INVESTIGATION OF BITUMINOUS PROPERTIES BY ADDING WASTE TYRE RUBBER IN BITUMEN

Mr.Deepak Ganesh Petkar[1] (Mtech EnvSci&Tech)
Prof.S.M.Bhosale.[2] Asst.Professor in Department of Technology,Shivaji University Kolhapur

Abstract— Development of this country has lead to construction of new roads, and the rising population has raised the vehicular density drastically. These vehicles produce large number of worn out and scrap tyres. A large number of waste and worn out tyres are already in existence and with an annual generation rate of 20-25% each year. These tyres are discarded indiscriminately or stockpiled. The used tyres pose a great threat to human health and environment, since they are non-biodegradable; the waste tyre rubber has become a problem of disposal. This paper is intended to study the feasibility of the waste tyre rubber as a blending material in bitumen, which is used for road construction. If Waste or used tyre rubber can be added in bitumen for improving the properties, and disposing off the tyres, thus the environmental gains can be achieved..

***Keywords*— Waste tyre rubber, Blended bitumen, Marshall Stability Test.**

INTRODUCTION

For a country like India an efficient road network is necessary for national integration, industrial development and as well as for socio-economic development. Due to improvement in living standards of the people, the use of vehicles has increased over a last few years, giving rise in the vehicular density on roads. As vehicles are used frequently the wear and tear of their tyres is obvious. Due to wear and tear of tyres the life of tyre reduces and at last it becomes useless. The disposal of these tyres has become a serious problem. These tyres are disposed easily by either burning or by dumping. Disposal by burning causes air pollution and dumping causes valuable land

So an attempt to use this waste tyre rubber for improving the properties of bitumen by blending it with crumb rubber and ultimately a new method to be introduced to reduce pollution problems and protect our environment.

However, with the use of waste tyre rubber in bitumen, it will definitely be environmentally beneficial, it can improve the bitumen binder properties and durability, and it will also have a potential to be cost effective.

Conventional bituminous materials have been used satisfactorily in most highway pavement Environmental factors such as temperature, air, and water can have a profound effect on durability of these pavements. The ideal bitumen should be strong enough, at optimum temperatures, to withstand rutting or permanent deformation, and soft enough to avoid excessive thermal stresses, at low pavement temperatures, and fatigue, at moderate temperatures. After adding the waste tyre rubber in bitumen the properties of the bitumen will be checked.

As disposal of waste tyres has become a worldwide problem and has caused worry to administrators, researchers and environmentalists. This paper is intended to study the feasibility of the waste tyre rubber as a blending material in bitumen, which is used for road construction. The Waste tyre rubber appears to possess the potential to be partially added in bitumen, providing a recycling opportunity. If Waste or used tyre rubber can be added in bitumen for improving the properties, and disposing off the tyres, thus the environmental gains can be achieved.

METHODOLOGY

Preparation of different mixes of bitumen and waste tyre rubber with varying proportions. Testing of these mixes for various tests to check the feasibility of mixing the waste tyre rubber with bitumen capacity

REUSULTS AND DISCUSSIONS

Table 1:Marshall Stability Readings

%of rubber	Wt. of sample (gm)		Bulk specific gravity (g/cc)	% air voids (Vv)	VMA	VFB	Marshall stability (kg)	Flow value (mm)
	Air	water						
0	1257	773	2.56	4.12	15.49	73.40	1190.56	3.3
5	1274	787	2.58	4.08	14.13	71.12	1051	3.0
10	1278	798	2.60	4.41	14.05	68.64	912.8	2.9
15	1269	790	2.63	4.36	12.64	65.30	843.8	3.6
20	1284	791	2.60	5.10	12.73	58.00	715.9	2.7
25	1270	789	2.63	5.05	10.81	53.28	652.9	2.9
30	1268	793	2.64	6.06	11.43	46.98	550.6	2.6

Table 2 : Details of sample constitution and percent constituents

Sample constitution	Sample preparation	% constituent by wt. of bitumen
60/70 grade bitumen + 0.2-1 mm particle size of crumb rubber	Wet process	5%
		10%
		15%
		20%
		25%
		30%

Table 3: physical properties of aggregate & filler used

Sieved size mm	Specific gravity	Water absorption
40-19	2.68	0.93
19-13	2.65	0.75
13-6	2.63	0.68
6-0	2.62	----

Table 4: physical properties of ground waste tyre rubber

Type of material	DBM
Grade of bitumen	UG-30
Specific gravity of asphalt (Gb)	1.036
Percentage of bitumen (Pb)	4.6

Properties	Measured value
Specific gravity	0.94
Unit weight g/cm^3	0.69
Absorption %	1.8
Fineness modulus	3.78

Table 5: Properties of bitumen

Table 6 : Marshall mix design criteria for bituminous concrete

Test property	Specified values
Marshall stability (kg)	340 minimum
Flow value 0.25 mm units	8 to 16
Air voids in total mix Vv%	3 to 5
Voids filled with bitumen VFB%	75 to 85
Compaction level (number of blows)	75 blows on each of the two faces of specimen

Table 7: physical properties of 60/70 bitumen with tyre dust particle size 0.2 to 1m for varying concentration

Properties	60/70 grade bitumn	Bitumen with rubber content %					
		5	10	15	20	25	30
Penetration value @ 25^{0}C, 5 S, 100 gm	65.6	59.3	56.3	45.6	35.3	27.2	21.6
Softening Point(^{0}C) @ ring ball test	57	62	62	65	72.5	77.5	83
Ductility test (cms) @ 27 ^{0}C, 5 cm/min	73	61	55	41.6	21.8	14.3	12.7
Viscosity test @ 27 ^{0}C(sec)	26	22.5	20	17	15.5	11.5	9
Specific Gravity	1.036	1.180	1.24	1.46	1.70	2.0	2.26

Overview of blended Bitumen

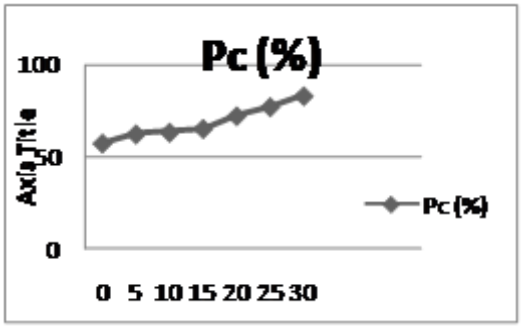
A) Softening point test

IRC Recommendation for modified blended bitumen

Grade of Bitumen	Specified value
60/70	Above 60^{0}C.

Conclusion: The values of softening point of bitumen are consistent for all rubber percentage reading.

Graph 1-X axis Rubber Percentage in Bitumen Vs Y axis Softening Point



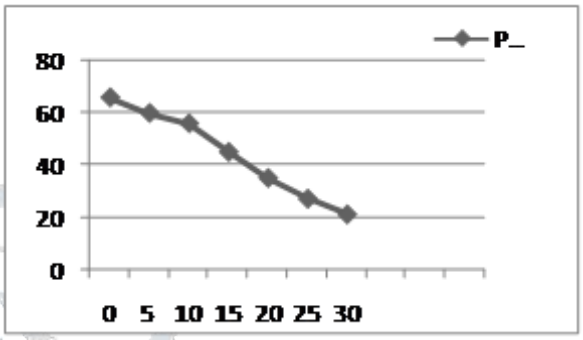
B) Penetration test

IRC Recommendation for modified blended bitumen

Grade of Bitumen	Specified value
60/70	Above 50

The values of penetration of bitumen are consistent up to 10% of addition of rubber.

Graph 2- X axis Rubber Percentage in Bitumen Vs Y axis Penetration Values



C) Ductility test

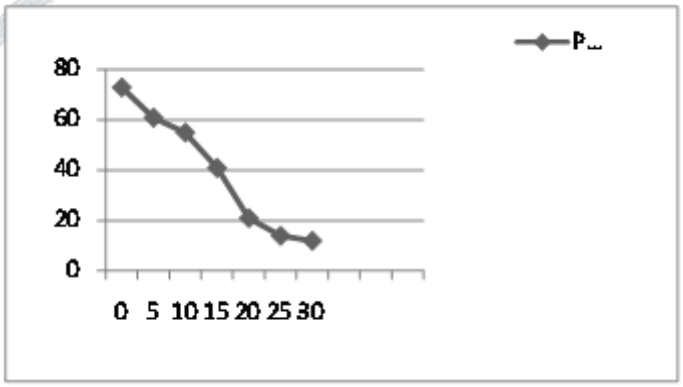
IRC Recommendation for modified blended bitumen

Grade of Bitumen	Specified value
60/70	Above 50 cm.

Conclusion:

The values of ductility of bitumen are consistent up to 10% of addition of rubber.

Graph 3- X axis Rubber Percentage in Bitumen Vs Y axis Ductility values



D) Viscosity test

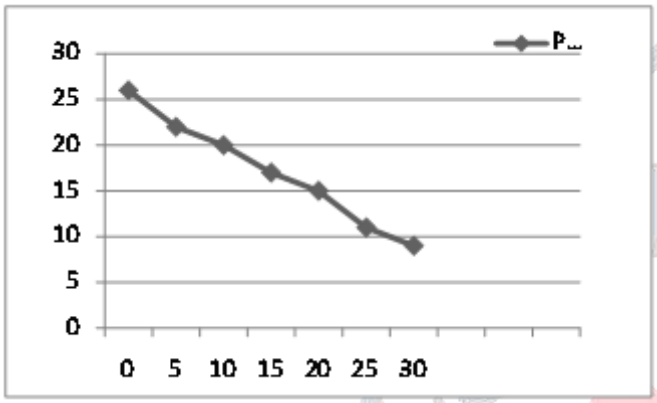
IRC Recommendation for modified blended bitumen

Grade of Bitumen	Specified value
60/70	Above 50

Conclusion:

The values of viscosity of bitumen are consistent up to 10% of addition of rubber.

Graph 4- X axis Rubber Percentage in Bitumen Vs Y axis Viscosity values



E) Marshall stability test

IRC Recommendation for modified blended bitumen

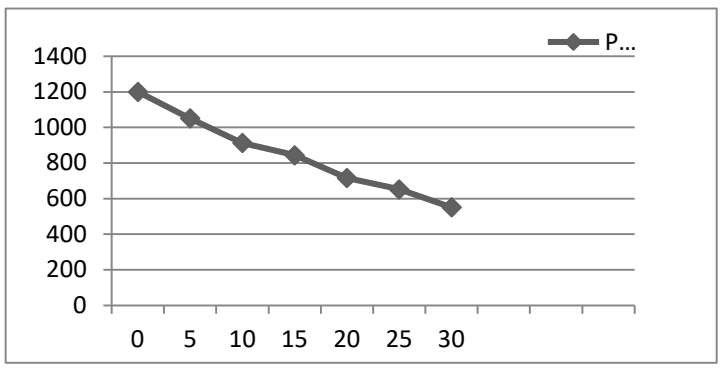
Bitumen Grade – 60/70

Test property	Specified value
Marshall Stability kg.	340 (minimum)
Flow value (mm)	2.5 – 4
Air voids in total mix Vv %	3 to 5
Voids filled with bitumen VFB %	65 to 85

Conclusion:

1) The values of Marshall Stability are consistent for all rubber percentage reading.

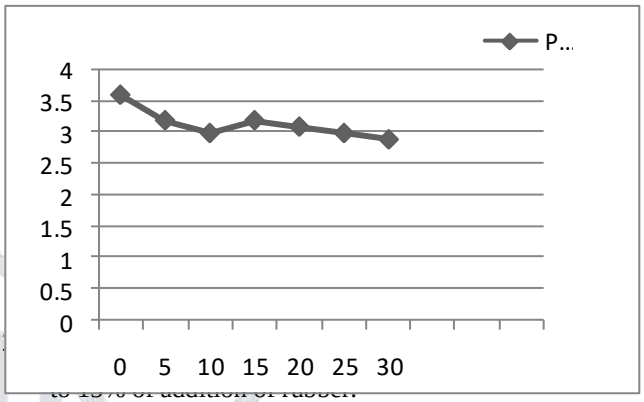
Graph 5- X axis Rubber Percentage in Bitumen Vs Y axis Marshall Stability values



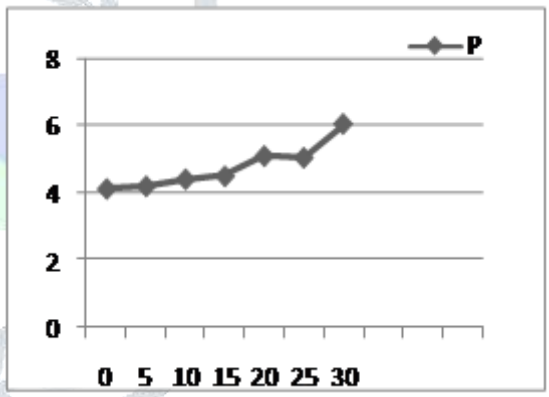
Conclusion:

2) The values of flow value are consistent for all rubber percentage reading.

Graph 6- X axis Rubber Percentage in Bitumen Vs Y axis Flow values

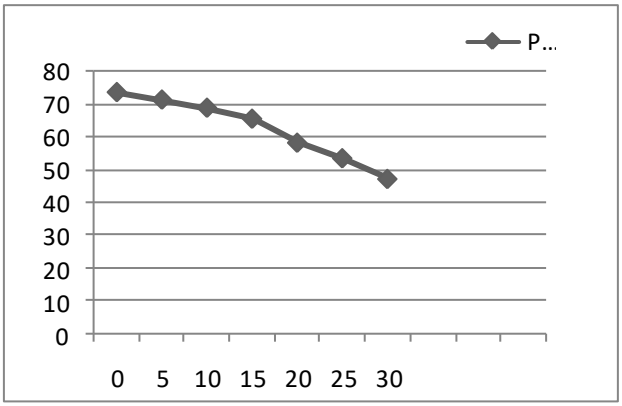


Graph 7- X axis Rubber Percentage in Bitumen Vs Y axis Air voids values



3) The values of voids filled with bitumen are consistent up to 10 % of addition of rubber.

Graph 8- X axis Rubber Percentage in Bitumen Vs Y axis Air voids Filled values



CONCLUSIONS

After careful evaluation of the properties and taking various tests as per standards the results shown by 10% to 12% addition of rubber of waste tyres has best suitability for blending it with bitumen.

This will help to dispose the waste tyre rubber and reduce the environmental pollution up to a certain limit.

REFERENCES

I. S.K.Palit,K.Sudhakar Reddy,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

II. Nuha S. Mashaan, Asim Hassan Ali, Mohamed Rehan Karim and Mahrez Abdelaziz. "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.

III. 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.

IV. M.M. Balaha, A.A. Badawy and M. Hashish. "Effect Of Using Ground Waste Tyre Rubber As Fine Aggregate On The Behaviour of Concrete Mixes" INDIAN JOURNAL OF ENGINEERING AND MATERIALS SCIENCES DOI: Vol 14, Dec 2007,pg 427-435.

V. Dr. M. Satyakumar and Surya S. Nair "Reusability of Waste Tyres as an Additive in Binder for Flexible Pavement Construction", National Technological Congress, Kerala – 2011 DOI: College of Engineering Trivandrum, January 28-29, 2011.

VI. Baha Vural Kok,Hakan Colak. "Laboratory comparison of the crumb rubber and SBS modified bitumen and hot mix asphalt", Construction And Building Materials.25(2011) 3204-3212 DOI: 29 march 2011.

VII. Yue Huang, Roger N.Bird, Oliver Heidrich. "A review of the use of recycled solid waste materials in asphalt pavements". Resources, Conservation and Recycling 52 (2007) 58–73.

VIII. Nuha S. Mashaan*, Asim Hassan Ali, Mohamed Rehan Karim and Mahrez Abdelaziz "An overview of crumb rubber modified asphalt". International Journal of the Physical Sciences Vol. 7(2), pp. 166 - 170, 9 January, 2012.

IX. Nuha S. Mashaan*, Asim H. Ali, Mohamed Rehan Karim and Mahrez Abdelaziz "Effect of crumb rubber concentration on the physical and rheological properties of rubberised bitumen binders". International Journal of the Physical Sciences Vol. 6(4), pp. 684-690, 18 February, 2011.

X. Gary Anderton, "Physical Properties and Aging Properties". DEPARTMENT OF THE ARMY WATERWAYS EXPERIMENT STATION CORPS OF ENGINEERS. Construction productivity advancement research program.,

XI. Prof Prithvi Singh Khandal "Quality Control Requirements For Using Crumb Rubber Modified Bitumen (Crmb) In Bituminous Mixtures". Indian Roads Congress, Indian Highways, 31Aug 2006.

XII. A. Ramalinga Chandra Seka B. Sundarakannan1 R. Vasudevan, S.K. Nigam, R. Velkennedy **"**Utilization of Waste Polymers for Flexible Pavement Easy and Disposal of Waste Polymers". Proceedings of the International Conference on Sustainable Solid Waste Management.Sep 5/2005 pg 105-111.