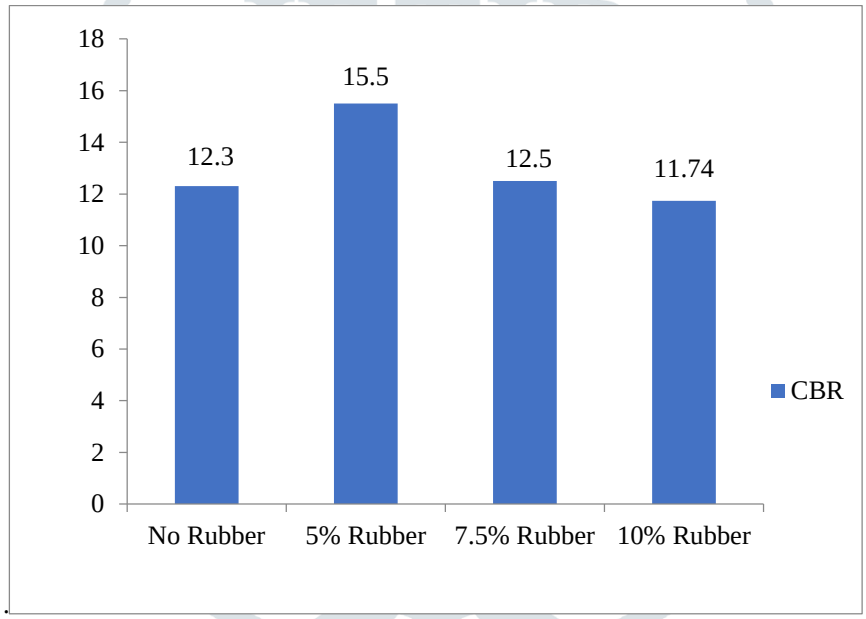

Fig. 3 CBR at different waste tyre content

Table 1

S.No.	Property	Units	Without Rubber	5% Tyre	7.5% Rubber	10% Rubber
1	OMC	%	12.80	11.50	12.50	13.29
2	MDD	gm/cc	1.979	1.879	1.830	1.799
3	CBR	%	12.30	15.50	12.50	11.4

IV. CONCLUSION

From the experiments conducted, it may be concluded that the scrap tyre shreds/chips when mixed with soil impart some percentage of shear strength to the soil that can help to counter the stresses. The waste tyre mixed upto a certain proportion with soil shows an improvement in CBR (California Bearing Ratio) value and a gradual decrement in MDD (Maximum Dry Density). Such effect on these two properties of the soil can reduce the quantity of soil required; thereby making the construction projects economical by reducing the material costs involved. Soil reinforced with waste tyre upto 5% by weight showed an increase in CBR value and the same decreased with further increase in tyre content in soaked condition. The decrement in MDD can be attributed to the loose grip of rubber surface with the soil. The decrement of OMC upto 5% tyre mixed sample is due to the good water absorption characteristic of waste tyre, but the further increment of OMC with higher percentages of tyre mixed can be credited to the uneven compaction causing greater range of voids in the sample. Hence, it is concluded that the waste rubber tyre (upto 5% by weight) can be used for improving the geotechnical properties of the soil. An increase in CBR value of 2% only can significantly reduce the total thickness of the pavement and hence the total cost involved in the project. The use of tyres in soil along with avoiding its improper disposal can find its applications in replacement of aggregates, construction of roads for low traffic intensity, lightweight backfill behind retaining walls; embankment fills with light-weight material for unstable underlying strata, etc.

V. REFERENCES

- Khanna, S.K. and Justo, C.E.G 2002 “Highway Engineering”
- Ghatge Sandeep Hambirao., and Rakaraddi, P.G. (2014) “Soil Stabilization Using Waste Shredded Rubber Tyre Chips”. Journal of Mechanical and Civil Engineering (JMCE), Vol. 11
- Bosscher, P. J., Edil, T. B. and Eldin, N. (1993)
- Construction and performance of shredded waste tyre test embankment, Transportation Research Record No. 1345, *Transportation Research Board*, Washington, D.C.
- Foose, G.J, Benson, C.H., and Bosscher, P.J. (1996)
- ‘Sand reinforced with shredded waste tyres’, Journal of *Geotechnical Engineering*, Vol. 122, No. 9

- V. Vinot, B. Singh, Investigation on Behaviour of Soils Reinforced With Shredded Waste Tyres, In: Proceedings of the Indian Geotechnical Conference Igc, Geotide. Guntur, INDIA, 2009.
- R.M. Subramanian, S.P. Jeyapriya, Study on Effect of Waste Tyres in Flexible Pavement System, Indian Geotech Soc. Chennai Chapter, 2009
- IS: 2720 Methods of test for soil: Grain size analysis, Bureau of Indian Standards, New Delhi.
- 5. IS: 2720 Methods of test for soil: Determination of liquid limit and plastic limit, Bureau of Indian Standards, New Delhi.
- IS: 2720 Methods of tests for soil : Determination of water content- dry density relation using light compaction, Bureau of Indian Standards, New Delhi.
- Rao G.V and Dutta R.K (2001), "Utilization of shredded tyres in highway engineering", Proceedings of the International seminar on sustainable development in road transport, New Delhi
- MORTH-2001: Specifications for Roads and Bridgeworks, Ministry of Road Transportation and Highways, Govt. of India.
- Prasad, Prasada Raju, Ramana Murthy (2008) 'Use of Waste Plastic and Tyre in Pavement Systems', *IE(I) Journal-CV*, Vol.89.