

# CRUMB RUBBER MODIFIED BITUMEN FOR SURFACE COURSE OF FLEXIBLE PAVEMENT STRUCTURE

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## ABSTRACT

The high traffic density in terms of commercial vehicles, overloading of trucks, aging of bitumen binder and adverse climate condition such as heavy rainfall, significant variation in delay and seasonal of the pavement have been responsible for early development of pavement distress resulting in pavement to provide expected service life with desired performance. Under such condition it is necessary to improve the strength characteristics of bituminous surface by adopting various alternatives like modifying the grade bitumen, aggregate gradation and mix proportions or by using various admixtures. So it was felt that a study can be done a utilization of modifier like crumb rubber which is easily available, very cheap and considered as waste material. The present indicates that the effect of crumb rubber by varying procedural parameters like modifier concentration, blending temperature and blending time for preparing the CRMB.

**Keyword:** - Crumb rubber modified bitumen, Easily available, Very Cheap, Waste Material

## 1. INTRODUCTION

Road transport has acquired dominant position amongst the various road transport system. The growth of freight and passenger traffic by road 8 to 10% by annum; while that by rail is 4%. Unfortunately the road infrastructure has not kept pace with demand put on it. Vehicle population has increased from 3 lakh (1951) to about  $3.3 \times 10^6$  km at present. At against this, the road network expanded only five times, from 4 lakh km to 20 lakh km. In India more than 98% road network is of flexible type due to one reason or other. So maintenance of the huge network is not easy task. Also the time period of next renewal may be extended by 50% with modified bitumen as compare to conventional bitumen. For example, if normal cycle is 4 years, this may be enhanced to 6 years in case of modified bitumen. The above consideration needs to review the whole process of construction/maintenance of flexible pavement, the modified improved basic ingredients for bitumen works are also required. Many modified bitumen such as styrene-butadiene rubber, polyethylene, polypropylene, etc. have been used for the modification of bitumen for paving purposes.

Most of the polymers, besides being costly are not available very commonly. Crumb rubber is economical solution and it is available in our country and it is used in present investigation to modified 60/70 penetration grade bitumen due to its multifarious benefits.

### 1.1 OBJECTIVES OF THE STUDY

This study has been planned with the following objectives.

1. To study the effect of crumb rubber powder on the basic properties of penetration grade bitumen (60/70 penetration grade).

2. To study the development of modified binders by doing percentage variation of modifier with concentration, blending temperature and blending time.
3. To study the mechanical properties of paving mix containing crumb rubber modified bitumen considering percentage variation of modifier with concentration, blending temperature and blending time of modified bitumen.
4. To study the economic cost using polymer binders.
5. To compare cost/km of mixture prepared with conventional and polymer modified binders.

## 1.2 TYPES OF ADDITIVES FOR BITUMEN MODIFICATION

A variety of additives for bitumen modification are used. The degree of modification depends on types of polymer and rubber, its dose and quality of the bitumen. For full scale performance trials in India, using SBS and CR modified bitumen have been conducted. The dose of crumb rubber(CR) is 10 to 12%.

## 2. SOURCES AND TYPES OF CRMB

Crumb rubber is obtained from truck tyre or automobile tyre or both. Whole truck tyre contain 18 percent natural rubber compared to 9 percent in automobile tyre.

CRMB can be classified as follows.

- 1-CRMB50- Recommended for cold weather.
- 2-CRMB55- Recommended for Moderate climate area.
- 3-CRMB60- Recommended for hot weather

### 2.1 Advantages of crumb rubber modified bitumen

The advantages of crumb rubber can include one or more of the following for road work:

- 1-Rubberized bitumen is not much affected by change of temperature.
- 2-better age resistance properties.
- 3-skid resistance is improved through increased aggregate retention and elimination of bleeding.
- 4-Higher fatigue life of mixes.
- 5-The road surfaces with rubberized bitumen provide at least 50percent more service life then normal bitumen roads.
- 6-Delay and reflective of cracking.
- 7-Reduce traffic noise up to 80 percent.
- 8-Overall improved performance in extreme climate condition and under traffic condition.
- 9-Improvement in strength and temperature susceptibility characteristic of paving mixes.



**Fig -1: CRUMB RUBBER**



Fig -2: CRUMB RUBBER ROAD

## 2.2 Requirement of crumb rubber modified bitumen

Designation	Grade and Requirements			Method of test
	CRMB 50	CRMB 55	CRMB 60	
Penetration at 25 <sup>0</sup> C 0.1 mm, 100g, 5 sec	<70	<60	<50	IS:1203- 1978
Softening point (R&B), <sup>0</sup> C	50	55	60	IS:1205-1978
Elastic recover at half thread in ductilometer at 15 <sup>0</sup> C,% minimum	50	50	50	IS:15462-2004
Flash point, <sup>0</sup> C, min	220	220	220	IS:1209-1978
Separation different in a softening, (R&B) <sup>0</sup> C, Maximum	4	4	4	IS:15462-2004
Thin film oven test (TFOT) on residue				
(a) Reduction is penetration of residue at 25 <sup>0</sup> C, max.	40	40	40	IS:1203- 1978
(b) Increase in softening point, (R&B), <sup>0</sup> C, max	7	6	5	IS:1205-1978
Elastic recovery of half thread in ductilometer at 25 <sup>0</sup> C, % min	35	35	35	IS:15462-2004

## 3. COMPARISION OF CONVENTIONAL BITUMEN GRADE-60/70 WITH CRMB-60

### 3.1 Penetration test

Number	Mould-1	Mould-2	Mould-3	Mould-4	Mould-5	Mould-6	Mould-7	Mould-8	Mould-9	Mould-10
1	63	64	61	62	66	61	62	66	61	62
2	66	62	64	66	64	65	62	62	63	62
3	61	62	66	65	63	61	64	63	63	65
4	64	65	62	65	66	63	63	64	61	63
5	66	64	61	63	65	65	65	65	67	65
<b>Avg:-</b>	64	63.4	62.8	64.2	64.8	63	62.8	64	63	63.4

$$\text{AVG}=(64+63.4+62.8+64.2+64.8+63+62.8+64+63+63.4)/10=63.54 \text{ (60-70) AS PER IS :1203-1978}$$

TABLE:- 03 PENETRATION TEST (CRMB- 60)

Number	Mould-1	Mould-2	Mould-3	Mould-4	Mould-5	Mould-6	Mould-7	Mould-8	Mould-9	Mould-10
1	49	46	48	46	46	47	45	46	45	48
2	48	46	47	46	48	47	43	46	43	49
3	46	48	47	45	48	46	46	48	42	43
4	47	45	45	48	43	45	48	47	49	48
5	49	47	44	49	49	48	43	45	49	46
<b>Avg:-</b>	47.8	46.4	46.2	46.8	46.8	46.6	45	46.4	45.6	46.8

$$\text{AVG}=(47.8+46.4+46.2+46.8+46.8+46.6+45+46.4+45.6+46.8)/10=46.44 \text{ (<50 AS PER 1203:1978)}$$

### 3.2 Softening point test

TABLE:- 04 SOFTNING POINT (GRADE- 60/70) IN °C

Number	Mould-1	Mould-2	Mould-3	Mould-4	Mould-5	Mould-6	Mould-7	Mould-8	Mould-9	Mould-10	AVG °C
1	48	50	45	47	44	46	48	45	47	47	46.7

$$\text{AVG.}=(48+50+45+47+44+46+48+45+47+47)/10=46.70 \text{ (40-55 AS PER IS: 1205-1978)}$$

TABLE:- 05 SOFTNING POINT (CRMB- 60) IN °C

Number	Mould-1	Mould-2	Mould-3	Mould-4	Mould-5	Mould-6	Mould-7	Mould-8	Mould-9	Mould-10	AVG °C
1	65	66	61	66	69	63	64	64	66	63	64.7

$$\text{AVG.}=(65+66+61+66+69+63+64+64+63)/10=64.70 \text{ (MINIMUM 60 AS PER IS: 1205-1978)}$$

### 3.3 Ductility test and elastic recovery test

TABLE:-06 DUCTILITY TEST (GRADE- 60/70) IN CM

Number	Mould-1	Mould-2	Mould-3	Mould-4	Mould-5	Mould-6	Mould-7	Mould-8	Mould-9	Mould-10	AVG °C
1	77	80	78	78	76	80	79	76	81	79	78.4

$$\text{AVG.}=(77+80+78+78+76+80+79+76+81+79)/10=78.40 \text{ (MINIMUM 75 AS PER IS: 1208-1978)}$$

TABLE:-07 ELASTIC RECOVERY TEST (CRUMB- 60) IN %

Number	Mould-1	Mould-2	Mould-3	Mould-4	Mould-5	Mould-6	Mould-7	Mould-8	Mould-9	Mould-10	AVG °C
1	3.5	3.6	3.8	3.9	3.4	3.6	2.9	2.9	3.1	3.5	3.42

$$\text{AVG.}=(10-3.42)/10*100=65.80 \text{ (MINIMUM -60 AS PER IS:- 15642-2004)}$$

## 4. CONCLUSIONS

It is found to be more economic and when compare cost per Km of mixture prepared with conventional and polymer modified it is better and easy to use. Also it improves the properties of binders so as to improve it's performance for road construction.



**5. REFERENCES**

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**BIOGRAPHIES**

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