

“Laboratory Evaluation of Usage of Waste Tyre Rubber in Bituminous Concrete”

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Abstract- Due to overall development, new roads is being constructed, and the ever increasing population has raised the vehicular density from last few decades. The wear and tear of tires from these vehicles is undoubted. So a large number of scrap tires are being generated. A large number of waste and worn out tires are already in existence and with an annual generation rate of 15-20% each year. These tires are discarded indiscriminately or stockpiled. The used tires pose a great threat to human health and environment, since they are non-biodegradable;the waste tire rubber has become a problem of disposal.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. The Waste tire rubber appears to possess the potential to be partially added in bitumen, providing a recycling opportunity. If Waste or used tire rubber can be added in bitumen for improving the properties, and disposing off the tires, thus the environmental gains can be achieved.

Index Terms- Waste tire rubber, Blended bitumen, Marshall Stability Test.

I. 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 tires is obvious. 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 causes air pollution and dumping causes valuable land to be wasted for stacking up the tires. So it is required to dispose these tires safely and economically.

So an attempt to use this waste tire 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 tire 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 tire rubber in bitumen the properties of the bitumen will be checked.

As disposal of waste tires 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 tire rubber as a blending material in bitumen, which is used for road construction. The Waste tire rubber appears to possess the potential to be partially added in bitumen, providing a recycling opportunity. If Waste or used tire rubber can be added in bitumen for improving the properties, and disposing off the tires, thus the environmental gains can be achieved.

II. METHODOLOGY

For this research work aggregate, bitumen and crumb of scrap tyre was used. Different properties of bitumen and aggregate have been tested. Then prepare different mixes of bitumen and crumb of waste tire rubber with varying proportions by using wet process. The percentage weight of crumb tyre rubber replace for percentage weight of bitumen taken for test. The feasibility of different mixes of bitumen and crumb tire rubber with varying proportions with aggregate has been tested.

III. RESULTS

Marshall Stability test has been preparing for bituminous mix design, for this research project the size of aggregate used as follows:

Table No. 1: Mix Proportion

Material	Sieve size mm	Wt. in kg.
Aggregate	40 – 19	74.10 gm.
	19 – 13	347.1 gm.
	13 – 6	260.00 gm.
	6 – 0	559.00 gm.
Bitumen		59.8 gm.
	Total	1300 gm.

Table No. 2: Physical properties of aggregate & filler used

Sr. No	Aggregate tests	Test results obtained
1	Crushing value (%)	24.8

2	Impact value (%)	20.8			
3	Los Angeles abrasion value (%)	32			
	Sieved size mm	40-19	19-13	13-6	6-0
4	Specific gravity	2.68	2.65	2.63	2.62
5	Water absorption	0.93	0.75	0.68	-----

Table No.3: Physical properties of ground waste tire rubber

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

Table No. 4: The properties of the bitumen without rubber content

Sr. No.	Penetration test @27 ⁰ C, 5S,100gm	Softening point @ ring ball test	Ductility(cms) @27 ⁰ C, 5cm/ min	Viscosity (sec) @ Viscometer by ball stopper	Specific gravity Reading (G)
1.	60-70 grade	60 ⁰ C	73	26	1.036

Table No. 5: 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 No. 6: Marshall Stability Readings

Table No. 7: Properties of bitumen by varying % of rubber

Properties	60/70 grade bitumen	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

- **Marshall stability test**

IRC Recommendation for modified blended bitumen

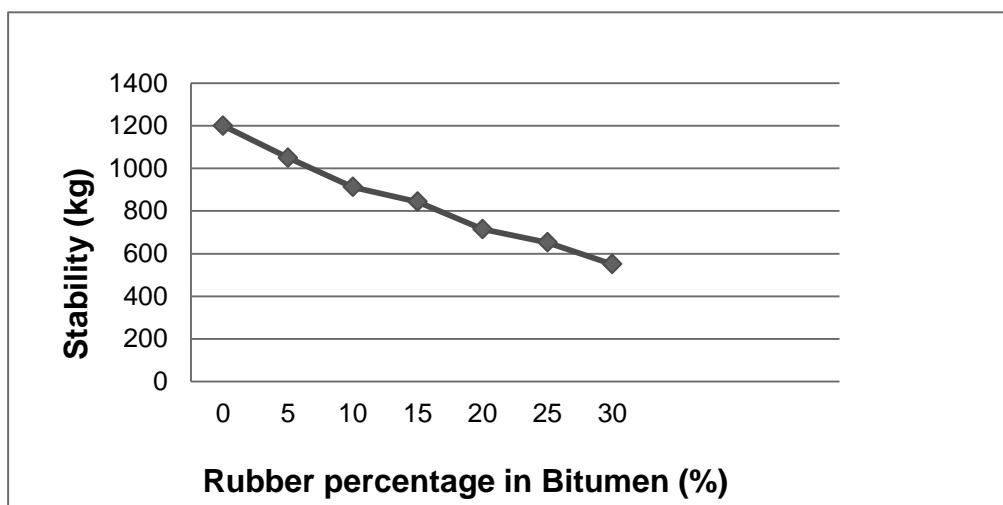
%of rubber	Wt. of sample (gm)		Bulk specific gravity (g/cc)	% air voids (Vv)	VMA	VFB	Marshall stability (kg)	Flow value (mm)
	Air	water						
0	1257	773	2.56	4.12	15.49	73.40	1190.56	3.3
5	1274	787	2.58	4.08	14.13	71.12	1051	3.0
10	1278	798	2.60	4.41	14.05	68.64	912.8	2.9
15	1269	790	2.63	4.36	12.64	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

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

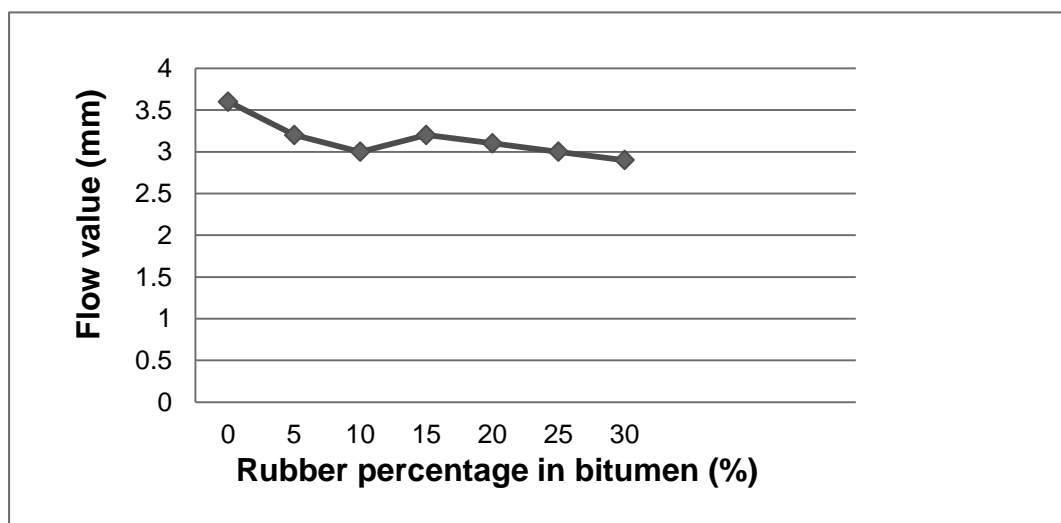
IV. CONCLUSION

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



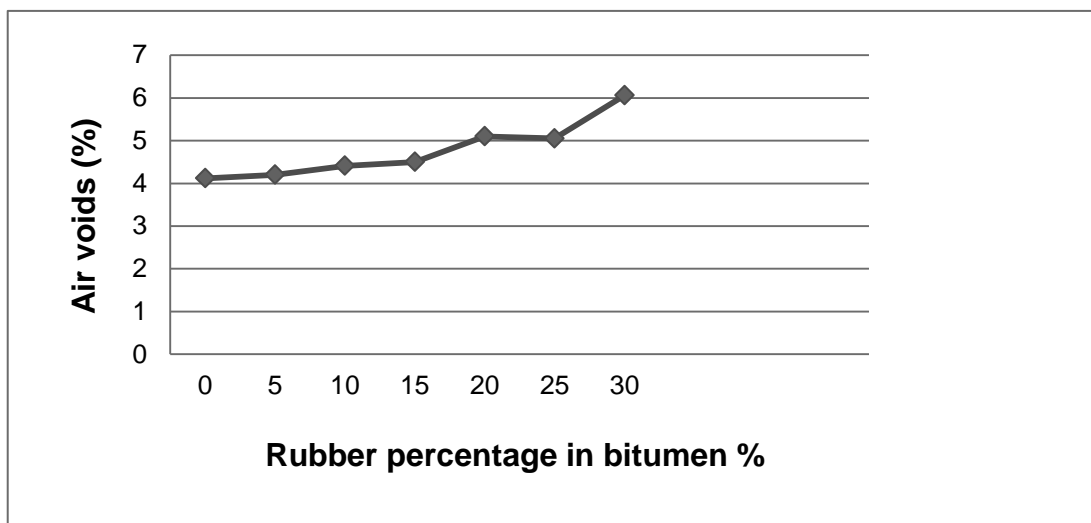
Graph No.1 Percentage of Rubber in Bituminous Concrete Vs Marshall Stability

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



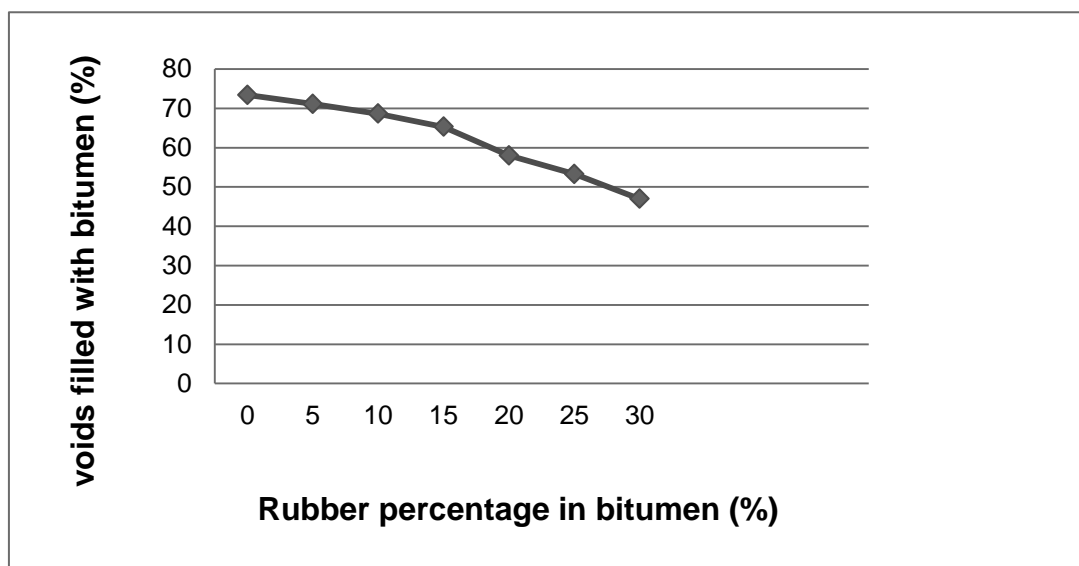
Graph No.2: Percentage of Rubber in Bituminous Concrete Vs flow value

3) The values of air voids in total mix are consistent up to 15% of addition of rubber.



Graph No.3: Percentage of Rubber in Bituminous Concrete Vs Air Voids(Vv)

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



Graph No.4 Percentage of Rubber in Bituminous Concrete Vs voids filled with bitumen (VFB)

V. FINAL CONCLUSIONS

After careful evaluation of the properties and taking various tests as per standards the results shown by 10% addition of rubber crumbs has best suitability for blending it with bitumen. This will help to dispose the waste tire rubber in a proper way and solve the problem of environmental concerns up to a certain extent.

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