

Influence of Crumb Rubber Addition to the Bitumen for Checking Strength Criteria: A Practical Approach

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ABSTRACT: Now-a-days Waste is a major problem and re-using it satisfying the environmental needs is big challenge. Crumb rubber obtained from shredding of those scrap tires has been proven to enhance the properties of plain bitumen since the 1840s. It can be used as a cheap and environmentally friendly modification process to minimize the damage of pavement due to increase in service traffic density, axle loading and low maintenance services which has deteriorated and subjected road structures to failure more rapidly. Use of crumb rubber leads to excellent pavement life, driving comfort and low maintenance. The aim of research is to check the strength criteria of pavement by the addition of Crumb rubber in 5%, 10% and 15 % respectively also checking cost feasibility. Also to focus on using the available waste rubber tyres present in abundant which can be used economically and conveniently. The use of these materials as a road construction proves eco friendly, economical and use of plastic will also give strength in the sub-base course of the pavement. The rheology of CRMB depends on internal factors such as crumb rubber quantity, type, particle size, source and pure bitumen composition, and external factors such as the mixing time, temperature, and also the mixing process (dry process or wet).

KEYWORDS: Crumb rubber, Bitumen, Experimental etc.

I. INTRODUCTION

India has a road network of over 4,689,842 kilometres in 2013, the second largest road network in the world. It has primarily flexible pavement design which constitutes more than 98% of the total road network. India being a very vast country has widely varying climates, terrains, construction materials and mixed traffic conditions both in terms of loads and volumes. Increased traffic factors such as heavier loads, higher traffic volume and higher tyre pressure demand higher performance pavements. So to minimize the damage of pavement surface and increase durability of flexible pavement, the conventional bitumen needs to be improved. Bitumen is used as binder material for construction of roads and pavements for several years. The demand of bitumen has increased because of rapid urbanization. Crumb-rubber the ideal modifier can prove to be economical as compared to conventional bitumen. The use of crumb-rubber and fly-ash in bitumen modification is helpful to get better performance.

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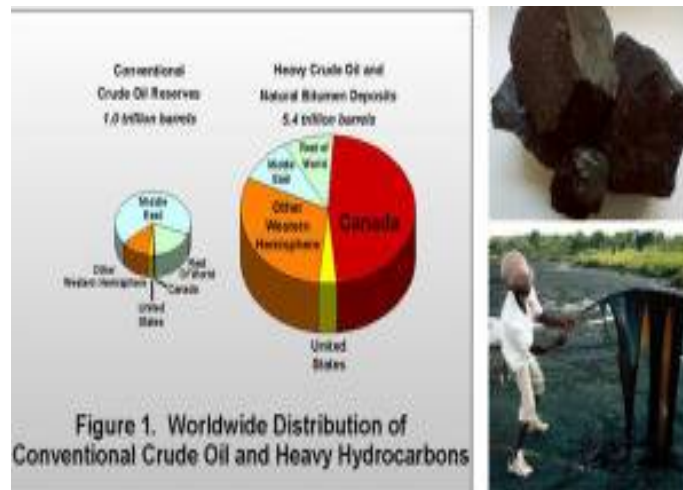


Fig. 1: Sources of Bitumen

II. RELATED WORK

1) Prof. Justo et al (2002), at the Centre for Transportation Engineering of Bangalore University compare the properties of the modified bitumen with ordinary bitumen. It was observed that the penetration and ductility values of the modified bitumen decreased with the increase in proportion of the plastic additive, up to 12 percent by weight. Therefore the life of the pavement surfacing using the modified bitumen is also expected to increase substantially in comparison to the use of ordinary bitumen.

2) Shankar et al (2009), crumb rubber modified bitumen (CRMB 55) was blended at specified temperatures. Marshall's mix design was carried out by changing the modified bitumen content at constant optimum rubber content and subsequent tests have been performed to determine the different mix design characteristics and for conventional bitumen (60/70) also. This has resulted in much improved characteristics when compared with straight run bitumen and that too at reduced optimum modified binder content (5.67 %).

3) Mohd.Imtiyaz (2002) concluded that the mix prepared with modifiers shows higher resistance to permanent deformation.

4) Use Of Waste Plastics And Waste Rubber Tyers: Worldwide, sustainability is the pressing need of the hour in the construction industry and towards this end use of waste material in road construction is being increasingly encouraged so as to reduce environmental impact. In the high way infrastructure, a large number of originate materials and technologies have been invented to determine their suitability for the design, construction and maintenance of these pavements. Plastics and rubbers are one of them. Also considering the environmental approach, due to excessive use of polythenes in day to day business, the pollution to the environment is enormous. The use of plastic materials such as carry bags, cups, etc. is constantly increasing day by day. Since the polythenes are not biodegradable, the need of the current hour is to use the waste polythene in some beneficial purposes.

III. EXPERIMENTAL WORK PERFORMED

1) **PENETRATION TEST:** This test is done to determine the penetration of bitumen. The principle is that the penetration of a bituminous material is the distance in tenths of a mm, that a standard needle would penetrate vertically, into a sample of the material under standard conditions of temperature, load and time.

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Fig. 2: Penetrometer

2) DUCTILITY TEST: The ductility of bituminous material is the distance in centimeters to which it will elongate before breaking when a briquette specimen of the materials is pulled at a specified speed and at specified temperature.



Fig. 3: Ductility Testing Machine

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3) SOFTENING POINT: This test is done to determine the softening point of asphaltic bitumen and fluxed native asphalt, road tar, coal tar pitch and blown type bitumen as per IS: 1205. The principle behind this test is that softening point is the temperature at which the substance attains a particular degree of softening under specified condition of the test.



Fig. 4: Ring and Ball Apparatus for Softening Point

4) VISCOSITY TEST: Viscosity is defined as the inverse of fluidity. The degree of fluidity at the application temperature greatly influences the ability of bituminous material to spread, penetrate and coating the aggregate and hence affect the strength characteristics of the paving mixes. It is necessary to have optimum value of fluidity. At higher fluidity the bitumen binder simply lubricates the aggregates and similarly at lower fluidity does not enable to bitumen to coat the entire surface of aggregate.

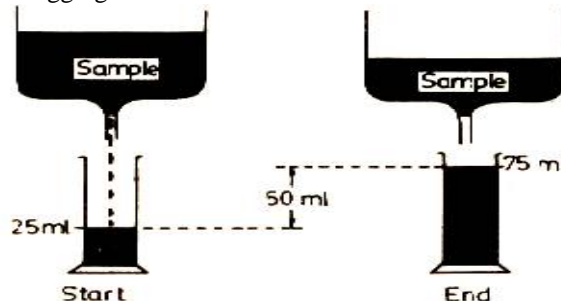


Fig. 5: Concept of Viscosity Test

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Vol. 6, Issue 2, February 2017

IV. EXPERIMENTAL RESULTS

1) PENETRATION TEST:

Table no. 1:

Sample	Crumb Rubber Replacement	Mean Penetration value at 3 Points (mm)
A	0%	30
B	5%	32.50
C	10%	36.66
D	15%	23

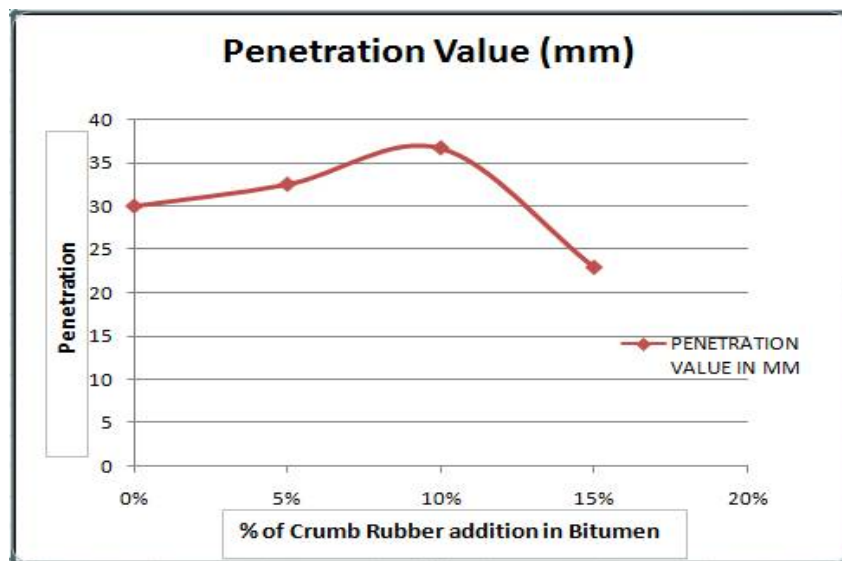


Fig. 6: Graph showing Penetration v/s Bitumen Percentage

2) DUCTILITY TEST:

Table no. 2:

Sample	Crumb Rubber Replacement	Failure value (cm)
A	0%	72
B	5%	53
C	10%	34
D	15%	36

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Vol. 6, Issue 2, February 2017

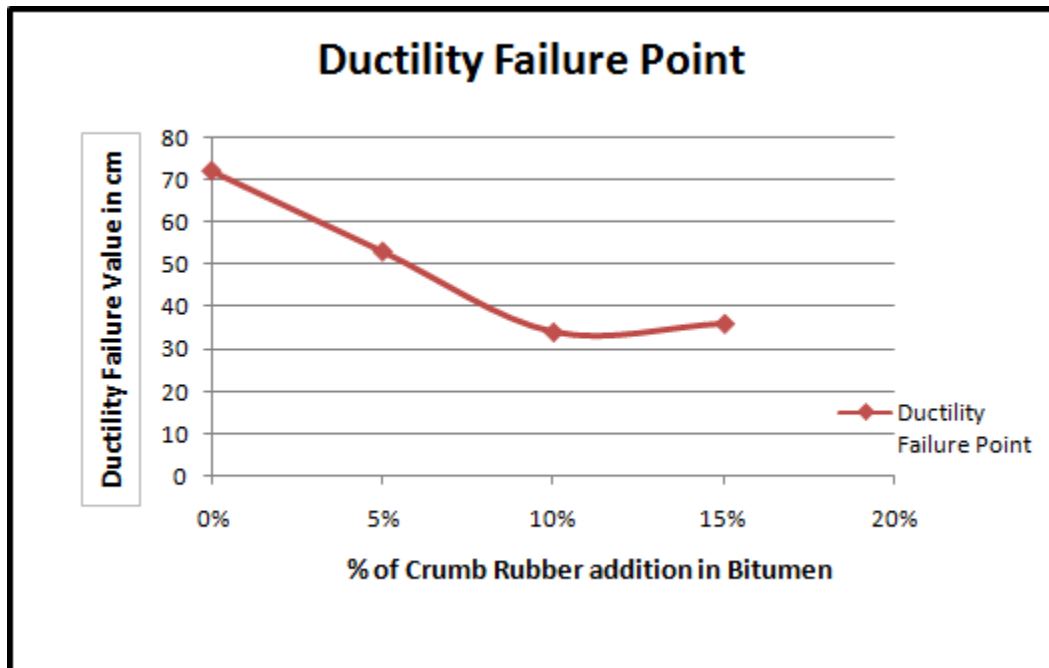


Fig. 7: Graph showing Ductility Failure v/s Bitumen Percentage

3) SOFTENING POINT TEST:

Table no. 3:

Sample	Replacement	Temperature of falling of ball of first ring (0 C)	Temperature of falling of ball of first ring (0 C)	Mean (0 C)
A	0%	61.1	61.3	61.2
B	5%	55	54	54.5
C	10%	57	57.4	57.2
D	15%	58	59	58.5

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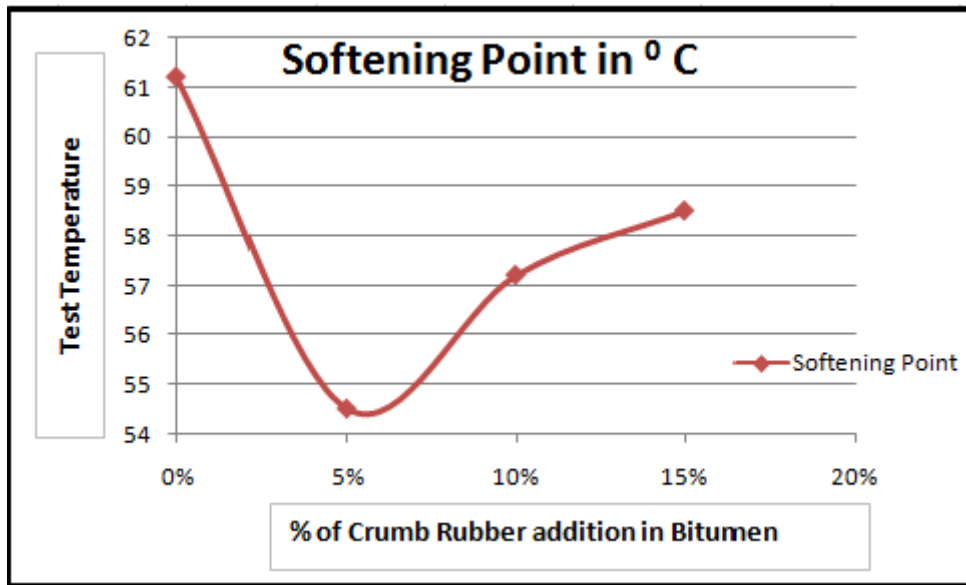


Fig. 8: Graph showing Test Temp. v/s Bitumen Percentage

4) VISCOSITY TEST:

A) At 60 °C

Viscosity of cutback for 0% replacement bitumen = 82 seconds.

Viscosity of cutback for 5% replacement bitumen = 96.45 seconds.

Viscosity of cutback for 10% replacement bitumen = 191.5 seconds

Viscosity of cutback for 15% replacement bitumen = Sample Failed

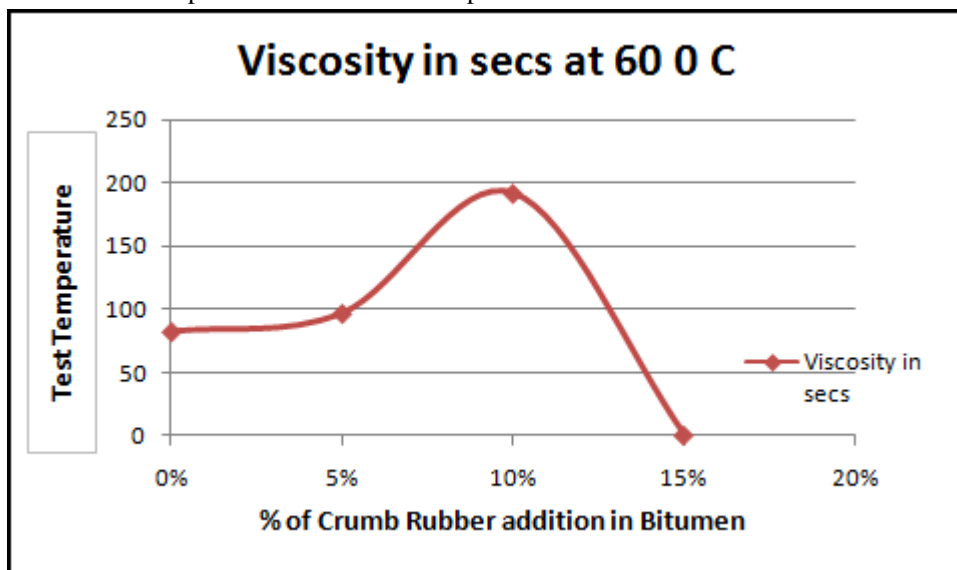


Fig. 9: Graph showing Test Temp. v/s Bitumen Percentage

International Journal of Innovative Research in Science, Engineering and Technology

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Vol. 6, Issue 2, February 2017

A) At 90°C

Viscosity of cutback for 0% replacement bitumen = 76 seconds.

Viscosity of cutback for 5% replacement bitumen = 90.34 seconds.

Viscosity of cutback for 10% replacement bitumen = 171.2 seconds

Viscosity of cutback for 15% replacement bitumen = Sample Failed

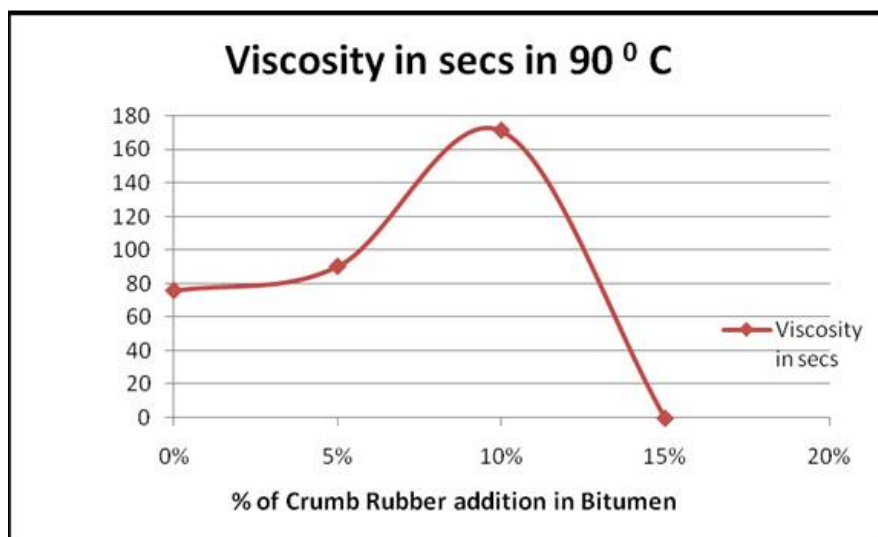


Fig. 10: Graph showing Test Temp. v/s Bitumen Percentage

V. CONCLUSION

- Ductility value is not achieved as per IS, but by testing it we came to this conclusion.
- Its result for penetration test, softening test, viscosity test is very good as per IS.
- The test results are very good not for only plain bitumen but also for the mixture of bitumen & crumb rubber, at the percentage of wt. of bitumen 5, 10, 15 percentage.
- Such Crumb Rubber is a waste in tyre industry & mixing it in a bitumen is giving the best strength & the property of Re-using it is worth noting.
- By using this waste rubber, the cost also goes to decrease moderately.
- It saves environment too, because rubber is that material which does not decay in soil & when the rubber is going to be burned then it creates poisonous gases and by that it affects environment. It causes health problems too.
- By using this property, consistency of bitumen is greatly achieved.

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Vol. 6, Issue 2, February 2017

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