

EVALUATION OF PROPERTIES OF CRUMB RUBBER MODIFIED BITUMEN

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Abstract- *The worn out tires of the old vehicles are discarded and replaced. In most parts of the country these tires are burnt causing numerous environmental hazards. These tires are non-biodegradable and hence have to be disposed off carefully. One of the ways to dispose them is to recycle them. They can also be shredded and can replace many construction materials. This paper aims at using crumb rubber (recycled tires) in modifying the bitumen and studying its properties.*

Keywords- *Crumb rubber, Modified bitumen, Pavement, Penetration, Softening point, Ductility, Distresses.*

I. INTRODUCTION

Over the years, there has been the tremendous increase in the number of vehicles plying on the roads. The traffic capacity has increased manifolds. Moreover the distresses in the pavements have worsened, the most common being rutting. The pavement distresses depend upon materials used in pavement construction, type of pavement, construction techniques and also the environmental factors like temperature. In India, 80% of the pavements are the bituminous pavements which are temperature dependent in their function. In order to decrease the distresses like rutting, cracking, fatigue failure, pavement deformation, etc. we can use modified bitumen.

The increase in the number of vehicles results in increase in the number of discarded tires. These tires are non-biodegradable, hence a nuisance to the environment. The accumulation of these tires is harmful as they can act as breeding place for mosquitoes resulting in the spread of diseases like malaria. Taking into account the above two problems, we can use these tires to modify the bitumen for the pavement construction. The aim of this study is to evaluate the effect of crumb rubber on modified bitumen. Crumb rubber is the recycled rubber produced from scrap tires.

II. MATERIALS USED

A. Bitumen

Bitumen is used as a binder in the pavements. It is a by-product of petroleum and is obtained by the distillation of crude petroleum. It is good in binding and water proofing. It is also highly susceptible to temperature.

B. Crumb Rubber

Crumb rubber is the recycled rubber produced from scrap tires. The old tires are shredded into the range of 450 mm to 25 mm and the most common size being between 100 mm to 200 mm. these shreds are further reduced to a smaller size of shreds and chips to produce crump and grounded rubber also known as size reduced rubber.

III. METHODOLOGY

The crumb rubber was added to the molten bitumen in different percentages by weight of the bitumen. And then both were heated together to obtain a uniform mix. According to ASTM D6114, to produce crumb modified asphalt, the crumb rubber should have following properties [3].

- It should have less than .75% of moisture.
- Specific gravity should be in the range of 1.15 ± 0.05 .
- Should be free from visible non-ferrous metal.
- Ferrous metal should not be more than 0.01% by weight.
- Fiber content should not be more than 0.5% by weight.
- All rubber particles should pass through No. 8 sieve.

The crumb rubber was added in the percentages of 0%, 3%, 5%, 7%, 9%, 11% and 13%.

The following tests were conducted on crumb rubber modified bitumen :

- Penetration test
- Ductility test
- Softening Point test

IV. RESULTS

A. Penetration Test

The results obtained are tabulated in Table 1 and shown in Fig. 1.

TABLE 1

S. NO	PERCENTAGE OF CRUMB RUBBER	PENETRATION VALUE (MM)
01	0	73
02	3	67
03	5	54
04	7	46
05	9	38
06	11	34
07	13	29

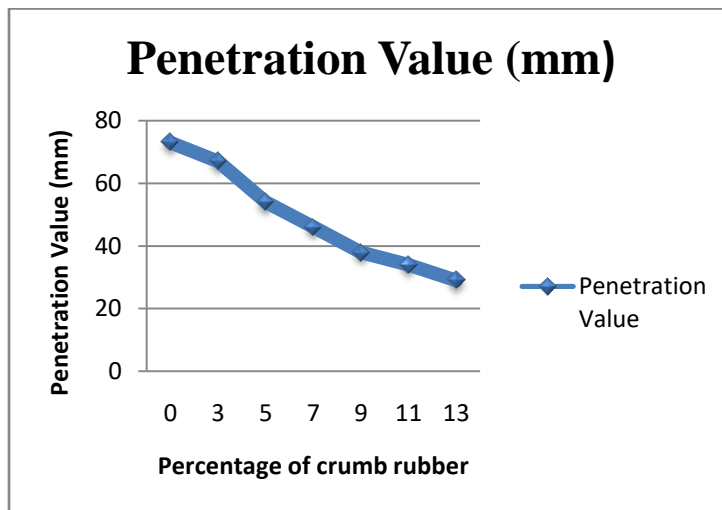


Fig. 1. A graph between the penetration value of bitumen in mm and the percentage of crumb rubber added.

B. Ductility Test

Table 2 tabulates the results obtained in ductility test.

TABLE 2

S. NO	PERCENTAGE OF CRUMB RUBBER	DUCTILITY VALUE (MM)
01	0	77
02	3	71
03	5	57
04	7	50
05	9	46
06	11	41
07	13	37

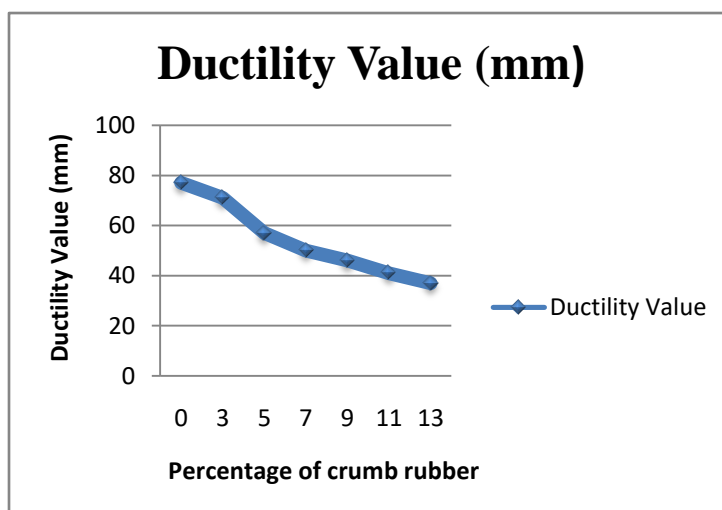


Fig. 2. A graph between the penetration value of bitumen in mm and the percentage of crumb rubber added.

C. Softening Point Test

Table 3 shows the results of the softening point test conducted on the crumb rubber modified bitumen.

TABLE 3

S. NO	PERCENTAGE OF CRUMB RUBBER	SOFTENING POINT (°C)
01	0	35
02	3	39
03	5	41
04	7	43
05	9	47
06	11	50
07	13	53

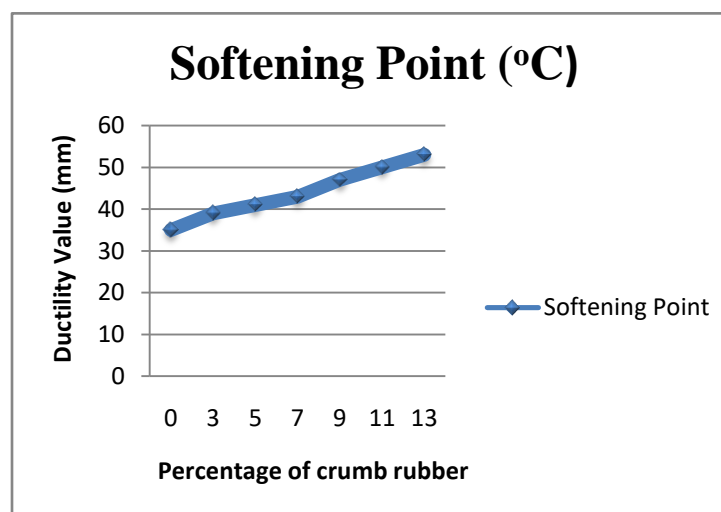


Fig. 3. A graph between the softening point of bitumen in °C and the percentage of crumb rubber added.

V. OBSERVATIONS AND CONCLUSION

The following conclusions can be drawn from the above results:

- The above results show that with the increase in the percentage of crumb rubber the penetration value increases. This means that the bitumen becomes harder with the increase in the percentage of crumb rubber.
- It was observed that with the increase in the percentage of crumb rubber the ductility decreases, hence making it stiff. Ductility is the property of adhesion of the bitumen. Hence the adhesion of the bitumen decreases with the increases in the percentage of crumb rubber.
- The results of the softening point test show that the softening point increases with the increases in the percentage of crumb rubber, thus making it less susceptible to higher temperatures and suitable to be used in warmer areas.

Based on the above results, it can be recommended to use crumb rubber modified bitumen in hot areas. The initial cost is high as it requires very high temperature to mix the crumb rubber with bitumen uniformly, but the properties can be enhanced tremendously which ultimately increases the design life of the pavement.

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