Performance Evaluation of Bitumen Mixtures Containing Waste Plastic and Reclaimed Asphalt Pavement (Rap)

Dr. G. Vijayakumar[1], Second D. Tulasi Ram[2]
[1]*Associate Professor, Department of Civil Engineering, St. Ann's College of Engineering & Technology*
M.Tech Student, Department of Civil Engineering, St. Ann's College of Engineering & Technology

Abstract: **Waste materials transfer including plastic sacks waste has turned into a noteworthy issueand plastic wastes are singed for transfer which makes extreme harms the earth Utilization of waste plastic in bituminous blends has demonstrated that these enhance the properties of blend notwithstanding diminishing transfer issues. Plastic waste which is isolated and cleaned is sliced with the end goal that it goes through the sieve having 2 mm 3 mm site utilizing shredding machine. Plastic roads would be an advantage for India's hot and sticky atmosphere. In our examination work we have done an intensive review on the technique of utilizing waste plastic in bitumen and with aggregates and exhibited the different tests performed on bitumen and aggregates This waste plastic changed bitumen blend demonstrate better restricting property, strength, thickness and show more imperviousness to water. Since the vast majority of the streets in India are of adaptable sort, the utilization of such techniques is effortlessly versatile on an extensive scale. Using of reclaimed asphalt pavement materials is a sustainable option of road construction which can result in considerable reduction in consumption of natural resources. It also disposal issue of RAP material and thereby saving huge landfill spaces. The coating of plastic changed bitumen and aggregates enhanced the fundamental properties of both aggregates and bitumen toan advantage.**

I. INTRODUCTION

Disposal of waste plastic is a major problem. It is non-biodegradable It mainly con-sists of low-density polyethylene. Burning of these waste plastic bags causes environmental pollution. To find its utility in bituminous mixes for road construction Laboratory perfor- mance studies were conducted on bituminous mixes. Laboratory studies proved that waste plastic enhances the property of the mix. Improvement in properties of bituminous mix provides the solution for disposal in a useful way.

Hot mix recycling is the process in which reclaimed asphalt pavement materials are combined with new materials, sometimes along with a recycling agent, to produce hot mix asphalt (HMA) mixtures. Just as in the case of conventional HMA, recycled mixtures must be designed properly to ensure proper performance. The objective of the material evaluation process is to determine the important properties of the component materials to come up with an optimum blend of materials to meet the mix requirements. The objective of themix design step is to determine the type and percentage of bituminous binder with thehelp of results from compacted test mixes.

II. LITERATURE REVIEW

Dr.R. Vasudevan, (2007) - stated that the polymer bitumen blend is a better binder compared to plain bitumen. Blend has increased softening point and decreased Penetration value with a suitable ductility.

S. Rajasekaran et al (2009)" Reuse of waste plastic coated aggregate" Marshall'smix design was carried out by changing the modified bitumen content at constant optimum rubber content and subsequent tests have been performed to determine the different mix design characteristics and for conventional bitumen (60/70) also. This has resulted in many improved characteristics when compared with straight run bi- tumen and that too at reduced optimum modified binder content (5.67%).

Vestal Patel et al (2014)" Utilization of plastic waste in road" described that the effect of wax in bitumen can be reduced by adding EVA (Ethyl Vinyl Acetate), aromatic resin and SBS in the waxy bitumen. The addition of 4% EVA or 6% SBSor % resin in waxy bitumen effectively reduces the Susceptibility to high temperatures, bleeding at high temperature and brittleness at a low temperature of the mixes.

Aznar Hamid Mir (2015)" Plastic waste in pavement construction" studied the viscos-elastic nature of binders and found that the complex modulus phase angles of the binders, need to be measured, at temperatures and loading rates which different resemble climatic and loading conditions.

III. EXPERIMENTAL INVESTIGATIONS

The following materials are used for the determination of properties Mix.

- Aggregate of 20mm down, 12.5mm and down, 6mm and down and dust (75 passing).
- VG-30 grade bitumen.
- Plastic.
- Reclaimed asphalt pavement.

The following tests were conducted in order to determine the physical properties of aggregates

Specific gravity
Water absorption
Aggregate impact test
Shape test
Los-Angeles abrasion test

Following tests were conducted in order to determine the physical properties of the bitumen.

- Penetration test
- Softening point test
- Specific gravity test on bitumen
- Flash and fire point test
- Marshal Stability Test

IV. RESULTS

Table 1 Correction factors for Marshall Stability values

Volume of specimen in cc	Thickness of specimen in mm	Correction factor
457-470	57.1	1.19
471-482	58.7	1.14
483-495	60.3	1.09
496-508	61.9	1.04
509-522	63.5	1.00
523-535	65.1	0.96
536-546	66.7	0.93
547-559	68.3	0.89
560-573	69.9	0.86

Table 2: Density and voids Analysis for VG30 Grade Bitumen

Sample No.	Bitumen content %	Height of sample in (cm)			Mean height (cm)	Weight of sample in (gm)		Bulk Density (Gb)	Theoretical Density (Gt)	Vv in %	Vb in %	VMA in %	VFB mix in %
		h1	h2	h3		Air	Water						
1.	5	6.0	6.1	6.1	6.1	1100	660	2.48	2.6	4.61	11.27	15.88	70.95
	5	6.2	6.3	6.5	6.33	1205	725	2.49	2.6	4.23	11.31	15.54	72.74
	5	6.7	6.5	6.4	6.53	1220	730	2.47	2.6	4.82	11.22	16.04	69.91
								2.48		**4.55**		**15.82**	**71.20**
2.	5.5	6.0	6.2	6.1	6.20	1227	740	2.50	2.59	3.47	12.05	15.97	78.27
	5.5	6.3	6.2	6.3	6.30	1150	695	2.51	2.59	3.05	10.75	13.78	76.81
	5.5	6.4	6.6	6.6	6.5	1220	735	2.51	2.59	3.47	12.50	15.97	78.27
								2.5		**3.33**		**15.24**	**77.78**
3.	6	6.2	6.3	6.3	6.3	1265	760	2.50	2.57	2.72	13.63	16.35	83.10
	6	6.10	6.3	6.3	6.23	1250	755	2.51	2.57	2.33	13.63	15.96	85.40
	6	6.4	6.5	6.5	6.45	1260	665	2.52	2.57	1.94	13.74	15.68	87.62
								2.51		**2.33**		**15.99**	**85.37**
4.	6.5	6.3	6.4	6.4	6.4	1275	775	2.51	2.56	1.95	14.59	16.54	88.60
	6.5	6.3	6.2	6.3	6.27	1250	745	2.24	2.50	2.33	14.77	17.00	86.38
	6.5	6.4	6.3	6.2	6.3	1240	750	2.50	2.56	2.30	14.77	17.07	86.52
								2.503		**2.193**		**16.87**	**87.16**

Table 3: Density and voids Analysis for PMB

Sample No.	Bitumen content %	Height of sample in (cm)			Mean height(cm)	Weight of sample in (gm)		Bulk Density (Gb)	Theoretical Density (Gt)	Vv in %	Vb in %	VMA in %	VFBmix in %
		h1	h2	h3		Air	Water						
1.	5	6.4	6.6	6.5	6.5	1100	660	2.47	2.58	4.26	11.22	15.48	72.48
	5	6.6	6.7	6.6	6.63	1095	655	2.46	2.58	4.65	11.18	15.83	70.62
	5	6.5	6.6	6.6	6.57	1100	660	2.46	2.58	4.65	11.18	15.83	70.62
								2.46		**4.52**		**15.71**	**71.24**
2.	5.5	6.6	6.5	6.6	6.67	1235	745	2.49	2.56	2.73	12.45	15.18	82.015
	5.5	6.7	6.6	6.6	6.63	1225	740	2.50	2.56	2.34	12.5	14.84	84.23
	5.5	6.6	6.7	6.5	6.6	1230	745	2.51	2.56	1.95	12.55	14.5	86.55
								2.50		**2.34**		**14.84**	**84.26**
3.	6	6.3	6.2	6.2	6.23	1260	765	2.51	2.54	1.18	13.69	14.87	92.06
	6	6.3	6.3	6.4	6.33	1230	745	2.51	2.54	1.18	13.69	14.87	92.10
	6	6.5	6.6	6.3	6.47	1225	740	2.51	2.54	1.17	13.69	14.86	92.12
								2.51		**1.17**		**14.86**	**92.09**
4.	6.5	6.3	6.3	6.2	6.27	1120	675	2.49	2.52	1.16	14.71	15.87	92.66
	6.5	6.2	6.3	6.5	6.33	1225	735	2.48	2.52	1.39	14.65	16.04	91.33
	6.5	6.2	6.4	6.5	6.36	1220	730	2.479	2.52	1.58	14.65	16.23	90.23
								2.48		**1.37**		**16.04**	**91.40**

The specimen to be tested is kept immersed under water in a thermostatically controlled water bath maintained at 60? for 30 to 40minutes. One specimen is taken out of the waterbath and is placed in the marshal test head. The loading unit of the Marshall Stability testing machine is started and load is applied at constant deformation rate of 51mm per minute. Maximum load reading and corresponding deformation dial reading are noted.

Table 4: Stability Test on VG 30 Grade Bitumen

Sl. No	Bitumen Content%	Mean Height(cm)	Flow dial reading	Flow value (mm)	Proving ring reading	Correction factor	Corrected stability (KN)
1.	5%	6.6	310	3.10	165	1	10.14
	5%	6.5	330	3.3	170	1	10.45
	5%	6.53	320	3.2	163	0.96	9.62
				3.2			**10.07**
2.	5.5%	6.36	350	3.5	230	1.04	14.71
	5.5%	6.33	340	3.4	250	1	15.37
	5.5%	6.46	370	3.7	190	1.04	12.15
				3.5			**14.07**
3.	6%	6.50	360	3.6	265	1	16.29
	6%	6.66	375	3.75	250	0.93	14.29
	6%	6.70	390	3.90	270	0.96	15.94
				3.7			**15.50**
4.	6.5%	6.33	400	4.00	280	1.04	17.9
	6.5%	6.40	390	3.9	260	1.09	17.49
	6.5%	6.50	420	4.2	250	1.00	15.37
				4.02			**16.92**

Table 5.32: STABILITY TEST RAP

Sl. No	Bitumen Content %	RAP Content %	Mean Height(cm)	Flow dial reading	Flow value (mm)	Proving ring reading	Correction factor	Corrected stability (kn)
1.	5	15%	6.5	290	2.9	210	0.96	5.33
	5	30%	6.53	350	3.5	220	0.96	5.59
	5	45%	6.3	380	3.8	255	1	6.74
					3.4			**5.89**
2.	5.5	15%	6.53	300	3.0	200	0.96	5.08
	5.5	30%	6.63	330	3.3	240	0.93	5.90
	5.5	45%	6.33	370	3.7	275	1	7.28
					3.33			**6.09**
3.	6.0	15%	6.56	310	3.1	205	0.96	5.20
	6.0	30%	6.6	340	3.4	250	0.93	6.15
	6.0	45%	6.4	390	3.9	300	1	7.94
					3.46			**6.43**
4.	6.5	15%	6.5	350	3.5	220	0.96	5.59
	6.5	30%	6.6	380	3.8	270	0.93	6.64
	6.5	45%	6.4	410	4.1	320	1	8.4
					3.8			**6.88**

V. CONCLUSIONS

Based on the experimental investigation conducted and the results obtained the following conclusions were drawn.

- Optimum bitumen content is determined as 5% of Marshall Mix design.
- Optimum Plastic content is determined as 8% of Marshall Mix design.
- Optimum Reclaimed asphalt pavement content is determined as 20% of MarshallMix design.
- Stability of bitumen with Reclaimed asphalt pavement PMB is (2775 KG) higher as compared to bitumen with plastic (2214 KG) at higher temperature.
- VMA of WMA is 14.8 which is less as compared to 15.2 of HMA is less comparedto 16.9 of RAP.
- VFB of WMA is 95 which more compared to 82.5 of HMA is less compared to 89.7of RAP.

VI. REFERENCES

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