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STYRENE-BUTADIENE-STYRENE POLYMER MODIFIED BITUMEN FOR SURFACE COURCE 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, cost effective and considered as waste material. The present indicates that the effect of SBSPMB by varying procedural parameters like modifier concentration, blending temperature and blending time for preparing the SBSPMB.

Keywords-SBS polymer modified bitumen, easily available, Cost effective, Compatible

I. 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 space with demand put on it. Vehicle population has increased from 3lakh (1951) to about 3.3×10^6 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. SBSPMB 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.

II. OBJECTIVES OF THE STUDY

This study has been planned with the following objectives.

1. To study the effect of SBSPMB 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 SBS polymer 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.

III. 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 modified bitumen have been conducted. The dose of Styrene-Butadiene-Styrene (SBS) is 3 to 5%.

IV. TYPES OF SBS POLYMER MODIFIED BITUMEN

SBSPMB can be classified as follows.

1-SBSPMB120- Recommended for cold climate area.

2-SBSPMB70- Recommended for Moderate climate area.

3-SBSPMB40- Recommended for hot climate area

(Images of SBS PMB)

4.1Advantages of SBS polymer modified bitumen

The advantages of SBS PMB can include one or more of the following for road work:
1-Higher resistance to deformation at increased road temperature enhances smooth drive comforts.
2-Improved adhesion and bonding with aggregates, higher softening point, high flow resistance and higher impact resistance, takes heavy vehicular traffic.
3-Higher skid resistance, better road grip and smother vehicle break application.
4-Higher elongation and tensile strength, increase elasticity.
5-Reduced degree of rutting, improves driving comforts even on higher axle loads.
6-No change in pavement laying practice, application and machinery.
7-Higher aging resistance due to passivity to oxidation.
8. No change pavement laying practice, application and machinery and overall cost reduction.

4.2Requirement of SBS polymer modified bitumen

TABLE 1:- Requirement of SBS polymer modified bitumen

Designation	**Grade and Requirements**			**Method of test**
	PMB120	**PMB70**	**PMB40**	
Penetration at 25^0 C 0.1 mm, 100g, 5 sec	90-150	50-90	30-50	IS:1203- 1978
Softening point (R&B), ^{0} C	50	55	60	IS:1205-1978
Elastic recover at half thread in ductilometer at 15^0 C,% minimum	70	70	70	IS:15462-2004
Flash point, ^{0}C, min	220	220	220	IS:1209-1978
Separation different in a softening, (R&B) ^{0}C, Maximum	3	3	3	IS:15462-2004
Thin film oven test (TFOT) on residue				
(a) Reduction is penetration of residue at 25 ^{0}C, max.	35	35	35	IS:1203- 1978
(b) Increase in softening point, (R&B), ^{0}C, max	7	6	5	IS:1205-1978
Elastic recovery of half thread in ductilometer at 25 ^{0}C, %min	50	50	50	IS:15462-2004

V. COMPARISION OF CONVENTIONAL BITUMEN GRADE-60/70 WITH SBSPMB-70

5.1 Penetration test

TABLE:- 02 PENETRATION TEST (GRADE- 60/70) IN 1/10 TH OF MM

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
Avg:-	64	63.4	62.8	64.2	64.8	63	62.8	64	63	63.4

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

TABLE:- 03 PENETRATION TEST (SBSPMB-70) IN 1/10 TH OF MM

Number	Mould-1	Mould-2	Mould-3	Mould-4	Mould-5	Mould-6	Mould-7	Mould-8	Mould-9	Mould-10
1	52	51	56	55	54	52	51	53	52	57
2	54	53	54	51	54	53	55	53	52	58
3	55	55	54	56	58	52	55	56	55	58
4	52	52	52	58	52	51	56	54	58	56
5	54	52	56	54	51	56	55	52	57	52
Avg:-	53.4	52.6	54.4	54.8	53.8	52.8	54.4	53.6	54.8	56.2

AVG=(53.4+52.6+54.4+54.8+53.8+52.8+54.4+53.6+54.8+56.2)/10=54.08 (50-90) AS PER IS :1203-1978

5.2 SOFTENING POINT TEST

TABLE:- 04 SOFTNING POINT (GRADE- 60/70) IN ^{0}C

Number	Mould-1	Mould-2	Mould-3	Mould-4	Mould-5	Mould-6	Mould-7	Mould-8	Mould-9	Mould-10	AVG ^{0}C
1	48	50	45	47	44	46	48	45	47	47	46.7

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

TABLE:- 05 SOFTNING POINT (SBSMB- 70) IN ^{0}C

Number	Mould-1	Mould-2	Mould-3	Mould-4	Mould-5	Mould-6	Mould-7	Mould-8	Mould-9	Mould-10	AVG ^{0}C
1	63	60	58	58	62	63	58	57	63	66	60.8

AVG. = (63+60+58+58+62+63+58+57+63+66)/10= 60.8 (MINIMUM-55 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 ^{0}C
1	77	80	78	78	76	80	79	76	81	79	78.4

AVG. = (77+)80/+781+78+76+80+79+76+81+79)/10 = 78.40 (MINIMUM 75 AS PER IS: 1208-1978)

TABLE:-07 ELASTIC RECOVERY TEST (SBSMB- 70) IN %

Number	Mould-1	Mould-2	Mould-3	Mould-4	Mould-5	Mould-6	Mould-7	Mould-8	Mould-9	Mould-10	AVG ^{0}C
1	2.68	2.66	2.35	2.64	2.66	2.54	2.1	2.1	2.2	2.2	2.413

AVG. = (10-2.413)/10*100)= 75.87 (MINIMUM -70 AS PER IS:- 15642-2004)

VI CONCLUSION

It is found that it is compatible with bitumen, resist degradation of bitumen at mixing temperature, improve temperature susceptibility of bitumen, be capable of being proceed by conventional mixing plants and laying machinery, produce coating viscosity at application temperature, and maintain premium properties during storage application and in service, economic in cost.

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