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Viability of Utilize Waste Material (LDPE- Low Density Polyethylene&HDPE-HighDensity Polyethylene) in Flexible Pavement in Indian Context.

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ABSTRACT—*The developments of paper is mix design of bitumen using waste material for the purpose of improving the capacity or condition of exiting pavement. First the mix design of bitumen is use to know about the percentage of binder content (Bitumen), Aggregate, dust which is use in DBM & BC layer. In this Paper waste materials like Rubber, Polymer (LDPE, HDPE) and mixing of both are used as a different proportion in Binder content(Bitumen).After that take a this mix in design of DBM & BC layer and check the property of mixing (Conventional Bitumen with waste materials) and compare with original limit of conventional bitumen*

Keywords: *Plastic waste, Cost efficiency, Plastic waste characteristics,Plastic waste, Waste in Road*

I. NECESSITY OF MIX DESIGN USING MODIFIED BITUMEN

The road transport carries close to 90% of passenger traffic and 70% of freight transport. 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.

Generally, permanent deformation (rutting) occurs due to heavy axial loads coming on the sub grade and also rutting appears on the surface due to poor mixing of bitumen and as a result sub grade is damaged. The bituminous mix used in the surface course should not only sufficient the required strength but also is required to have enough internal resistance to withstand repeated heavy load. Commercially available bitumen in the country needs modification as they have characteristics that are not able to satisfy the performance requirements resulting in premature failure of bitumen surfacing. Bituminous materials with modified binders provide higher strength and longer lives as the provide better resistance to rutting, stripping, and exhibit lower rate of weathering.

II. TYPES OF MODIFIERS

Type of Modifiers		Example
Synthetic polymer	**Plastomeric Thermoplastics**	Polyethylene (PE), Acetate (EVA), Ethylene butyl Acrylate (EBA) and Ethylene Ter Polymer (ETP), etc.
	Elastomeric Thermoplastics	Styrene Isoprene Styrene (SIS), Styrene-Butadiene-Styrene co polymer, etc.
Synthetic Rubbers	**Synthetics Rubber Latex**	Styrene Butadiene Rubber (SBR) latex and any other suitable synthetic rubber
Other rubbers	**Natural Rubber**	Latex or Rubber powder
	Crumb Rubber	Crumb Rubber powder from discarded truck tyre further improved by additives, viz., gilsonite resin, etc.

Source:

III. PROPERTIES AND IDENTIFICATION OF MATERIALS DESIGN

A. Bitumen:

Figure 1: Bitumen

The following are the property of conventional bitumen:

- It is strong and durable adhesive.
- Bitumen is insoluble in water.
- Effective sealant.
- Bitumen is thermoplastic material.
- It resists action by most of the acids, alkalis and salts.

B. Crumb Rubber:

Figure 1: Crumb Rubber

Crumb rubber is prepared by grinding of waste tyre rubber. The following are the property of crumb rubber:

- Physical State: Black powder
- Odor and Appearance: Mild rubber
- Softening Point: 130 °C
- Flash Point: 220°C to 316°C
- Specific gravity: 2.1

C. Polypropylene:

Figure 3: LDPE-low density polyethylene

Polypropylene is getting from waste of yarn and having follow property

- Thermoplastic polymer
- Melting point-105 to 115 °C
- Flash point-250 °C.
- Resistance to chemical attack
- Density: 0.910-0.928

IV. ADVANTAGE OF MODIFIED BITUMEN

- Lower susceptibility to daily and seasonal temperature variations
- Higher resistance to deformation at high pavement temperature
- Better age resistance properties
- Better adhesion between aggregate and binder
- Higher fatigue life of mix
- Delay the cracking and reflective cracking
- Overall improved performance in extreme climatic conditions and under heavy traffic condition

V. ASSUMPTIONS

The following are the assumption made by us before conduct various test.

- It should be noted that the proportion of crumbed rubber in conventional bitumen is 12% as per IRC.
- It should be noted that the proportion of LDPE in conventional bitumen is 4% and 6% as per IRC.
- Heat and blending of mixing of bitumen and crumb rubber at 177°C.
- Heat and blending of mixing of bitumen and LDPE at 164°C.
- Take Bitumen= PMB and CRMB

VI. RESULTS AND DISCUSSION

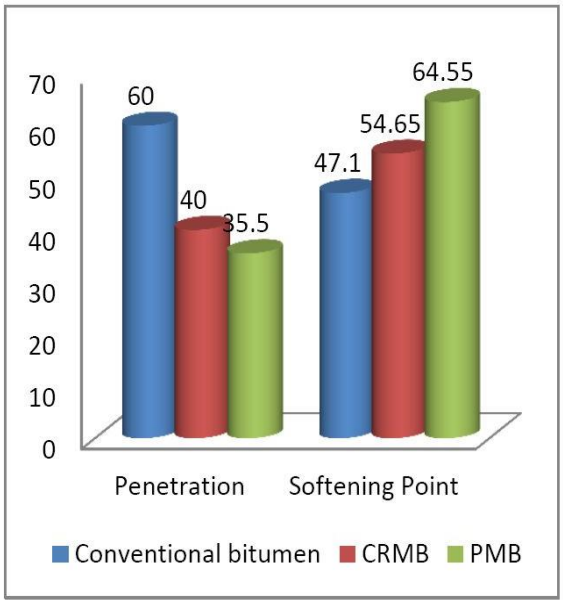
PENETRATION TEST [IS: 1203-1978]										
			Penetration of conventional bitumen		CRMB made by 12% waste tyre rubber		PMB made by 4% polymer		PMB made by 6% polymer	
Sr. No	Description	Units	Sample-1	Sample-2	Sample-1	Sample-2	Sample-1	Sample-2	Sample-1	Sample-2
1	Pouring Temperature	˚C	145.7	145.7	140	140	145	145	145.7	145.7
2	Period of cooling in atmosphere	Minutes	60	60	60	60	60	60	60	60
3	Room Temperature	˚C	31.2	31.2	22.5	22.5	27	27	31.2	31.2
4	Period of cooling in water bath	Minutes	60	60	60	60	60	60	60	60
5	Actual test Temperature	˚C	24.3	24.3	23.5	23.5	24.5	24.5	24.3	24.3
6	Penetration reading (initial)	1/10 mm	0	0	0	0	0	0	0	0
7	Penetration reading (final)	1/10 mm	62	58	40	40	41	43	33	38
8	Penetration	1/10 mm	62	58	40	40	41	43	33	38
9	Average penetration	1/10 mm	60		40		42		35.5	

SOFTENING POINT TEST [IS: 1205-1978]								
	Softening point for conventional bitumen		CRMB made by 12% waste tyre rubber		PMB made by 4% polymer		PMB made by 6% polymer	
Sr. No.	Time in minutes	Temperature (˚C)	Time in minutes	Temperature (˚C)	Time in minutes	Temperature (˚C)	Time in minutes	Temperature (˚C)
1	0	8	0	5	0	5	0	8
2	1	14.2	1	10	1	9.8	1	14.2
3	2	19.7	2	15	2	14.9	2	19.7
4	3	25.2	3	20.5	3	20.2	3	25.2
5	4	31.9	4	24.5	4	25.1	4	31.9
6	5	34.9	5	29.8	5	29.7	5	34.9
7	6	40.3	6	34.8	6	34.5	6	40.3
8	7	44.8	7	40.2	7	40.2	7	44.8
9	8	46.9	8	45.4	8	45	8	49.2
10	9	47.3	9	50	9	49.8	9	55.5
11	10	-----	10	55	10	54.7	10	59
12	11	-----	11	-----	11	-----	11	64.7
Test property	Ball no.-1	Ball no.-2	Ball no.-1	Ball no.-2	Ball no.-1	Ball no.-2	Ball no.-1	Ball no.-2
Temperature at which sample	46.9	47.3	54.3	55	54.1	54.7	64.4	64.7
Softening point mean value (˚C)	47.1		54.65		54.4		64.55	
Note:- Rate of heating : 5˚C ± 0.5 ˚C								

DUCTILITY TEST [IS: 1208-1978]										
			Penetration of conventional bitumen		CRMB made by 12% waste tyre rubber		PMB made by 4% polymer		PMB made by 6% polymer	
Sr. No,	Description	Units	Sample-1	Sample-2	Sample-1	Sample-2	Sample-1	Sample-2	Sample-1	Sample-2
1	Pouring Temperature	˚C	90	90	90	90	90	90	90	90
2	Period of cooling in atmosphere	Minutes	30	30	30	30	30	30	30	30
3	Room Temperature	˚C	29	29	32	32	30	30	32	32
4	Period of cooling in water bath at 27˚C	Minutes	30	30	30	30	30	30	30	30
5	Period of cooling in water bath after Trimming	Minutes	85	85	85	85	85	85	85	85
6	Actual test Temperature	˚C	35	35	37	37	34	34	37	37
7	Reading (initial)	Cm	0	0	0	0	0	0	0	0
8	Reading (final)	Cm	75	85	64	72	60	62	77	70
9	Ductility	Cm	75	85	64	72	60	62	77	70
10	Average ductility	Cm	80		68		61		73.5	

KINEMETIC VISCOSITY TEST [IS 1206: PART 3]									
		Penetration of conventional bitumen		CRMB made by 12% waste tyre rubber		PMB made by 4% polymer		PMB made by 6% polymer	
Sr. No,	Description	Sample-1	Sample-2	Sample-1	Sample-2	Sample-1	Sample-2	Sample-1	Sample-2
1	Pouring temperature not less than 90	100	100	100	100	100	100	100	100
2	Efflux time in second, T	1150	1200	1482	1467	1250	1378	1442	1430
3	Calibration constant of the viscometer in centistokes in per second	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025
4	Kinematic viscosity at 135	2.875	3	3.705	3.66	3.125	3.445	3.605	3.575
5	Average kinematic viscosity at 135	2.9375		3.7		3.285		3.6	

VII. CONCLUSION



Various tests were conducted on conventional and modified bitumen. The various test include Ductility test and Penetration test. The test result showed improvement in the properties like Penetration, Softening point and Marshall Stability. No major change in the specific gravity, kinematic viscosity.

In the shown graph, it can clearly be seen that the bitumen modified with rubber and polymer showed in improvement in property

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[10] IS (Indian standard) codes.

[11] American Standard of Testing Materials (ASTM)

[12] MORTH (Ministry of Road Transport and Highways)

