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Study and Use of Crumb Rubber on the Properties of Bitumen

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ABSTRACT: Researches have been done to find some different material to use crumb rubber as modifier in bitumen mixes. In this current paper, the entire focus was carried on asphalt binder by adding crumb rubber (CR) in different proportions. The mixture were evaluated under several tests like softening point, ductility test, penetration test etc. Addition of crumb rubber has proven to improve the properties of ordinary bitumen (OB). Bitumen along with crumb rubber has been studied and its impact on properties are shown.

The rubberized bitumen formed decreases permanent deformations due to heavy loads on the road and thus increases the skid resistance. With the addition of rubber there is increase in resistance to brittle fracture at low temperatures. It has been observed with the addition of crumb rubber there is increase in overall performance in bituminous mixes. With this addition of crumb rubber in bitumen service life of roads (Rubberized) has increased to greater extent.

KEYWORDS: Pavements, Bitumen, Crumb Rubber, Highway Industry.

I. INTRODUCTION

An attempt to use this Crumb Rubber (CR) originated from waste tires for improving the qualities of bitumen by adhering it with crumb rubber. It will make bitumen binder more advanced and there is increment in the effectiveness of cost. The proposed revenues for the construction of highways will get decreased to greater extent and will result in economical stability of the country. Two things are of major consideration in this regard i.e; Mix design and Pavement design.

In mix design, bituminous mixtures are formed which consists of two main ingredients i.e; aggregate (coarse, fine and filler) and binder (bitumen or modified bitumen/rubberized bitumen). Different gradations of each may be used in different compositions to produce mixes with entirely different design qualities.

Various mixtures of bitumen have evolved to suit the range of different circumstances in which they can be used. Broadly they can be classified into two main categories, the macadam and the asphalt. A better design of bituminous mixes is expected to yield a mix which is (i) durable (ii) hard (iii) resistance to wear out and permanent deformation (iv)



Eco friendly (v) Economical and so on. Material that adds flexible properties to flexible pavements. In this paper we have shown how bitumen with crumb rubber enhances the properties of pavement relative to ordinary bitumen. For this we have conducted the series of experiments on normal bitumen and rubberized bitumen. The result of these tests has been shown later in this paper.

In pavement design one of the important factors is tyre-pavement noise. At highway speeds tyre-pavement noise contributes to the largest part of total traffic noise. With the addition of crumb rubber one of the advantages is reduction in the tyre-pavement noise.

II. LITERATURE REVIEW

Yazan Issa (2016): The objective of this paper was to study the alteration in asphalt properties on adding tire rubber. Various properties of asphalt mix, with stability and flow were analyzed. Sample was prepared by adding rubber to bitumen at 4.5%, 5% and 5.5%. Other samples were prepared by the addition of rubber to bitumen in wet process with different percentages by bitumen weight (5%, 10% and 20%). The results showed that the qualities of rubber asphalt mixture are enhanced in comparison with normal asphalt pavement. It is now summarized that the use of tire rubber is advantageous.

Debashish Kar (2010): Crumb rubber extracted from rejected tyre with 80/100 penetration grade bitumen in Stone Mixed Bitumen. It was concluded that fatigue and permanent deformation characteristics improved significantly.

Chui-Techiu and Li-Cheng Lu (2007): In this study was done on bitumen rubber for Stone Mixed Bitumen and was concluded to have better rutting resistance compared to Dense graded mixture.

Kamaraj C et al (2004): In this laboratory study was done on natural rubber powder with 80/100 penetration grade bitumen in Stone Mixed Bitumen by wet process as well as dense graded bituminous mix with cellulose fiber, Stone dust and lime stone as filler.

Punith V.S et al (2004): A comparative study was done on Stone Mixed Bitumen with bitumen concrete mix utilizing reclaimed polythene. The test results showed that the mix properties of Stone Mixed Bitumen (SMB) and BC (Bituminous Concrete) mixture are getting advanced by the addition of reclaimed polythene as stabilizer which shows better resistance to creep ageing and moisture damage.

III. DISCUSSIONS

- a) Bitumen: Bitumen is black, sticky, viscous semi solid at room temperature used in flexible pavement. When heated it becomes less viscous and flows easily. On heating it to the temperature of 160⁰ C and mixed with aggregates to form bituminous concrete and on cooling it returns back to a semisolid state with the Aggregates suspended in it.
- b) Modified bitumen: Crumb rubber from the base tyres is used in pavement construction by two processes, the dry process and the wet process. In the dry process the rubber is mixed with aggregates within the asphaltic mix preparation but when the rubber is blended in bitumen at a specific temperature where the crumb rubber serves as modifier is the wet process. The crumb rubber modification by the wet process shows the ability to improve the rutting resistance and the fatigue cracking of the asphaltic mixes. This is due to the change in the qualities of bitumen in terms of viscosity, softening point and ductility.
The wet mixing process for 13 minutes at temperature of 175⁰C for 9% crumb rubber sizing between 30 and 40 mesh size is used to fully interact with binder. The average mixing temperatures for percentages less than 12% is less than 175⁰C.

Tests on Bitumen and Rubberized Bitumen.

1. Penetration test: Penetration test of bitumen gives a measure of its consistency. It is an important factor which varies with the temperature. More the penetration of needle into bitumen less is the consistency and vice versa.
2. Viscosity test: This test gives the measure of resistance to flow. The viscosity shows a great variation with the temperature. Increase in temperature results in decrease in viscosity of bitumen and vice versa. At higher viscosity the bitumen resists the compactive effort and thereby resulting the mix of heterogeneous character,

hence shows low stability values. At lower viscosity it lubricates the aggregates and provides a uniform film over aggregates.

3. Ductility test: Ductility is the property of bitumen that allows it to undergo the elongation up to certain limit without fracturing. More ductility of bitumen (binder) means less fatigue and rutting failure of pavement.
4. Softening point test: This test is used to calculate the temperature at which the bitumen attains the particular degree of softening. Higher the softening point implies lower temperature susceptibility and such bitumen is preferred in hot climatic conditions and vice versa is the case with lower softening point.
5. Flash and fire point test: Bitumen is highly volatile and is operated at higher temperatures during mixing it with aggregates, so can catch fire easily. It is thus necessary to recognize the flash and fire point.

IV. RESULTS

Table-1
Average penetration value of ordinary and Modified Bitumen

S.No.	Sample	Average value obtained
01	Ordinary Bitumen	87
02	Ordinary Bitumen + 1% crumb rubber	89
03	Ordinary Bitumen + 2% crumb rubber	91
04	Ordinary Bitumen + 3% crumb rubber	86
05	Ordinary Bitumen + 4% crumb rubber	78

Table-2
Average viscosity (at 135⁰C) of Ordinary and Modified Bitumen

S.No.	Test	Average value obtained
01	Ordinary Bitumen	263
02	Ordinary Bitumen + 1% crumb rubber	199
03	Ordinary Bitumen + 2% crumb rubber	305
04	Ordinary Bitumen + 3% crumb rubber	375
05	Ordinary Bitumen + 4% crumb rubber	162

Table-3
Average Ductility value (at 25⁰C) for ordinary and Modified Bitumen

S.No.	Sample	Average value obtained
01	Ordinary Bitumen	69
02	Ordinary Bitumen + 1% crumb rubber	68
03	Ordinary Bitumen + 2% crumb rubber	68
04	Ordinary Bitumen + 3% crumb rubber	62
05	Ordinary Bitumen + 4% crumb rubber	58

Table – 4
Average Softening point of ordinary and Modified Bitumen

S.No.	Test	Average value obtained
01	Ordinary Bitumen	54 ⁰ C
02	Ordinary Bitumen + 1% crumb rubber	50 ⁰ C
03	Ordinary Bitumen + 2% crumb rubber	49 ⁰ C
04	Ordinary Bitumen + 3% crumb rubber	52 ⁰ C
05	Ordinary Bitumen + 4% crumb rubber	54 ⁰ C

Table-5
Average fire and flash point of Ordinary and Modified Bitumen

S.No.	Sample	Fire point	Flash point
01	Ordinary Bitumen	268 ⁰ C	247 ⁰ C
02	Ordinary Bitumen + 1% crumb rubber	238 ⁰ C	218 ⁰ C
03	Ordinary Bitumen + 2% crumb rubber	249 ⁰ C	228 ⁰ C
04	Ordinary Bitumen + 3% crumb rubber	259 ⁰ C	218 ⁰ C
05	Ordinary Bitumen + 4% crumb rubber	278 ⁰ C	237 ⁰ C



V. CONCLUSION

1. Softening point gives information about temperature at which bituminous material acquires suitable viscosity, so bitumen with more softening point is preferred in hot places and is also used to recognize hot bitumen. Since the obtained value is in between 49°C and 54°C and can be preferred in warmer climate conditions in the given concentration of modifier.
2. Since the viscosity is increased with the increase in bitumen percentage modifier, it can be summarized that resistance of flow also increases. As viscosity is large, it can be used in construction of pavement.
3. The Indian standard Institution specifies the minimum value of ductility as 50 cm. Here we get the ductility range of more than 50 cm for all the four concentrations, so each percentage can be effectively used in pavement construction, but at higher concentration of modifier it may not be used well.
4. Penetration test at 25°C is frequently adopted test on bitumen to grade material in terms of hardness. So, in the regions with more temperature lower penetration grade Bitumen is preferred and in cold regions higher penetration grade Bitumen is used. Since the obtained values get smaller after particular concentration therefore their tendency to be used in warmer regions increases after that particular concentration.
5. Since flash and fire point have no significance regarding the strength of mix, but they are used to know the working temperature of the bitumen and bituminous mixes. Here the working temperature are less than the flash and the fire point in rubberized bitumen, hence can be used without any hazard.
6. Crumb rubber as a modifier in bitumen makes the pavement noiseless as the tyre pavement noise is much reduced in the modified bitumen.
7. Using crumb rubber as a modifier of binder is economical as crumb rubber used is obtained from waste tyres which are useless and as a pollutant for the environment.
8. Thus, it can be concluded from the discussion, conclusion and results that bitumen blended with crumb rubber can be used in places with relatively warmer conditions than ordinary bitumen

REFERENCES

1. "Highway Engineering" by S.K Khanna, C.E.O Justo and A.Veeraragavan/10th Ed.
2. IS 1208 1978:" Ductility of bitumen is its property to elongate under traffic load without getting cracked in road construction works."
3. IS : 1203-1978-Indian standard methods for testing tar and bituminous materials (Determination of penetration)
4. IS: 1206 (Part 2) – Method for Testing Tar and Bitumen Materials: Determination of Absolute Viscosity.
5. IS: 1205-1978-Indian standard methods for testing tar and bituminous materials (Determination of softening point).
6. IS 1209Determination of flash point and fire point



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