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USE OF WASTE TYRE RUBBER POWDER AND WASTE PLASTIC IN BITUMINOUS ROAD CONSTRUCTION

Abhinand Hidakal[1], Ashlesh.D.Karpe[2], Siddartha T[3]

[1]*PG student, Transportation engineering and management Reva University, Bengaluru,*
[2]*PG student, Transportation engineering and management Reva University, Bengaluru,*
[3] *PG student, Transportation engineering and management Reva University, Bengaluru*

Abstract
Construction of new roads are important, to provide standard of transportation system. The wear and tear of tyres is undisputed. Such huge numbers of scrap tires are being produced. Many waste and destroyed tires are now in presence and with yearly age rate of 15 to 20% every year. These tyres are discarded indiscriminately. Therefore it is required to use old rubber tyres to prevent posing threat to environment. various waste materials like waste plastic and metropolitan waste are of extraordinary concern. Among these strong waste administration is the pushed region. This paper talks with respect to the appropriateness of plastic waste materials for asphalt development. We can diminish the expense of street development by application of plastics in road development. Plastic is a decent fastener with bitumen. It gives better strength, protection from water and durability. The mix of plastic coated aggregates gives higher strength. application of plastic in materials is becoming more and more acceptable due to improved properties of material.

Keywords— waste plastic, waste rubber tyre, Indirect Tensile Strength (ITS), Marshall Mix Design, aggregate, bitumen.

INTRODUCTION

Day by day growing more automobiles in India during recent years the demand of tyres as original equipment has increased. As every new tyre manufactured is designed go to waste stream for discharge or recycling or reclamation, the number of used tires being discarded is going to increase significantly. Auspicious activity in regards to reusing of utilized tires is important in view to take care of the issue of transfer of utilized tires keeping in view the expanding cost of crude substance, asset requirements and condition issue including fire and health risk related with the reserves of the utilized tires. The world generates about 1.5 billon of waste tyre annually, Analysis indicates that 0.6 million tons of tyres scraps is produced in the country annually. The management of scrap tyre is becoming issue in recent years, scrap tyres represent one of several special wastes that are difficult for municipalities to handle. All old tyres are difficult to discharge because they tend to float to the surface. These stockpiles are also direct loss of energy and resources in addition to fire & health hazards and, also nature issues.
The average annual rate of growth of solid polymers from 7million tons in the world in 1960 to 196 million tons in 2005 and to continue reaching above 365million tons in 2015,540tons in 2020 using more conservative annual rate of 6.5%.Once used, plastic materials are thrown out. They do not undergo bio-decomposition Hence they are also landfilled or burned. Both are not eco-friendly processes as they pollute land and air

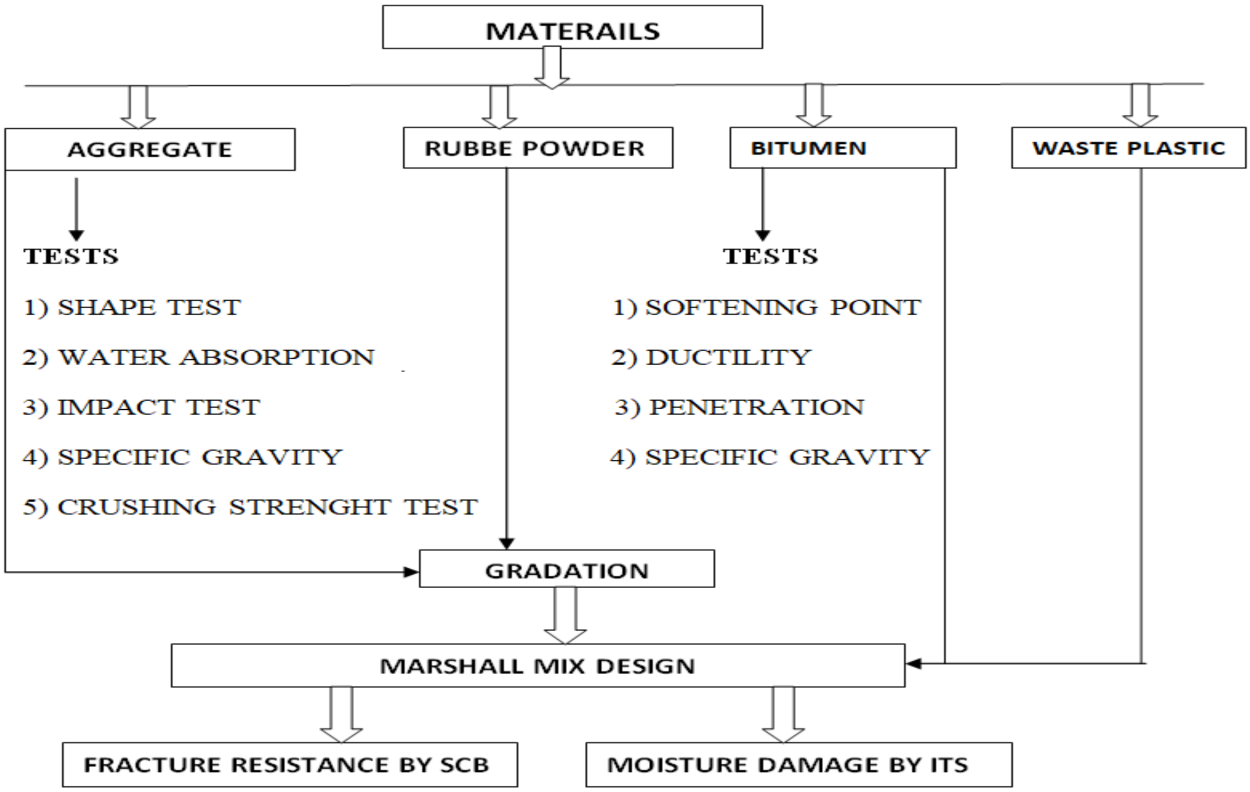
Objectives

- Study on utilization of waste tyre (rubber powder) and waste plastic in the bituminous road using Marshall mix design method.
- To minimize the increasing number of waste tyre rubber and waste plastic in the country.

METHODOLOGY

MATERIAL COLLECTION

Tyre Rubber Powder
Aggregates
Hydrated Lime powder
Waste plastic



TEST ON AGGREGATES

Table 1. Test Results of Aggregate

Test	**Average Value Obtained**	**IRC and IS maximum limits (%)**	**Test Method**
Aggregate Impact value (%)	10.98	30	IS: 2386 – Part – 4
Aggregate Crushing value (%)	17.11	30	IS: 2386 – Part – 4
Flakiness Index of the aggregates (%)	34	35	IS: 2386 - Part -1
Elongation Index of the aggregates (%)	24	25	IS: 2386 - Part -1
Bulk Specific gravity			IS: 2386 - Part -1
20 mm aggregates	2.87	--	
10 mm aggregates	2.87	--	
6 mm aggregates	2.97	--	
Stone Dust	2.69	--	
Lime	2	--	
Water absorption (%) max.	0.51	2	IS: 2386 – Part – 3

TESTS ON BITUMEN

The viscosity grade (VG) binder VG 30 used in the present project. The initial laboratory tests namely softening point, specific gravity, ductility and penetration tests were conducted on VG 30 a in accordance with IS: 1205:1978 and IS: 1208-1978 has shown.

Table 2. Test Results of Bitumen VG 30

Test	Test Result	Limiting Value	Test Method
Softening Point, °C	54	45 to 55	IS 1205 : 1978
Penetration	65	60-70	IS 1203: 1978
Ductility at 27 °C, cm	88	Min 70	IS 1208 :1978
Specific gravity	0.98	.97-1.02	IS 1206(Part 3):1978

PERFORMANCE EVALUATION OF MIXES

By Indirect Tensile Strength (ITS) Test

Table 3. 0 % Rubber and plastic

0% Rubber and Plastic	Sl	Load (P)	Diameter	Height	Indirect Tensile Strength,	TSR,
	No	kN	(D)	(t)	S=2P/πDt	%
			Cm	Cm		
Conditional Samples	1	5.17	10	6	0.0548	85.60%
	2	5.32	10	6	0.0561	
	Average				0.0555	
Unconditional Samples	1	6.6	10	6.1	0.0689	
	2	5.82	10	6.1	0.0607	
	Average				0.0648	

Table 4. 2% Rubber and Plastic

2% Rubber and Plastic	Sl	Load (P)	Diameter	Height	Indirect Tensile Strength,	TSR,
	No	kN	(D)	(t)	S=2P/πDt	%
			Cm	Cm		
Conditional Samples	1	6.82	10	6.1	0.0716	92.20%
	2	6.91	10	6.1	0.0721	
	Average				0.0718	
Unconditional Samples	1	7.71	10	6.1	0.0805	
	2	7.19	10	6.1	0.0751	
	Average				0.0778	

Table 5.4% Rubber and Plastic

4% Rubber and Plastic	Sl	Load (P)	Diameter	Height	Indirect Tensile Strength,	TSR,
	No	kN	(D)	(t)	S=2P/πDt	%
			Cm	Cm		
Conditional Samples	1	5.26	10	6.2	0.0541	89.30%
	2	5.86	10	6.2	0.0603	
	Average				0.0572	
Unconditional Samples	1	6.3	10	6.1	0.0658	
	2	6	10	6.1	0.0622	
	Average				0.064	

Table 6. 6% Rubber and Plastic

6% Rubber and Plastic	Sl	Load (P)	Diameter	Height	Indirect Tensile Strength,	TSR,
	No	kN	(D)	(t)	S=2P/πDt	%
			Cm	Cm		
Conditional Samples	1	5.12	10	6.1	0.0534	87.80%
	2	5.23	10	6.2	0.0537	
	Average				0.0535	
Unconditional Samples	1	6.14	10	6.2	0.063	
	2	5.81	10	6.3	0.0587	
	Average				0.0608	

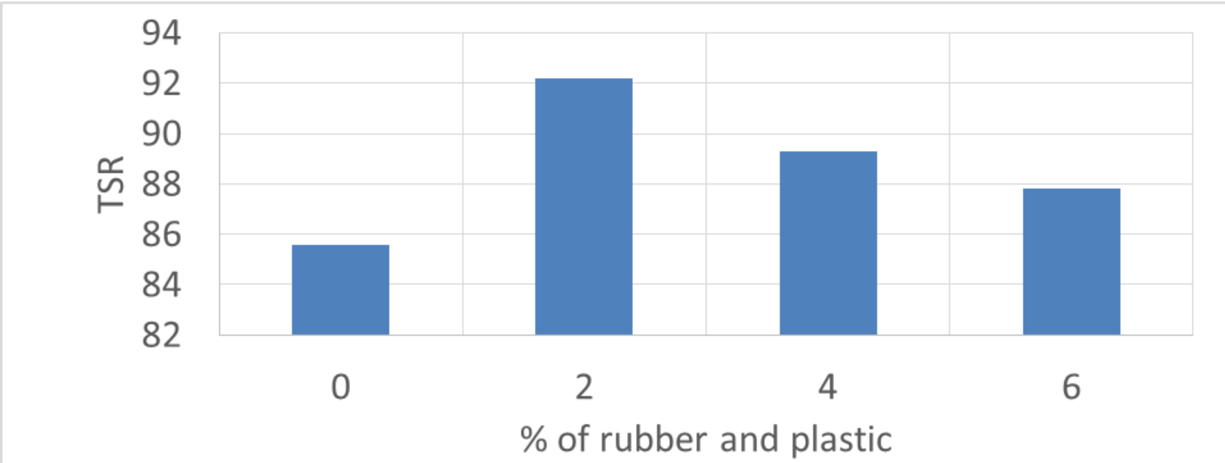


Figure 1. TSR vs % of Rubber and Plastic

COMPARISON OF LOAD AT FAILURE

The Figure shows variations of load at failure for HMA mixes, estimated at 20 mm, 25 mm and 32 mm notch depths for different percentage of Rubber. As it can be seen from this figure that at 20 mm notch depth, HMA mixes take a higher load for 2% Rubber.

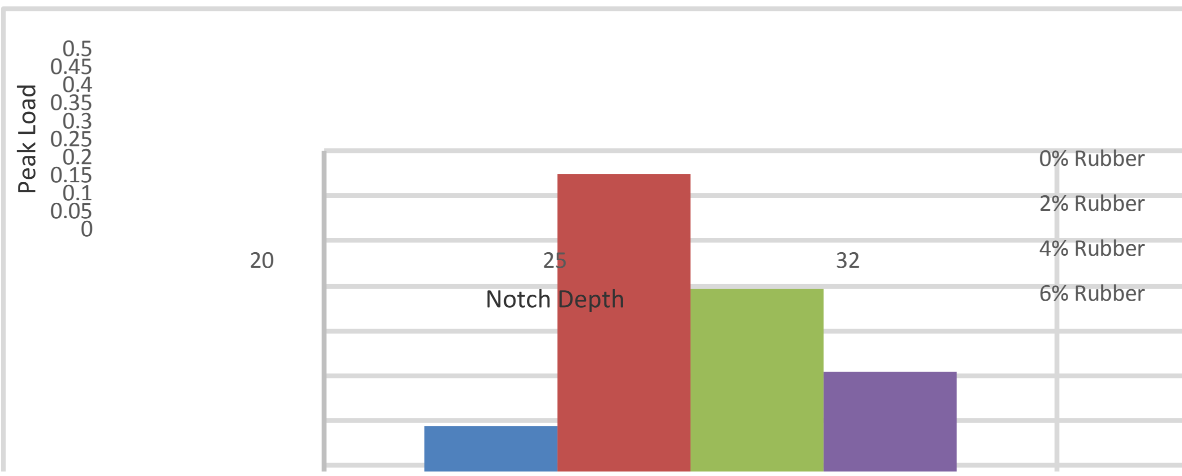


Figure 2. Comparison of Load at Failure vs notch depth of HMA for different % of rubber

COMPARISON OF VERTICAL DEFORMATION AT FAILURE

The Figure shows variations of load at failure for HMA mixes, estimated at 20 mm, 25 mm and 32 mm notch depths for different percentage of Rubber and Plastic. As it can be seen from this figure that at 32 mm notch depth, HMA mixes take a higher deformation for 6% Rubber and Plastic.

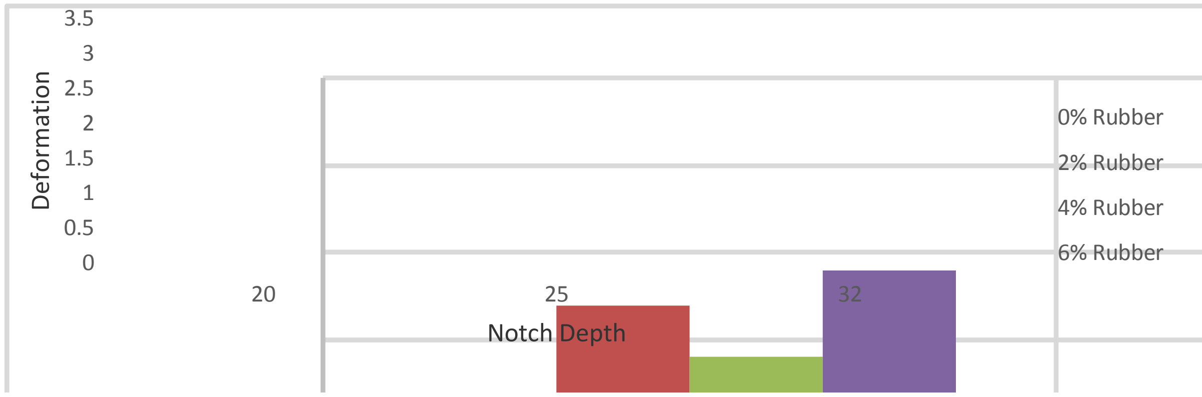


Figure 3.Vertical deformation at Failure vs notch depth of HMA for different % of rubber

COMPARISON OF STRAIN ENERGY AT FAILURE

The Figure 4.23 shows variations of load at failure for HMA mixes, estimated at 20 mm, 25 mm and 32 mm notch depths for different percentage of Rubber. As it can be seen from this figure that at 20 mm notch depth, HMA mixes take a higher load for 6%Rubber.

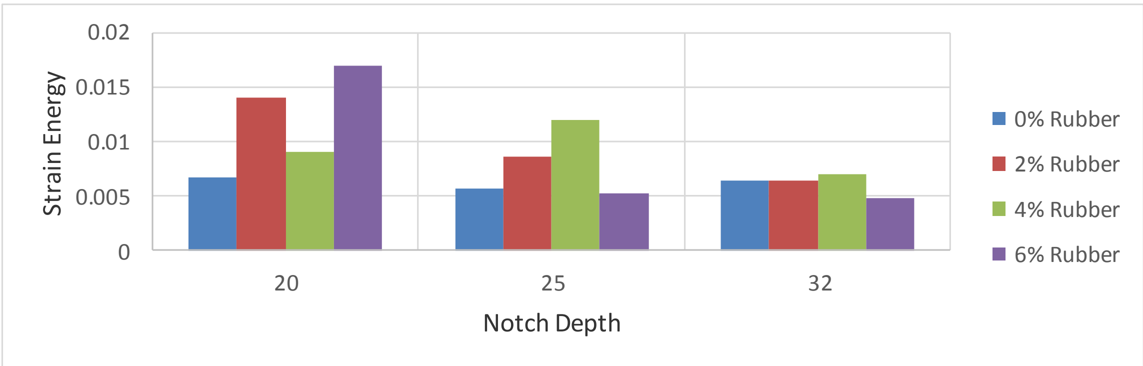


Figure 4. Strain Energy at Failure vs notch depth of HMA and WMA mixes

The Figure shows comparison of Critical Energy Release Rate- J_c for HMA mixes for different percentage of Rubber. It can be seen from this graph that J_c values for HMA mixes for 2% of rubber.. The results show that HMA mixes of 2% rubber are stronger and more fracture resistance compared to HMA mixes containing other percentages of Rubber.

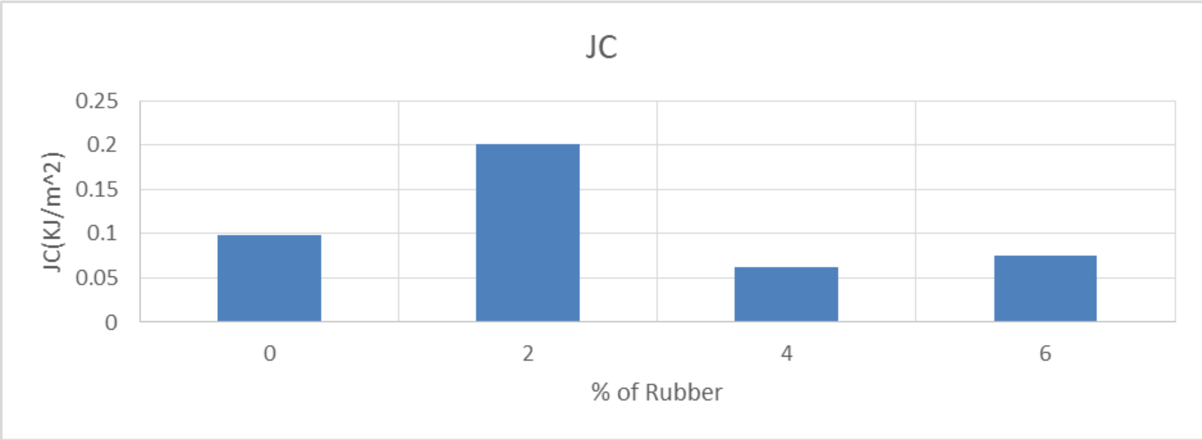


Figure 5. jc vs % of rubber

CONCLUSION

- Expansion of waste rubber tyre powder in bituminous mix changes the flexibility of surface layer and covering of low density polyethylene improves the quality of binding between bitumen and aggregate.
- It reduced the long term deformation and cracking in high temperature area.
- Rubber is a good sound absorbing material, so it decrease the noise pollution in heavy traffic areas
- standard sand can be reduced to the certain amounts.
- The waste rubber tyre is utilized in road construction, so improves the life span of the road.

REFERENCES

[1]. Rokade S. "Use of Waste Plastic and Waste Rubber Tyres in Flexible Highway Pavements," 2012 International Conference on Future Environment and Energy(IPCBEE), vol.28(2012), IACSIT press, Singapore.

[2]. M Naskar. "effect of waste plastic as a modifier on thermal stability and degradation kinetics of bitumen/waste plastic blend".Thermo chimica Acta 509,pp 128-134,2010

[3]. T Awwad Mohammad, "Use of Polyethylene in Hot Asphalt Mixtures"American Journal of Applied Sciences,pp-390-396,2007

[4]. Abhaykumar.S.W,Mudassi.D.W(2013), "Use of Plastic Waste and Waste Rubber in Aggregate and Bitumen for Road Materials" International Journal of Emerging Technology and Advanced Engineering,Volume 3,Issue 7,PP-301.

[5]. Apurva J C,(2013), "Use of Plastic Waste in Flexible Pavements",International Journal Of Application or Innovation In Engineering,vol 2, Issue 4,PP.540-552.

[6]. S. Shankar and C.S.R.K. Prasad, "Evaluation of Rutting Potential for Crumb Rubber Modified Bitumen in Asphaltic Mixes," Emirates Journal for Engineering Research, pp.91-95, 14(2), 2009.

[7]. S.K.Palit,K.SudhakarReddy,B.B.Pandey. 'Laboratory evaluation of crumb rubber modified asphalt mixes' journal of materials in civil engineering © asce / january/february 2004 doi: 10.1061/asce/0899-1561/2004/16:1/45

[8]. Nuha S. Mashaan, Asim Hassan Ali, Mohamed RehanKarim and MahrezAbdelaziz. "Effect of blending time and crumb rubber content on compacting-properties of crumb rubber modified asphalt binder" international journal of the physical sciences doi: vol. 6(9), pp. 2189-2193, 4 may, 2011.

[9]. F.A.Aisen, F.K.Hymore and R.O.Ebewele. "Application of ground tyre rubbers in asphalt concrete pavements" Indian journal of engineering and materials sciences doi: vol 13, august 2006, pg 333-338