Utilization of Scrap Tyre as Resource for Flexible Road Pavement

Samir Barge[1], Kiran Mane[2], Vaibhav Takawane[3], Sanjay Avhad[4], Nikhil Yokar[5]

[1,2,3,4]*Student, Department of Civil Engineering, Dr. D. Y. Patil Inst. of Tech., Pimpri, India*

[5]*Assistant Professor, Department of Civil Engineering, Dr. D. Y. Patil Inst. of Tech., Pimpri, India*

***Abstract*—Use of four wheeler, two wheeler vehicles etc. is increasing day by day. It is estimated that about 60 per cent of waste tyres are disposed via unknown routes in the urban as well as rural areas. The increase of waste tyre disposal is a serious problem that leads to environmental pollution. It can be used as a cheap and environmental friendly modification process to minimize the damage of pavement. Use of crumb rubber helps to excellent pavement life, driving comfort and low maintenance. Therefore, it is necessary to replacing the bitumen with the same percentage as 7, 9, 11, 13, and 15 and carried out the different test on bitumen to analyze or comparing the normal and rubber pavement and rubber is cheaper than bitumen.**

Index Terms— Aggregate, Crumb Rubber, Modified Bitumen, Pavement

I. INTRODUCTION

A country like India an efficient road network is necessary for national integration, industrial development and as well as for socio-economic development and about 0.6 million tonne of scrap tyre are generated annually5. Day by day with the increase in number of automobiles in India during recent years. Due to wear and tear of tires the life of tire reduces and at last it becomes useless. The disposal of these tires has become a serious problem. These tires are disposed easily by either burning or by dumping. Disposal by burning cause's air pollution and dumping causes valuable land to be wasted for stacking up the tires, Whole tyres are difficult to landfill 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 environmental issues. The main constituent of tyre is rubber and the largest single application of rubber is vehicle tyres. Also, the requirement of tyre is directly related to growth of automobile.

Hence it is required to dispose these tires safely and economically. Hence, the modification of bitumen to meet the required performance standards of the pavement appears to be logical & economical approach. Hence use of crumb-rubber in bitumen modification helps in achieving better performance of wearing courses.

This paper is intended to study the feasibility of the waste tire rubber as a blending material in bitumen, which is used for road construction. Replacing bitumen by waste crumb rubber to give proper strength by taken various test like Penetration test, Ductility test, Marshal Stability and flash and Fire point Test.

II. METHODOLOGY

1) Waste rubber tyres were collected from roads sides, dumpsites and waste-buyers.

2) The waste tyres were cut in the form of various sizes ranging from 600 microns to 100-micron size in the tyre cutting machine.

3) The crumb rubber is sieved through 300 microns and retain on 150 microns and add with bitumen.

4) It was cleaned by de-dusting or washing if required. These rubber particles were mixed with bitumen in 7, 9, 11, 13 and 15% by weight of bitumen at temperature between 160°c to 170°c for proper mixing of bituminous mix.

5) Also, we have conducted a different test on bitumen. Bitumen are replacing with rubber in percentage after conducting all the tests we are making two sample one is normal and other is rubber mixed and comparing on different basis.

III. MATERIALS

1) Bitumen:

Bituminous materials or asphalts are extensively used for roadway construction, primarily because of their excellent binding characteristics and water proofing properties and relatively low cost. Bituminous materials consist of bitumen which is a black or dark coloured solid or viscous cementitious substances consists chiefly high molecular weight hydrocarbons derived from distillation of petroleum or natural asphalt, has adhesive properties, and is soluble in carbon disulphide. Tars are residues from the destructive distillation of organic substances such as coal, wood, or petroleum and are temperature sensitive than bitumen. Bitumen will be dissolved in petroleum oils where unlike tar. The desirable properties of bitumen depend on the mix type and construction.

Fig. 1. Bitumen

2) Crumb Rubber:

Crumb rubber is a term usually applied to recycled rubber from automotive and truck scrap tires. During the recycling process steel and fluff is removed leaving

tire rubber with a granular consistency. From physical and chemical interaction of crumb rubber with conventional bitumen Crumb Rubber Modified Bitumen (CRMB) is made.

Fig. 2. Crumb Rubber

IV. Tests and Results

1) Penetration test:

Objective: To determine the penetration value of given bitumen sample.

Fig. 3. Sieving of Sample

Fig. 4. Mixing of Sample

Fig. 5. Test on Penetration Apparatus

TABLE I
Observation: Percentage Replace Bitumen (Sample)

S. No.	Sample	Penetration Value			Mean Value
		Initial	Final	Diff.	
Observation: 7% Replace Bitumen					
1.	60/70	120	184	64	59.33
		95	154	59	
		164	219	55	
Observation: 9% Replace Bitumen					
2.	60/70	63	124	61	54.66
		124	178	54	
		212	261	49	
Observation: 11% Replace Bitumen					
3.	60/70	112	165	53	49
		144	194	50	
		186	230	44	
Observation: 13% Replace Bitumen					
4.	60/70	209	253	44	43
		207	250	43	
		253	295	42	
Observation: 15% Replace Bitumen					
5.	60/70	208	248	40	36.33
		149	187	38	
		114	145	31	

2) Ductility test:

Objective: To determine ductility of given sample.

Fig. 6. Sample filling

Fig. 7. During test

Fig. 8. After test

TABLE II
OBSERVATION: PERCENTAGE OF REPLACE BITUMEN (TEST PROPERTY)

Observation : 7% Replace Bitumen				
Test Property	**Briquette**			**Mean Value**
Ductility test (cm)@ 27^0C, 5 cm/min	60	62	63	61.66
Observation : 9% Replace Bitumen				
Ductility test (cm)@ 27^0C, 5 cm/min	61	58	62	60.33
Observation : 11% Replace Bitumen				
Ductility test (cm)@ 27^0C, 5 cm/min	51	57	56	56.67
Observation : 13% Replace Bitumen				
Ductility test (cm)@ 27^0C, 5 cm/min	54	52	52	52.33
Observation : 15% Replace Bitumen				
Ductility test (cm)@ 27^0C, 5 cm/min	51	48	46	48.33

V. CONCLUSION

After studying the test results of common laboratory tests on plain bitumen and crumb rubber modified bitumen it is concluded that: 1) Penetration value of plain bitumen can be improved significantly by modifying it with addition of crumb rubber which is a major environment pollutant. After careful evaluation of the properties and taking various tests as per standards the results shown by 9% addition of rubber crumbs has best suitability for blending it with bitumen. 2) From Ductility test, 10% addition of crumb rubber has best suitability for blending it with bitumen.

VI. FUTURE SCOPE

To get more precise results to make comments about replacement of bitumen by crumbled rubber. Conduction of the marshal stability test, fire flash point and field test can be performed to judge the performance precisely.

ACKNOWLEDGMENT

Author want to acknowledge Principle, Head of Department and Guide of the project for all the support and help rendered. To express profound feeling of appreciation to their regarded guidance for giving the motivation required to the finishing of paper.

REFERENCES

[1] S. K. Khanna and C.G. Justo, "Highway Engineering," 8th edition, Nemchand & Bros., pp. 304.
[2] P. P. Waychal and P. Sagar, "Construction of Flexible Road Pavement by using Waste Rubber Tyre", *International Engineering Research Journal*, vol. 2, no. 3, 2016.
[3] K. N. Kumar and H. N. Rajakumara, "Study of Using Waste Rubber Tyres in Construction of Bituminous Road," *International Journal of Scientific & Engineering Research*, vol. 7, no. 5, pp. 23-27, May 2016.
[4] N. R. Magar, "A Study on the Performance of Crumb Rubber Modified Bitumen by Varying the Sizes of Crumb Rubber, *International Journal of Engineering Trends and Technology*, vol. 14, no. 2, pp. 51-56, August 2014.
[5] M. Priyanka, P. Deepak and S. M. Bhosale, "Laboratory Evaluation of Usage of Waste Tyre Rubber in Bituminous Concrete," *International journal of Scientific and Research Publication*, vol. 3, no. 9, pp. 1-7, September 2013.
[6] R. Mandal, M. Singhal and Y. Yadav, "Use of Modified Bitumen in Highway Construction," *International Journal for Innovative Research in Science & Technology*, vol. 2, no. 2, pp. 376-382, May 2016.
[7] N. D. Baraiya, "Use of Waste Rubber Tyres in Construction of Bituminous Road – An Overview," *International Journal of Application or Innovation in Engineering & Management*, vol. 2, no. 7, pp. 108-110, July 2013.
[8] IS 1203-1978 Penetration test
[9] IS 1208-1978 Ductility test