Impact of Waste Rubber Tyre on Subgrade of Srinagar-Banihal-Highway

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ABSTRACT
Automotive uses are increasing every day as a result of which the loss of tyres is increasing. The waste tyres, in India, are graded as solid waste. The proper handling of these waste tyres has become difficult due to the production of tyres with synthetic rubber. It is estimated to dispose of 60 to 70 per cent of waste tyres in different areas in an inappropriate manner. As a result, eco-systems such as air pollution and aesthetic pollution are experiencing considerable harm. 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 is in low quantity. In this investigation, we put our effort to make an effective use of waste tyres to stabilize the subgrade of highway pavement.

Keywords: Pavement, Subgrade, CBR, Modified Proctor test, Waste Rubber tyres.

1.INTRODUCTION

Since time immemorial, civil engineering has been very kind to humanity, and is one of the ancient sciences. What Civil Engineering has not given us, from underground metro to sky-high towers, from clean, pure water to drink, from airways to highways, to a non-reluctant and welcoming atmosphere. The list of deeds never shortens, it goes on. The fact that an earthling is not a good civil engineer until and unless he or she is not a good environmentalist is well-versed. And we had made an effort to make our atmosphere less hostile and non-obnoxious, to maintain and retain this environmental dimension of Civil Engineering. What drives and makes Civil Engineering conform? Civil Engineering is this law and tradition to search and quest for more than better without in the future making the resources less or more redundant. As a civil engineer I mainly focused on the same idea and stuck to the history and culture and essence of civil engineering. In this paper I have provided a series of engineering results regarding the **IMPACT OF WASTE RUBBER TYRES ON SUBGRADE OF SRINAGAR-BANIHAL HIGHWAY**, which I am very sure, will provide the edge to the scholars in future.
Followed by the US, India has the second-largest road network in the world. The bigger the road network, the bigger the car density of India will be. As a geotechnical engineer, my aim is to meet and develop road components not only from the point of view of engineering but also from the point of view of road users. With the advancement of technology and the sophisticated life style of the masses, the use of automobiles is increasing day by day. As the number of vehicles grows so are the heaps of discarded rubber tyres, or the waste of tyres. Today most tyres, particularly those fitted to motor vehicles, are made from synthetic rubber. Waste tyres, in India, are classified as solid waste. The proper disposal of these waste tyres has become difficult due to the manufacture of tyres with synthetic rubber. It is estimated that 60 to 70 per cent of waste tyres are inappropriately disposed of in various areas. As a result of this, there is a great damage to eco-system like air pollution and aesthetic pollution. As discussed, earlier environment is our duty and to prevent this harm by inadequate disposal of worn-out tyres, we can use these tyre-wastes with technological advancement in different fields, such as using tyre-waste in flexible pavements construction.

It is not only about reducing pollution but also about reducing the quantity of materials required in flexible pavements. In this investigation, I put my efforts to make an effective use of waste tyres to stabilise the sub grade of highway pavement. Generations of scrap tyres, everywhere in the world, are always on the growing trend. Most of them end up in the already congested landfill, or become breeding grounds for mosquitos. Worst when they are burned. Our goal is to research the suitability of shredded rubber tyres for their application in pavement engineering. As previously reported, one of the key problems relating to the management of scrap tyres was their proper disposal. So, in this project work, a effort has been made to make use of these waste tyres in subgrade of the flexible pavement. Usually tyres are used in civil engineering applications in a shred form referred to as "tyre chips" or "tyre threads" These chips are between 12 and 50 mm in size or threads passing through 4.75 mm IS Sieve and with steel belt removed during processing. Approximately 12 million scrap tyres were used for civil engineering applications in 1995 and 15 million in 1996, including leachate collection systems, landfill cover, artificial reefs, and clean fill for road embankments, road bed support and similar projects (Liu et al., 2000). Although of their particular characteristics the use of tyre shreds for civil engineering applications has many advantages. One of the most significant properties is that shreds of tyres are a lightweight material. Compared to other light-fill materials it is relatively inexpensive. Tyre shreds cause low horizontal stresses because they are lightweight and have relatively high shear power. However, tyre shreds have not been tried extensively for using it in subgrade and subbase layers of the pavement. An attempt has been made in this project to discover its possible use in those layers.

Now, talking about Srinagar-Banihal highway which is the only connecting link to the subcontinent and is still under construction for almost 20 years now. There are many low-lying areas like Awantipora stretch or Panthachowk- Nowgam area where the construction of highway is still going on. Also, worthy to mention there is no such area for deposition of solid wastes like tyre waste. What we do there is simply dispose the wastes on the banks of Jhelum which not only pollutes the water body but affects the surrounding environment drastically.

Objectives:

I aimed to know how the parameters of the soil subgrade will affect by the introduction of waste rubber which later was executed in a very positive fashion and the results were quite satisfactory.

2. EXPERIMENTAL WORK

The experimental work consists of the following steps:

I. Grain size analysis
II. Free Swell Index
III. Atterberg's limits
IV. Modified proctor test (For Soil without addition of waste tyre and with addition of waste tyre (5%, 7.5%, 10%)
V. CBR (For Soil without addition of waste tyre and with addition of waste tyre (5%, 7.5%, 10%)

3. RESULTS AND DISCUSSION

Sieve Analysis Result

[As per IS 2720, Part 4] Subgrade sample from Nowgam borrow area.

IS Sieve (mm)	Wt. Retained (g)	Cumulative Wt. Retained (g)	Cumulative Held Proportion (%)	Cumulative Percentage Passing (%)	Remarks
100					Gravel
75					Gravel
19					Gravel
4.75	-	-	-	100	Gravel
2.00	12.55	12.55	2.51	97.49	Sand
0.425	21.85	34.40	6.68	93.32	Sand
0.075	33.40	67.80	13.56	86.44	Sand
Pan					Silt & Clay

Description of particle		Sieve size (mm)	Percentage (%)
Gravel	Coarse	75 – 20	0
	Fine	20 – 4.75	
Sand	Coarse	4.75 – 2.00	13.56
	Medium	2.00 – 0.425	
	Fine	0.425 – 0.075	
Silt & Clay		Passing through 0.0075	86.44

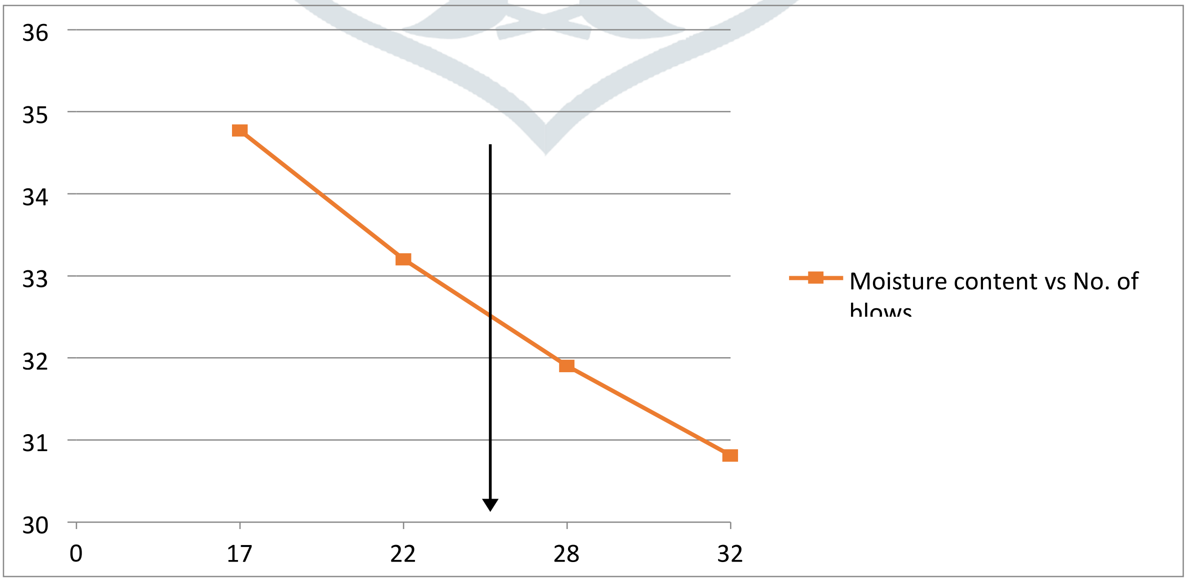
Table 1

FSI Result

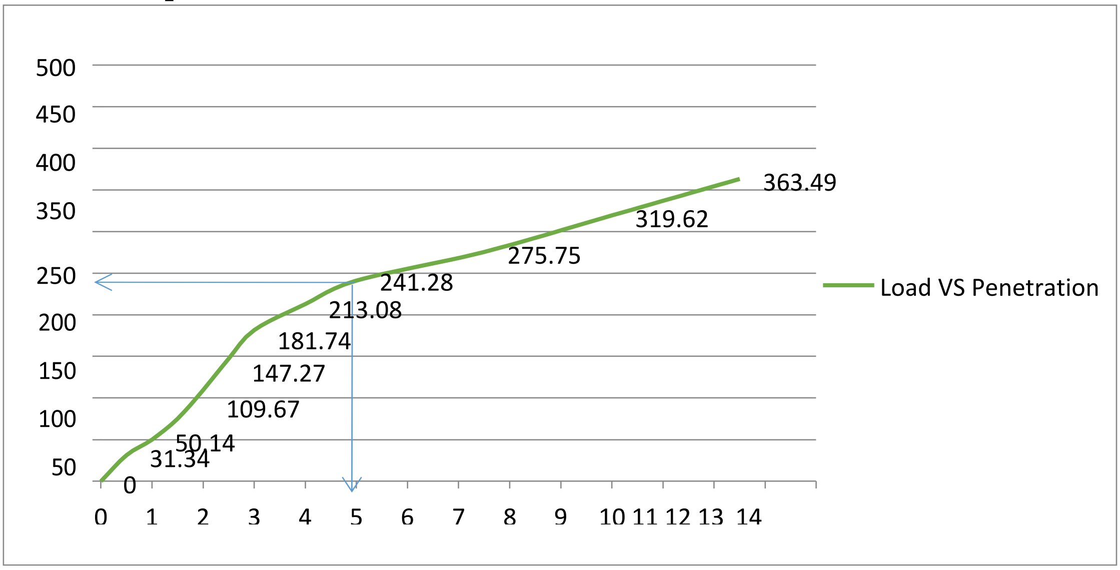
[As per IS 2720, Part 40] Subgrade sample from Nowgam borrow area.

S.No.	Sample level in water (Vw) ml	Sample level in kerosene (Vk) ml	Free Swell in Water (Vw-Vk) ml	FSI 100x (Vw-Vk)/Vk (%)	Average FSI (%)
1	12.5	11	1.5	13.64	13.64

Table 2

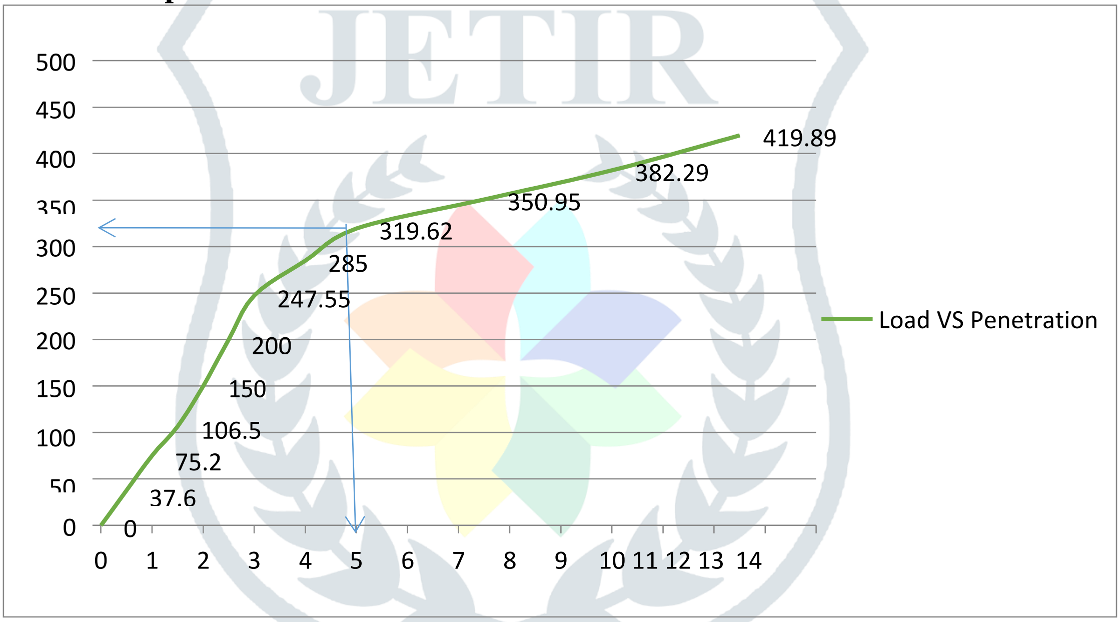


Load VS Penetration Graph



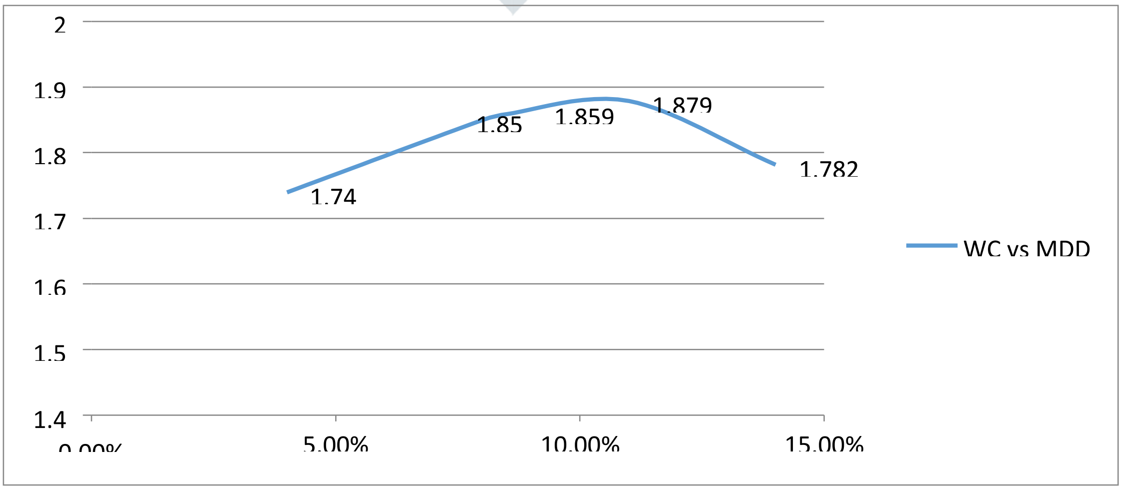
Without Addition of waste tyre

Load VS Penetration Graph



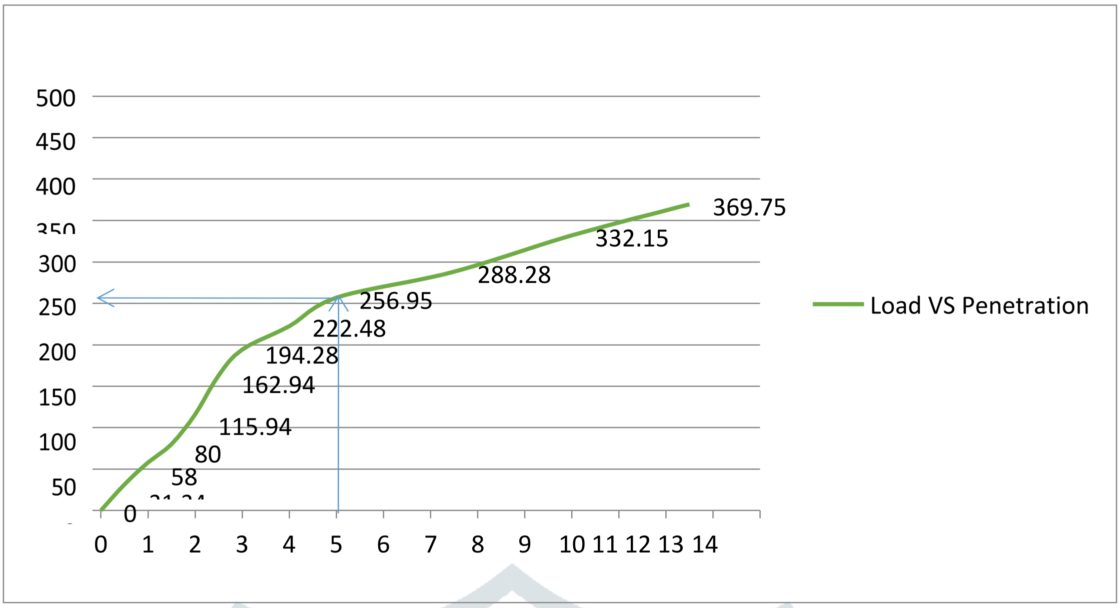
By Adding 5% of Waste tyre

Maximum Dry Density Graph



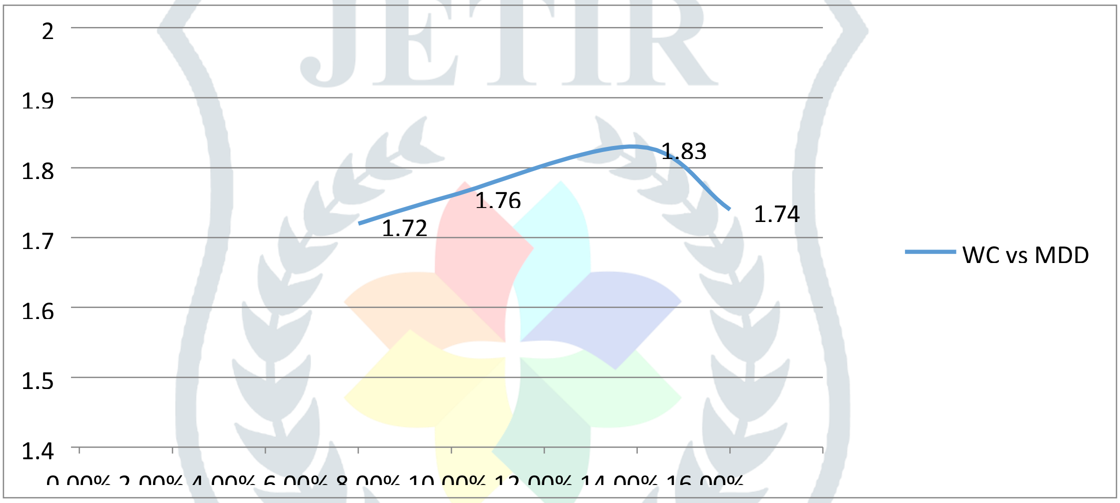
By Adding 5% of waste tyre

Load VS Penetration Graph



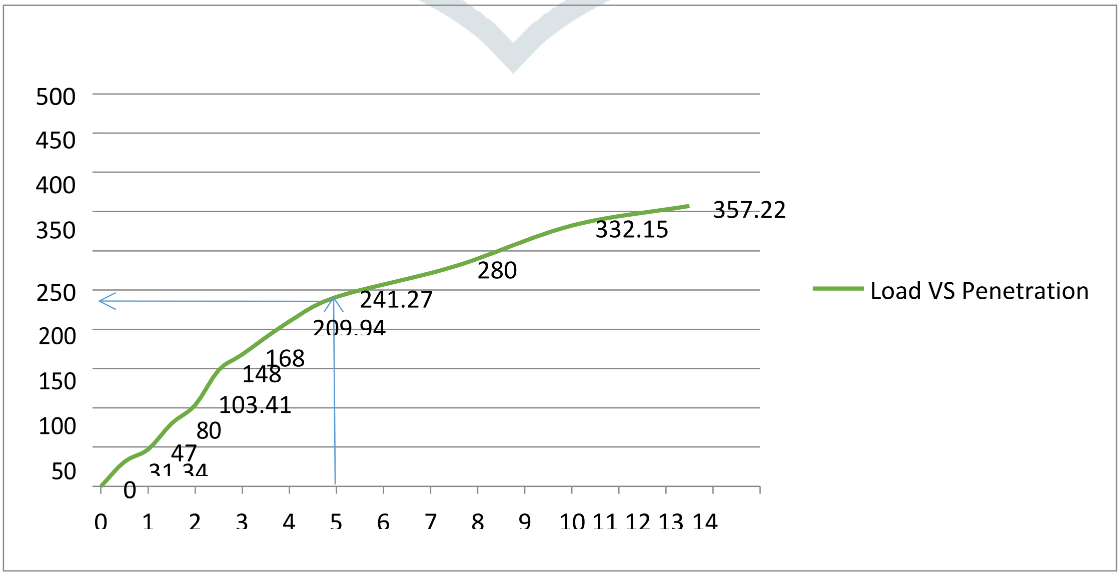
By adding 7.5% of waste tyre

Maximum Dry Density Graph



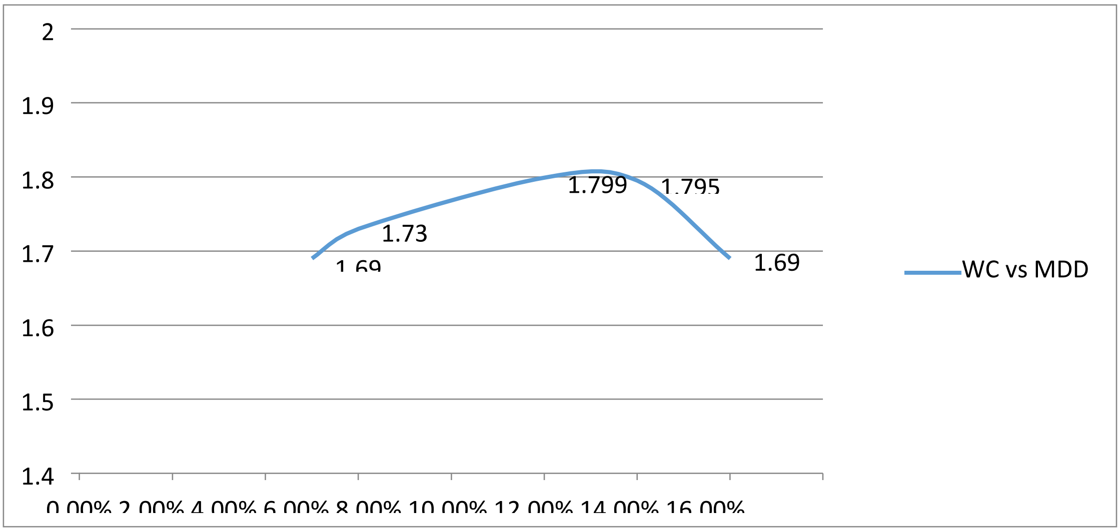
By adding 7.5% of waste tyre

Load VS Penetration Graph



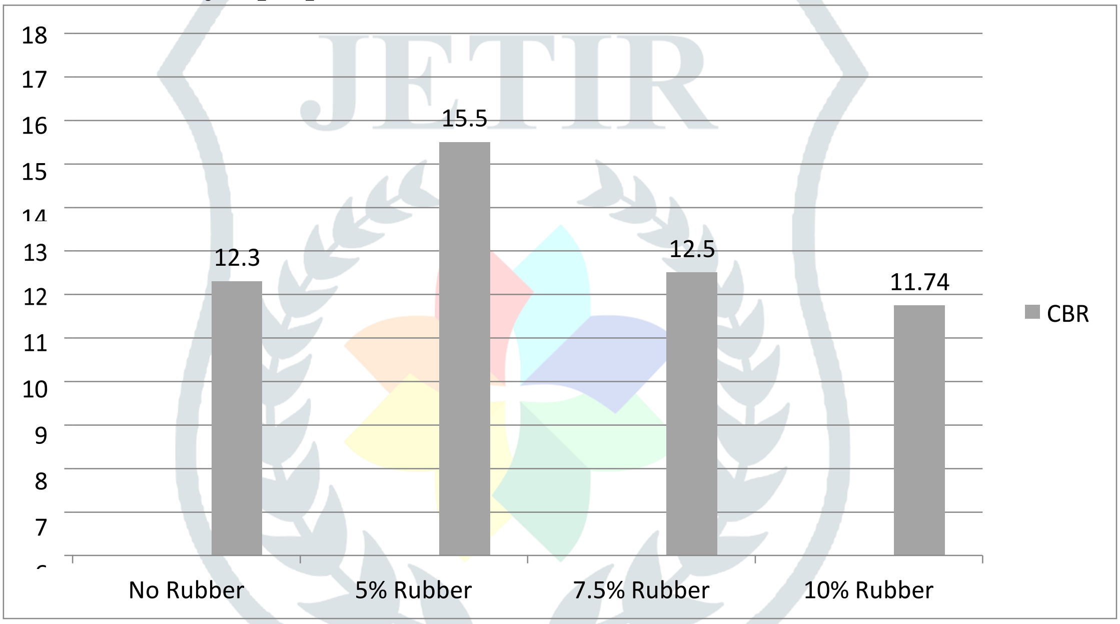
By Adding 10% of waste tyre

Maximum Dry Density Graph

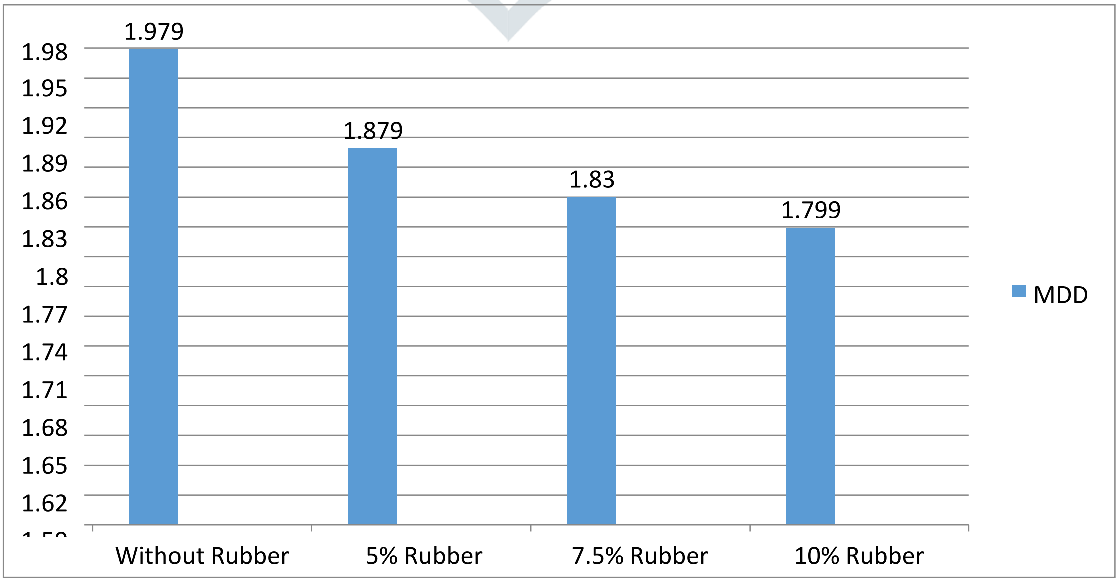


By adding 10% of waste tyre

CBR on different Waste Tyre proportions



MDD on different Waste Tyre proportions



Summary of Results

The table below highlights the general summary of the geotechnical parameters of the specimen with and without the inclusion of waste rubber.

S.No	Geotechnical Parameter	Units	Without Rubber	5% Rubber	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	12.5	11.4

4. CONCLUSION

The following findings are drawn from the experimental investigations and the results obtained:

1.1 Waste tyre combined with soil has shown an increase in CBR value and a steady decrease in MDD.

1.2 Giving importance to the CBR value in pavement design, the mixing of waste tyres in the soil is found to be successful when the waste rubber is combined with the soil up to 5 per cent by weight.

1.3 Soil-reinforced waste tyre showed an improvement in the CBR value with an addition of up to 5% and subsequently decreased with an additional increase in soaked tyre content.

1.4 The drop in MDD can be due to the loose grip of the rubber surface with the soil and the weight of the waste rubber unit is lower than that of the soil.

1.5 In this particular soil, the waste tyre can be used effectively in subgrades to improve its CBR value in areas where the rainfall is lower and the groundwater table is at a great depth below.

1.6 The decrease of the OMC to 5% of the waste tyre mixed sample is due to the good water absorption characteristic of the waste tyre, and thereafter, with 7% and 10% of the waste tyre mixture in the soil sample, the increase in the OMC credits is due to the uneven compaction that leaves significant amounts of waste in the sample..

1.7 The waste tyre mix is up to 5% to the degree that it is feasible in the pavement sub-layer because it will effectively minimize the amount of soil and substantially reduce the environmental aesthetic emissions.

1.8 An increase in CBR value of 2% can significantly reduce the total thickness of the pavement and hence the total cost involved in the project.

It is therefore concluded that waste rubber (up to 5 per cent) can be used to enhance the soil's geotechnical properties. By using waste crumb rubber immensely to enhance the geotechnical properties of clay, it helps to address the safety and environmental problems associated with disposal of this hazardous waste.

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