Determination of Optimum Binder Content with Polymer Modified Bitumen in BC

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***Abstract*-Plastic is used everywhere in today's lifestyle. It is used for packing, protecting, serving and even disposing all kinds of consumer goods. With the industrial revolution, mass production of goods started and plastic seemed to be a cheaper and effective raw material. Plastic are users friendly but not eco-friendly because they are non- biodegradable and generally it is disposed by way of land filling or incineration of materials which are hazardous. Today, every vital sector of the economy starting from agriculture to packing, automobile, building construction, communication or info tech has been virtually revolutionized by the application of plastics use of this biodegradable product is growing rapidly and the problem is what to do with plastic waste. Studies have linked the improper disposal of plastic to problems as distant as breast cancer, reproductive problems in humans and animals, genital abnormalities. The better way of disposal of waste plastic may be using it in molten state for bituminous road. In the present work an attempt has been made to work out job mix formula for BC mix design in the highways.**

1.INTRODUCTION

In India the road transport carries close to 90% of passenger traffic and 70% of freight transport. Investigations in India and abroad have revealed that a property of bitumen and bitumen mixes can be improved to meet out requirements with additional certain additives called "Bitumen modifiers".

Modified bitumen is expected to give higher life of Pavement. The different types of modifiers used are polymers, natural rubbers and crumb rubber.

The use of modified bitumen helps in substantially improving the stability, fatigue life, strength and reduced rutting and water damage of bituminous roads under adverse water logging conditions. Therefore the life of the pavement surface course using the modified bitumen is expected to increase substantially in comparison to the use of conventional bituminous mix.

The effective utilization of the waste plastic bags for the preparation of modified bituminous mix will result in substantial increase in the scrap value for this otherwise "undesirable waste material" which are getting littered all over the urban areas.

The concept of utilization of waste plastic in construction of flexible road pavement has been done since 2000 in India. In the construction of flexible pavement, bitumen plays the role of binding the aggregate together by coating over the aggregate. It also helps to improve the strength and life of the road pavement. But its resistance towards water is poor. A common method to improve the quality of bitumen is by modifying the rheological properties of bitumen by blending with synthetic polymers like rubber and plastics.

2.MATERIAL CHARACTERIZATION

Study involves the aggregate and polymer modified bitumen (PMB-40)

a) PMB is a material which is obtained by mixing some modifiers like (SBS, PP, PE, EVA, EBA, SBR, etc.) Basic properties are given below (Table-1)

b) Aggregate –
An aggregate which has good and sufficient strength, hardness, toughness and soundness has to be chosen crushed aggregate produce higher stability. Basic physical parameters of aggregate are show in Table-2

3.OBJECTIVES

- To conduct the standard tests for the properties of Polymer modified Bitumen.
- To determine the optimum binder content for Bituminous concrete by Marshall Stability Method.

4.METHODOLOGY

There are two important process namely dry process and wet process used for bitumen mix flexible pavement.

a) *Dry Process:* - For the flexible pavement stone aggregate (170ºc) is mixed with hot PMB (160ºc) and the mix is used for road laying. The aggregate is chosen on the basis of its strength, Porosity and moisture absorption capacity as per IS coding. The PMB is chosen on the basis of its binding property, Penetration value and visco-elastic property. The aggregate, when coated with PMB improved its quality with respect to voids, moisture absorption and

soundness. The coating of PMB decreases the Porosity and helps to improve the quality of the aggregate and its performance in the flexible pavement.

b) *Wet Process:* - Modified Bitumen is mixed with aggregate. A mechanical stirrer is used for mixing. The mixture is heated upto temp. 155 to 160ºc.

5.OPTIMUM BINDER CONTENT: -

Selection of proper gradation for the mix is one of the most important parameter. Ministry of road transport (MORTH) has given some of the grading specifications for all the bituminous and non-bituminous layers used in road construction. Bituminous concrete (BC) is considered as the wearing course or the surface course. Nominal aggregate size of 19mm and layer thickness of 50-60mm is selected. Grading specification for bituminous concrete course is given in Table- 3.

6. TEST RESULT & DISCUSSION -

At 5.2 % Binder content –

Density = 2.567 gm/cc
Air voids (%) = 4.25 (with in specified limit)
VMA (%) = 16.80 (Greater than 13)
VFB (%) = 74.69 (with in specified limit)
Stability = 1335 kg (with in specified limit)
Flow = 3.5 mm (with in specified limit)

Optimum binder content obtained for bituminous concrete grade- I mix for PMB was 5.2% as per the specification of MORTH standards.

7. CONCLUSION

Plastic will increase the melting point of the bitumen . The use of the innovative technology not only strengthened the road construction but also increased the road life as well as will help to improve the environment and also creating a sources of income. Where temperatures frequently cross 48ºc and torrential rains create , havoc leaving most of the roads with big potholes. It is hoped that in near future we will have strong , durable and eco-friendly roads which will relieve the earth from all type of plastic-waste.

The use of waste plastic helps in substantially improving the stability, fatigue life, indirect tensile strength, and reduced rutting & water damage of bituminous mixes under adverse water-logging conditions. Therefore, the life of the pavement surface course using the waste plastic is expected to increase substantially in comparison to the use of conventional bituminous mix.

The effective utilization of the waste plastic bags for the preparation of modified bituminous mix will result in substantial increase in the scrap value for this otherwise "undesirable waste material" , which are getting littered all over the urban areas. These waste plastic bags will not therefore be thrown out along with the garbage; instead the same will get collected and sold by the consumers themselves or other agencies due to the attractive scrap value.

The cost of plastic road construction may be slightly higher compared to the conventional method. However, this should not deter the adoption of the technology as the benefits are much then the cost.

It is hoped that on completion of the above project waste materials will be put to use in road construction industry, resulting in improved road pavements and also relief from the waste plastic materials being littered all around urban areas.

From an environmental and economic standpoint , use of waste plastic fibers, as a bitumen modifying agent may contribute to solving a waste disposal problem to improving the quality of road pavements .

Table- 1: - Properties of PMB- 40 used in Present study

Sr. no.	Properties	Result	Test Method
1	Penetration at 25ºc	34.33	IS : 1203 – 1978
2	Softening point (R&B)	73.00	IS : 1205 – 1978
3	Ductility	78.00	IS : 1208 – 1978
4	Flash Point ºc	285	IS : 1209 – 1981
5	Sp. Gravity of Binder	1.021	IS : 1202 - 1980

Table-2: - Properties of aggregate used in present study.

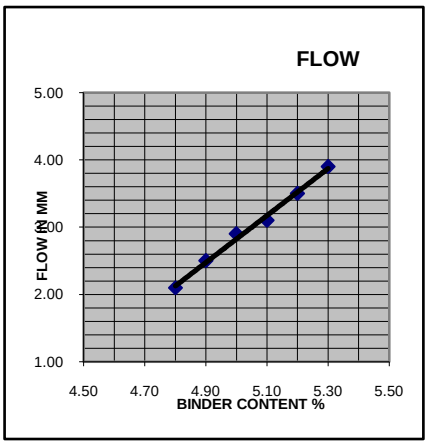
Sr. no.	Aggregate Test	Test Result Obtained	Requirement as per Table 500-16 of MORTH (5th revision) specification
1	Crushing value (%)	24.8	Max. 24 (%)
2	Impact value (%)	11.2	Max. 24(%)
3	Los Angeles abrasion value (%)	14.87	Max. 30 (%)
4	Combined Index (%)	19.16	Max. 35(%)
5	Water Absorption (%) 20mm 10mm Fine Aggregate	 0.12 0.23 0.49	Max. 2(%)
6	Sp. Gravity 20mm 10mm Fine Aggregate Filler	 2.983 2.954 2.903 2.43	
7	Stripping value of aggregate (20mm paving & 12.5mm retained)	100%	Min. retained coating 95%

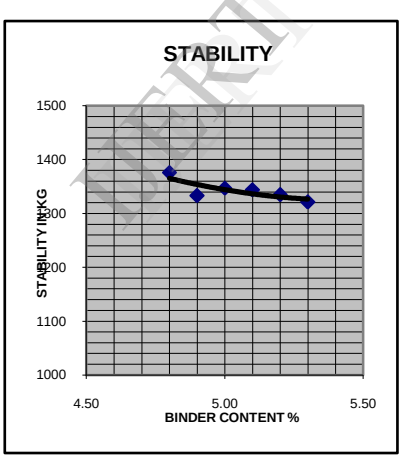
Table - 3

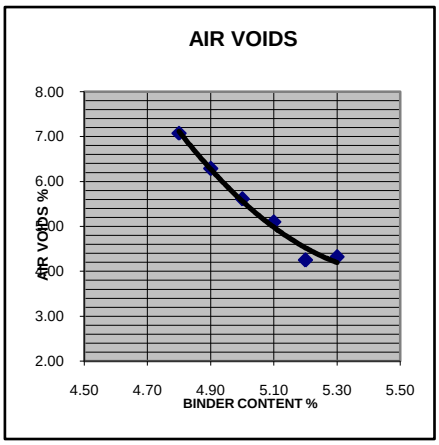
Blending For Bituminous Concrete										
Sieve Size In mm	20 mm		10 mm		Fine Aggregate		Filler		Actual Achieve	Permissible Limits
	% Passing	26	% Passing	28	% Passing	44	% Passing	2	100.00	
26.50	100	26.00	100	28.00	100	44.00	100	2	100.00	100
19.00	70.56	18.35	100	28.00	100	44.00	100	2	92.35	90-100
13.20	6.18	1.61	100	28.00	100	44.00	100	2	75.61	59-79
9.50	1.04	0.27	71.58	20.04	100	44.00	100	2	66.31	52-72
4.75	0	0.00	4.96	1.39	97.08	42.72	100	2	46.10	35-55
2.36			0.91	0.25	71.19	31.32	100	2	33.58	28-44
1.18					48.97	21.55	100	2	23.55	20-34
0.60					35.45	15.60	100	2	17.60	15-27
0.30					24.70	10.87	100	2	12.87	10-20
0.15					13.49	5.94	91	1.82	7.76	5-13
0.075					3.43	1.51	88	1.76	3.27	2-8

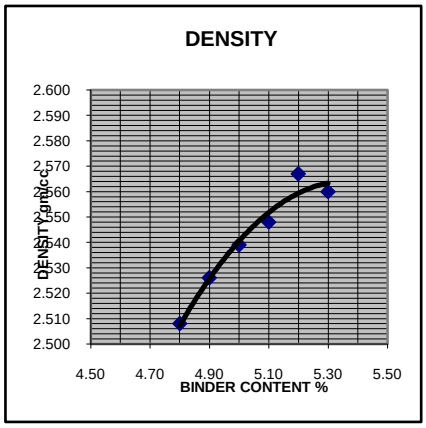
Table – 4

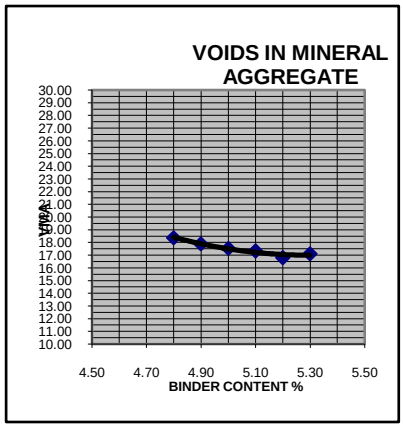
Observation Summary of Bituminous Concrete								
Sr. No.	**Binder Content %**	**Density gm/cc**	**Air Voids %**	**VMA %**	**VFB %**	**Stability kg**	**Flow mm**	**GMM gm/cc**
1	4.80	2.508	7.08	18.37	61.48	1376	2.10	2.699
2	4.90	2.526	6.29	17.89	64.85	1333	2.50	2.695
3	5.00	2.539	5.61	17.54	67.99	1347	2.90	2.690
4	5.10	2.548	5.10	17.33	70.56	1344	3.10	2.685
5	5.20	2.567	4.25	16.80	74.69	1335	3.50	2.681
6	5.30	2.560	4.32	17.11	74.75	1321	3.90	2.676
Specified Limits as per MORTH table 500-19 & TS		**-**	**3 - 6**	**Min 13.00**	**65 – 75**	**Min 900**	**2 – 4**	
Specified Limits as per IRC SP 53 2002		**-**	**3 - 5**	**Min 13.00**	**65 – 75**	**Min 1200**	**2.5 - 4**	

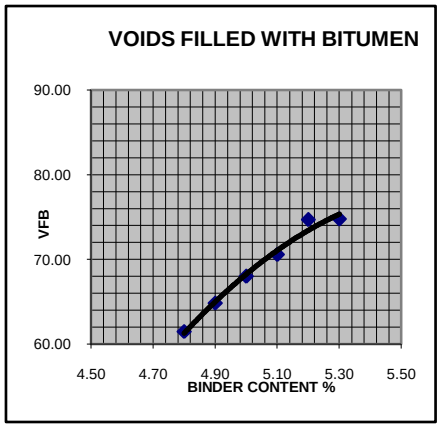


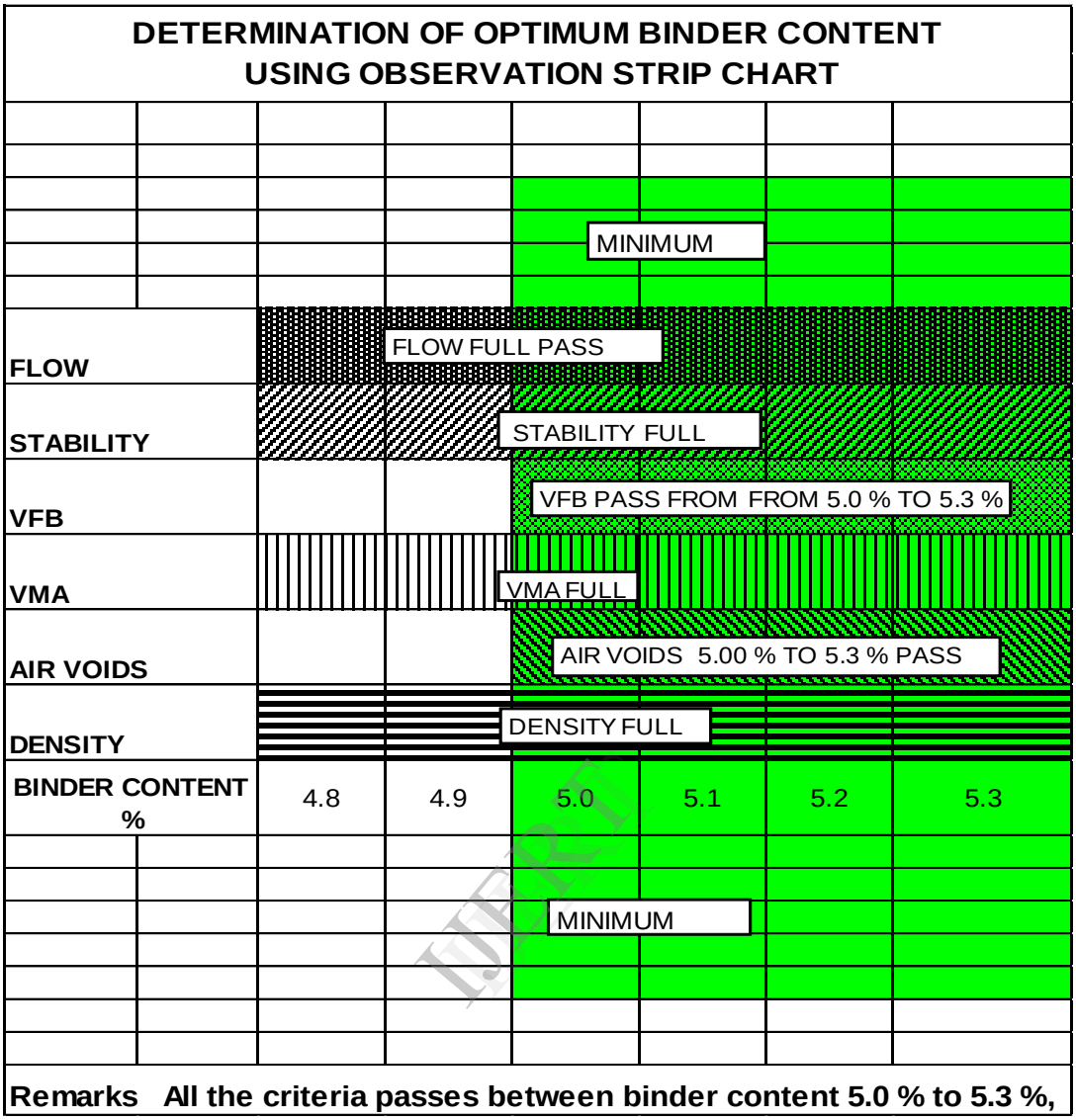












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IS : 1202-1980

IRC: SP: 53 (2010)