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Laboratory Analysis of Crumb Rubber Mixed With Bitumen on Asphalt Road

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ABSTRACT

India has a wide road network of more than 3 million km is one of the largest in the world. For the development of Indian infrastructure and industrial growth the fast transportation is necessary as well as wide road network is also necessary. Due to fast transportation the vehicles used for transportation is increased due to this use of vehicles the wear and tear of tyres is occurring. For high use of tyres it becomes useless and discarded. These useless tyres are disposed by burning or landfilling, due to these processes the burning causes the environmental pollution and landfill causes the valuable land wastages. To avoid or minimizes this pollution the new method is to be used to recycles this tyres and to overcome this problem. So the use of waste tyre rubber mixed with bitumen and enhances the properties of bitumen as well as achieving the economy in bitumen.

Keywords : Crumb rubber, Asphalt, Bitumen, Marshall Stability test, Crumb rubber modifier (CRM).

I. INTRODUCTION

1.1 General Information

Emerging economies need a proper transportation system, of which roadways are a crucial fragment. The construction and maintenance of road pavements should be long enduring due to their extensive influence on the economy of a nation. The increase in overall traffic, poor material quality and climatic effects are Prime reasons of the damaged conditions of roads. Recycled tyre rubber constitutes Vulcanized natural and synthetic rubber which is highly valuable. Therefore, beyond the conventional components of the bituminous pavement layers, the use of crumb rubber recycled from used tires should be studied as a form of environmental stewardship and as a pavement performance enhancer. It will be substitute way of solid waste disposal.

Over the years, road structures have deteriorated more promptly due to increasing in service traffic density, axle loading, and poor maintenance services. To minimize the damage of pavement surface and increase the durability of flexible pavement, the conventional bitumen needs to be improved with regards to performance related properties, such as resistance to permanent deformation (rutting) and fatigue cracking. The modification of bituminous binder has been explored over the past years in order to improve road pavement performance properties. There are many modification processes and additives that are currently used in bitumen modifications, such as styrene butadiene styrene (SBS), styrene-butadiene rubber (SBR), ethylene vinyl acetate (EVA) and crumb rubber modifier (CRM). The use of commercial polymers, such as SBS and SBR in road and pavement construction will increase the construction cost as they are highly expensive materials. However, with the use of alternative materials, such as CRM, will definitely be environmentally beneficial, and not only it can improve the bitumen binder properties and durability, but it also has a potential to be cost effective.

1.1.1 Aim & Objectives of Study

A planned disposal of waste tyre rubber is quite essential for attaining sustainability and economy.

Objectives of study:-

1. To check the feasibility of the waste tire rubber blended with bitumen.
2. To study the properties of bitumen after blended with waste tyre rubber.
3. To check the safe disposal of waste tyre rubber.

1.2 Bitumen

Crude petroleum obtained from different places has quite a different composition. It varies place to place. Crude petroleum is not pure at the first place. Hence, the petroleum should be dehydrated first before carrying out the distillation. General types of distillation processes are a fractional distillation and destructive distillation. In fractional distillation, the various volatile constituents are separated at successively higher temperatures without substantial chemical change. The successive fractions obtained yield gasoline. Naphtha, kerosene, and lubricating oil; the residue would be petroleum bitumen.

1.3 Crumb rubber

Crumb rubber is a term usually applied to recycled rubber from vehicle waste tires. During the recycled process steel and blub is removed leaving tyre with a granular consistency. The particles are sized and classified based on various certain including colour. The CRM shall be 100% passing 1 mm sieve. The amount of CRM by weight of terminal blend RAC shall be between 10 to 15%.

1.4 Asphalt

Asphalt is a mixture of a bituminous binder with mineral aggregate (stone), sand and filler, typically containing approximately 4-7% bitumen. Asphalt is primarily used for road construction, the properties being dependent upon the type, size and amount of aggregate used in the mixture, all of which are adjusted to provide the required properties for the desired application.

1.5 Marshall stability test

This test covers the measurement of resistance to plastic flow of 102 mm cylindrical specimens of bituminous paving mixture loaded in a direction perpendicular to the cylindrical axis by means of the Marshall apparatus. This test is for use with dense graded bituminous mixtures prepared with asphalt cement (modified and unmodified), cutback asphalt, tar, and tar-rubber with maximum size aggregate up to 25 mm in size (passing 25 mm sieve).

II. METHODS AND MATERIAL

For this research work aggregate, bitumen and crumb of scrap tyre were used. Different properties of bitumen and aggregate have been tested. Then prepared different mixes of bitumen and crumb of waste tire rubber with varying proportions by using the wet process. The percentage weight of crumb tyre rubber replaces for percentage weight of bitumen taken for the test. The feasibility of different mixes of bitumen and crumb tire rubber with varying proportions with aggregate has tested(5).

2.1 Mix proportion

Material	**Sieve size mm**	**Weight 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.

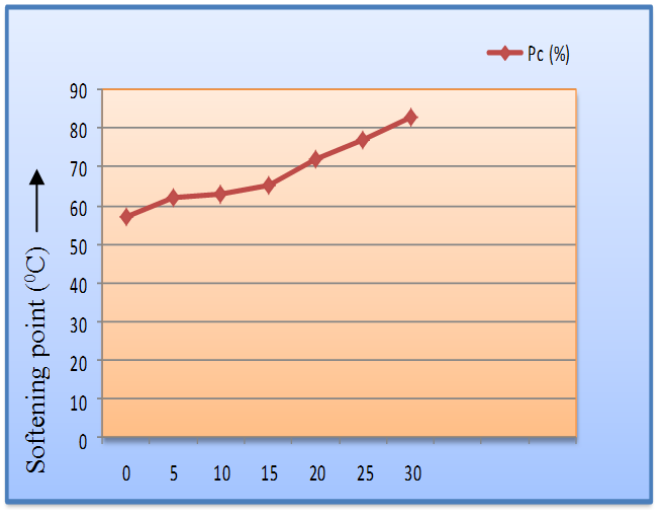
2.2 Physical properties of aggregate & filler used

Sr. no.	**Tests on Aggregate**	**Test result obtained**			
1	Crushing value (%)	24			
2	Impact value	20.7			
3	Los Angeles abrasion value	31.8			
	Sieve size in mm	40-19	19-13	13-6	6-0
4	Specific gravity	2.67	2.64	2.62	2.64
5	Water Absorption	0.92	0.76	0.65	-

III. RESULTS AND DISCUSSION

A) Softening Point Test

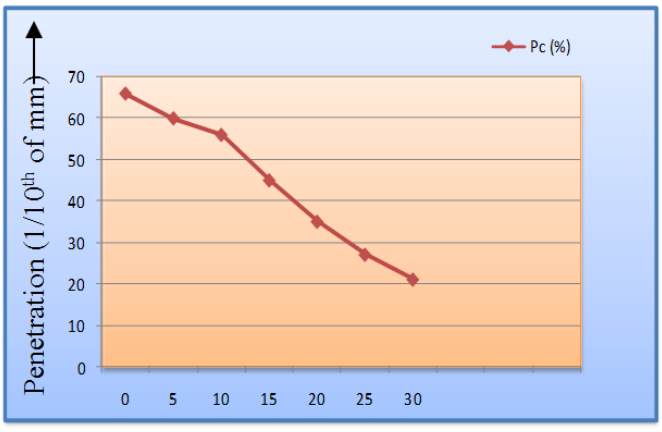
The values of softening point of bitumen are consistent for all rubber percentage reading



Graph No.1: Softening point

B) Penetration Test

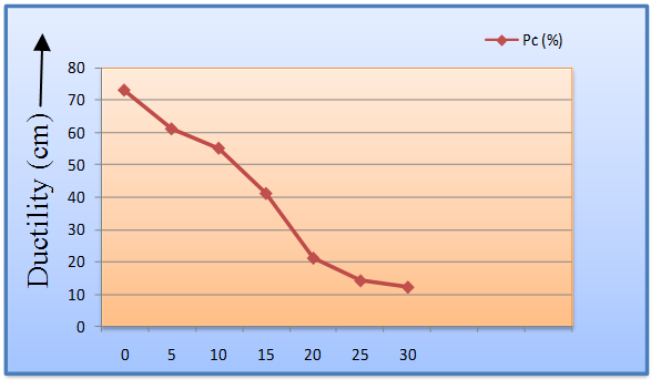
The values of penetration of bitumen are consistent up to 10% of addition of rubber.



Graph No. 2: Penetration

C) Ductility Test

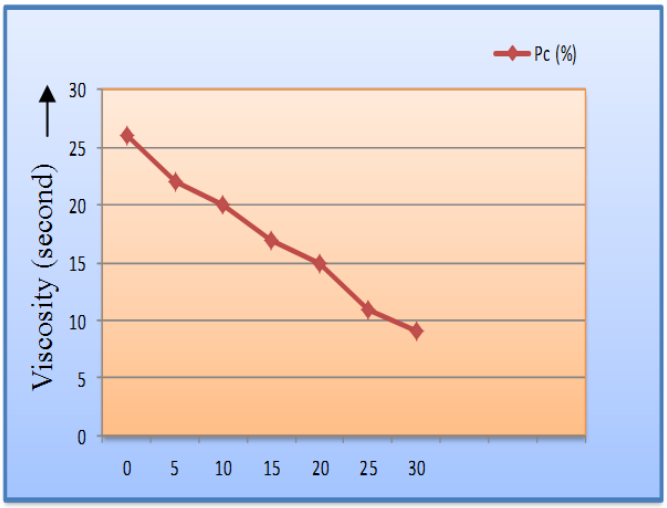
The values of ductility of bitumen are consistent up to 10% of addition of rubber.



Graph No.3: Ductility

D) Viscosity Test

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



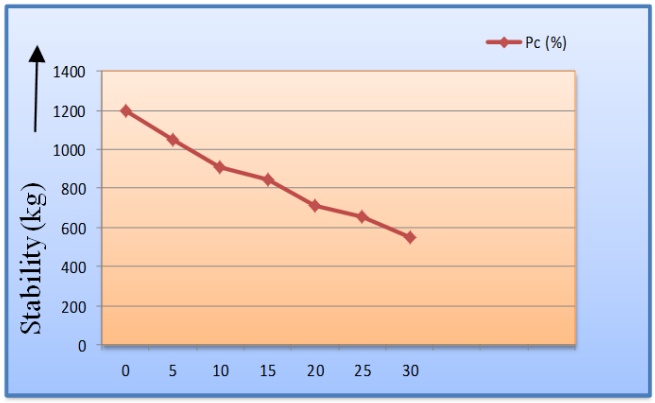
Graph No 4: Viscosity

E) Marshall Stability Test

IRC Recommendation for modified blended bitumen Grade – 60/70

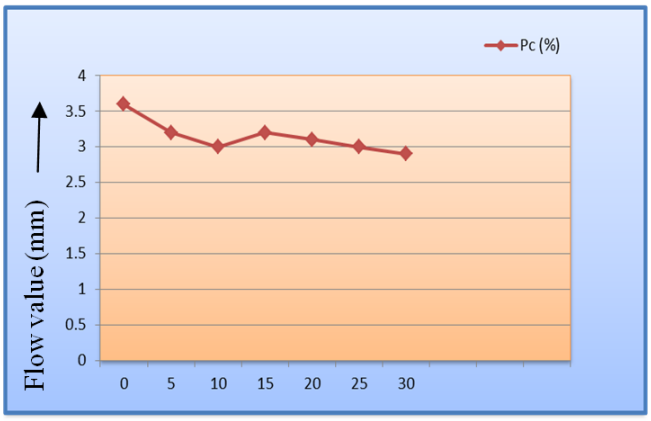
Test property	Specified value
Marshall Stability kg.	340 (minimum)
Flow value (mm)	2.5 – 4
Air voids in total mix Vv %	3 to 5
Voids filled with bitumen VFB %	65 o 85

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



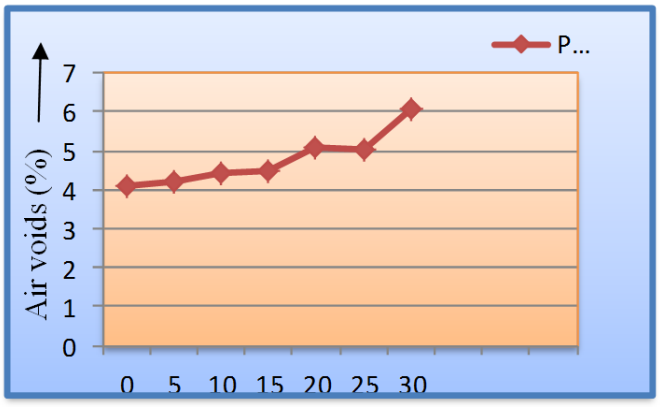
Graph No.5: Marshall Stability (A)

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



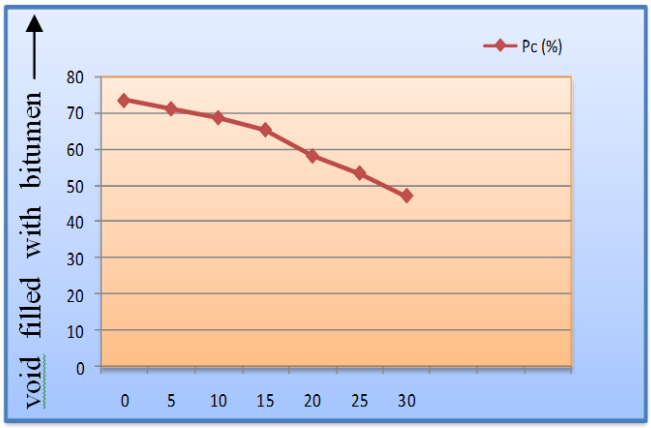
Graph No.6: Marshall Stability (B)

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



Graph No.7: Marshall Stability (C)

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



Graph No.8: Marshall Stability (D)

IV. CONCLUSION

The mixing of crumb rubber to 60/70 grade bitumen. The penetration, ductility, viscosity values are decreases significantly. The values of softening point are increases. The test result shows that 10% addition of rubber gives an optimum result to the certain extent. And as well as it reduces the 10% bitumen cost. The addition of crumb rubber to the bitumen it increases the properties of bitumen binder. And one more benefit of the using crumb rubber mixed with bitumen is to decrease pollution and save the valuable land. And a new method to be introduced.

V. ACKNOWLEDGEMENT

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