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A STUDY ON PERFORMANCE CHARACTERISTICS OF CRUMB RUBBER MODIFIED BITUMEN FOR VARIOUS BLENDING TEMPERATURE AND BLENDING TIME

Dipak Rathva[1], Manish Jain[2], Ashish Talati[3]

[1 & 2] Assistant Professor, CED, Faculty of Technology and Engineering, The M.S. University of Baroda,Vadodara, Gujarat
[3] Assistant Professor and Head, CED, DJIMIT, Mogar, Anand, Gujarat

[1] dipak_rathva@yahoo.co.in [2] manishjain_09@yahoo.com [3] ashishvtalati@gmail.com

Abstract: It is extremely important that the modifier is thoroughly mixed with bitumen before the preparation of the bituminous mix so that the modified bitumen retains its premium properties. Different types of modifiers require different techniques of blending. The exact temperature and time of blending depends upon the type and amount of modifier use as it plays very vital role in obtaining the required properties of modified bitumen. In this study the crumb rubber modified bitumen (CRMB) samples are prepared for varying blending temperature and blending time. From the study it is determine that the various properties of CRMB varies with blending temperature and blending time. The optimum blending temperature and blending time found out 175^0C and 45 minutes respectively for preparing high quality CRMB.

Key Words: *Modified Bitumen, Modifier, Crumb rubber modified bitumen (CRMB), Blending Temperature, Blending Time*

1. Introduction

Investigations in India and countries abroad have revealed that properties of bitumen and bituminous mixes can be improved to meet requirements of pavement with the incorporation of certain additives or blend of additives. These additives are called “Bitumen Modifiers” and the bitumen premixed with these modifiers is known as “Modified Bitumen”. Investigations on the use of rubber as an admixture to bitumen to improve the qualities of bitumen in the construction of road pavements are going on in several countries. It has been claimed that the addition of a small proportion of rubber to bitumen can influence the properties of the binder in a manner likely to result in improved road performance. When bitumen is blended with rubber a material is produced having greater viscosity than the original bitumen and possessing elastic or “rubbery qualities”. The material is called “Rubberised Bitumen” [1], [2], [3], [4]

The rubber used as admixture to bitumen may be vulcanized or unvulcanised rubber powder,

rubber latex, rubber powder with sulphur, rubber powder derived from waste rubber tyres etc. [5].

The temperature of blending and rolling shall be slightly higher than conventional bituminous mixes. The range of temperature at different stages is given in Table-1 [6].

Table -1: Range of Temperature Requirements for Modified Binders

Stage of Work	Indicated Temperature (^{0}C)
Binder at blending	165 – 185
Mix at blending plant	140 – 160
Mix at laying site	130 – 150
Rolling at laying site	115 - 135

Source: IRC: SP – 53

2. Laboratory Investigation

As modifier added in bitumen its properties get changed. These properties are affected by blending temperature and blending time for blending modifier with bitumen.

1) Blending Temperature

Some initial efforts were made to mix manually crumb rubber and bitumen but it could not produce a homogeneous binder. It was observed that the crumb rubber particles settle to the bottom of the container. Subsequently mechanical stirrer was used for blending the crumb rubber with bitumen. Initial efforts were made by varying the blending temperature from 160^{o}C to 190^{o}C. It was observed that for the lower temperature i.e. 160^{o}C, homogeneous mix was not obtained. Hence it was decided to vary blending temperature between 165^{o}C to 185^{o}C and hence three blending temperatures like 165^{o}C, 175^{o}C and 185^{o}C were considered for present study [1], [6].

2) Blending Time

This parameter also pleases an important role in preparing the modified binder. Several efforts were made to mix crumb rubber and bitumen by varying the blending time from 5 min to 50 min. It was observed that for blending time less than 15 min homogeneous mix was not obtained and for blending time more than 45 min segregation of crumb rubber starts. Hence three blending times were considered like 15 min., 30 min and 45 min. for present study [1].

As discuss various properties of modified bitumen are to be checked for find the effect of blending temperature and blending time. All these properties are tested by the methods given in various codes as shown in table-2. [7].

Table-2: Conventional and Non-Conventional Tests on Bitumen

Name of Test	Codes for T
enetration at 25°C, mm	IS:1203-197
oftening Point, °C	IS:1205-197
uctility test, cm	IS:1208-1978
astic Recovery of Half Thread in Ductilometer at 5°C, %	ASTM D 5976-1996
eparation difference in Softening Point, °C	ASTM D 5976-

3. Analysis and Results

Various conventional and non-conventional tests have been conducted on the prepared crumb rubber modified bitumen as indicated above. The analysis and the results obtained are presented graphically and shown as below in figure from 1 to 5.

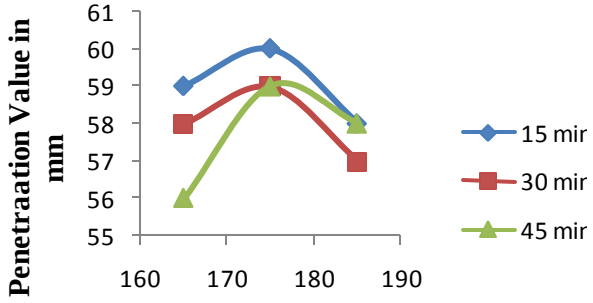

Figure:1 Penetration Value v/s Blending Temperature

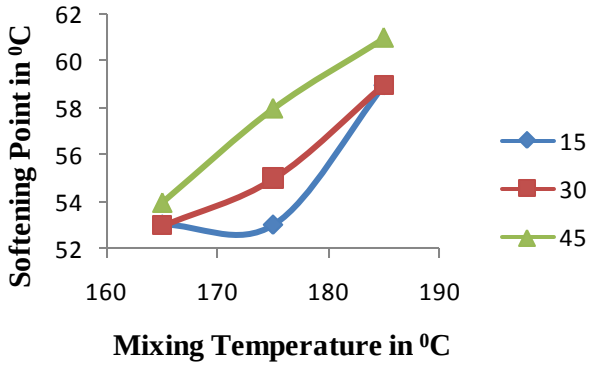

Figure:2 Softening Point v/s Blending Temperature

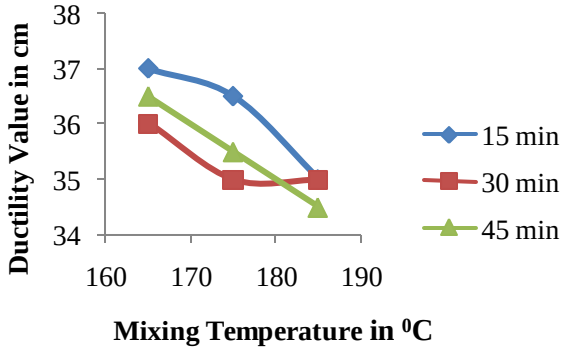

Figure:3 Ductility Value v/s Blending Temperature

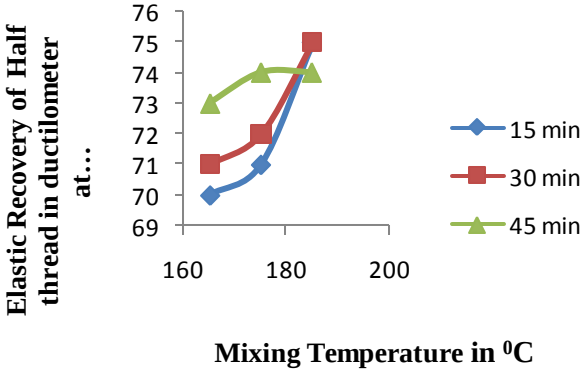

Figure:4 Elastic Recovery v/s Blending Temperature

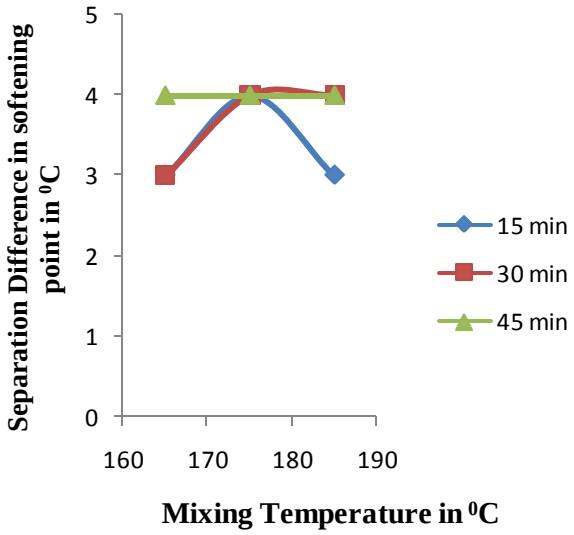

Figure: 5 Separation Difference v/s Blending Temperature

It has been observed from the test results and figure-1 that penetration value of crumb rubber modified bitumen prepared with 15 minutes blending time comes higher for all blending temperatures and lower values for 45 minutes blending time. This shows at less blending time mix is not properly formed and penetration values comes higher for less blending time. Aslo, it is observed that at 175^0C the pentraion value is higher for various blending time. Further, at blending temperature of 165^0C and blending time of 45 minutes penetration values comes lowest. Figure-2 shows that softening point of crumb rubber modified bitumen prepared with 45 minutes blending time comes higher for all blending temperature. It reveals that more time in blending make the mix more stiff. Also it has been seen that as the blending temperature increases the softening point also increases for all blending time.

From ductilty test and figure-3 it has been found that ductility property of crumb rubber modified bitumen prepared with all blending time and with respective blending temperature remains almost constant. So, the blending temperature and blending time does not influence ductility property of crumb rubber modified bitumen. The elastic recovery value of crumb rubber modified bitumen prepared with 45 minutes blending time comes higher for blending temperature of 165^0C and 175^0C but for blending temperature of 185^0C the elastic recovery value remains almost same for all blending time. Figure-4 shows that at 185^0 C blending temperature the elastic recovery value is constant, it menas at higher temperature blending time have no effent on elastic recovery, as it is more depend on temperature. Figure-5 shows the separation difference for top and bottom sample of different crumb rubber modified bitumen comes nearly same. So, there is not much effect of blending temperature and blending time on separation of modifier with bitumen.

4. Conclusion

From the present study it is established that the crumb rubber modified bitumen can impart beneficial properties of bitumen. Crum rubber modified bitumen used at various places now days because of its better performance

compare to conventional bitumen. In this study main emphasis was on determining the optimum blending time and blending temperature for preparing crumb rubber modified bitumen to get proper mix. On the basis of practical analysis, the observation obtained by performing various conventional and non-conventional tests on bitumen. Results shows that at less blending time homogenous mix is not prepared and hence penetration values comes higher for less blending time. Also it has been seen that as the blending temperature increases the softening point also increases for all blending time. Further, for blending temperature of 185^0C the elastic recovery value remains almost same for all blending time. Also, the blending temperature and blending time does not influence ductility property of crumb rubber modified bitumen. It was observed that there is not much effect of blending temperature and blending time on separation of modifier with bitumen. The optimum temperature is found out 175^0C and optimum blending time is 45 minutes for preparing the high-quality crumb rubber modified bitumen.

5. References

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6) Indian Roads Congress code: SP-53 (2002), Guidelines on use of polymer and rubber modified bitumen in road construction.
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    b) IS:1205-1978 Determination of Softening point of Bitumen
    c) IS:1208-1978 Determination of Ductility value of Bitumen
    d) ASTM D 5976-1996 Standard Specification for Type I Polymer Modified Asphalt Cement for Use in Pavement Construction.