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WARM MIX ASPHALT

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Abstract: **Warm mix asphalt (WMA) is a relatively new technology. It was developed in response to needs for reduced energy consumption and stack emissions during the production of asphalt concrete, improved workability and compaction after long hauls and when using lower placement temperatures, and better working conditions for plant and paving crews. Studies in the United States and Europe indicate that significant reductions in production and placement temperatures, and, potentially, in related emissions are possible. However, concerns exist about how these lower production and placement temperatures could influence asphalt binder aging and, consequently, short- and long term performance, specifically rutting. The testing completed in this warm mix asphalt study provided no results to suggest that warm mix technologies should not be used in conventional, gap-graded asphalt rubber, and open-graded friction course mixes in California, provided that standard specified mix design, construction, and performance limits for hot mix asphalt are met. The use of warm mix asphalt has clear benefits when compared to hot mixes. These include significant reductions in, or even elimination of, smoke and odours, lower emissions, improved workability, better working conditions, and better performance on projects with long hauls or where mixes are placed under cool conditions. The slightly higher costs of using warm mix technologies are outweighed by these benefits. Based on the findings of this study, the use of warm mix**

Keywords: **Organic additive: SASOBIT (Paraffin wax), Chemical additive: EVOTHERM (Soya wax).**

1. INTRODUCTION

Over the last two decades, the production and appliance of asphalt mixtures have been improving, particularly to achieve economic and environmental objectives. Recently, the improvement has paid more attention to the reduction of energy consumption throughout the process, without changing the in-service mechanical performance of these asphalt mixtures. There is a growing international pressure on the reduction of fossil fuels consumption and the emission of greenhouse effect gases (GHG) such as carbon dioxide If a significant temperature decrease could be achieved within the production practice of asphalt mixtures, while the workability of the material is adequate and mechanical performance attained is the same as or even better than HMA, the gain for the environment and the society in general would be significant. The hot-mix asphalt industry is constantly exploring technological improvements that will enhance the material's performance, increase construction efficiency, conserve resources, and advance environmental stewardship. It is logical that one approach to achieving these goals would involve methods to reduce material production temperatures. The concept of warm-mix asphalt has been introduced over the last few years as a means to these ends. Warm-mix asphalt is produced at temperatures in the range of 30˚to 100˚F lower than typical hot-mix asphalt (HMA). The production and placement of HMA pavements has evolved over the last 130 years from hand mixing and manual placement with rakes and shovels to computerized plants feeding highly automated remixing, placement, and compaction equipment that track location and material quality. During this period, it has become recognized that temperature control is crucial to aggregate coating, matrix stability during production and transport, ease of placement, compaction, and ultimately the performance of the pavement.

II. ADDITIVES USED IN WARM MIX ASPHALT MIXTURES

ORGANIC ADDITIVE: Sasobit is a product of Sasol Wax (formerly Schümann Sasol), South Africa. Sasobit is described as a modifier or "asphalt flow improver". It is available in 2, 5, 20 and 600 kg bags. On request it can be supplied in flakes or powdered form. Sasobit is a fine crystalline, long chain aliphatic hydrocarbon produced from coal gasification using the Fischer-Tropsch (FT) process and is otherwise known as an FT paraffin wax.

CHEMICAL ADDITIVE: Evotherm is a product developed by MeadWestvaco Asphalt Innovations, Charleston, South Carolina. Evotherm uses a chemical additive technology and a "Dispersed Asphalt Technology" delivery system. MeadWestvaco states that by using this technology a unique chemistry customized for aggregate compatibility is delivered into a dispersed asphalt phase (emulsion). During production, the asphalt emulsion with Evotherm chemical package is used in place of the traditional asphalt binder. The emulsion is then mixed with the aggregate in the HMA plant. MeadWestvaco reports that this chemistry provides aggregate coating, workability, adhesion, and improved compaction with no change in materials or job mix formula required.

III. AIM AND OBJECTIVES

1. To determine the reduction in Viscosity of bitumen with additives in making of WMA.

2. To determine Marshall Properties of WMA with different percentages of additives at various temperatures.

3. Comparison of Marshall Properties of WMA with different additives and HMA.

4. To determine Optimum Binder Content in the mixes with varying percentages of reclaimed asphalt pavement.

5. To study the changes in structure of Bitumen after adding warm mix additive.

6. To study the properties of bituminous concrete mix and mixes containing varying percentages of reclaimed asphalt pavement.

7. To develop an economical blend of aggregates and asphalt that meet design requirements

IV. METHODOLOGY

CHARACTERIZATION OF AGGREGATES:

Aggregate samples of sizes 40mm down, 20mm down, 12.5mm down and Quarry dust are collected from the crusher and sampled aggregates are characterized for the following properties.

- Aggregate Impact Value
- Aggregate Crushing Strength
- Los Angeles Abrasion
- Specific gravity and Water absorption
- Particle shape (Flakiness and Elongation Index)

Aggregates are tested as per the procedure laid in the IS Code-2386, Part-IV.

Physical Properties of Aggregates

Sl.no	Test	Result	Specifications as per MORTH	Reference
1	Aggregate impact value test	18.17%	Max 24%	IS:2386 Part 4
2	Aggregate Crushing value test	23.46%	Max 30%	IS:2386 part 4
3	Los Angeles abrasion test	29.8%	Max 30%	IS:2386 part 4
4	Water absorption 12.5mm down 4.75 mm down	 0.63% 1.3%	Max 2%	IS:2386 part 3
5	Specific gravity 12.5mm down 4.75mm down	 2.45 3.18	--------	IS:2386 part 3

CHARACTERIZATION OF BINDER

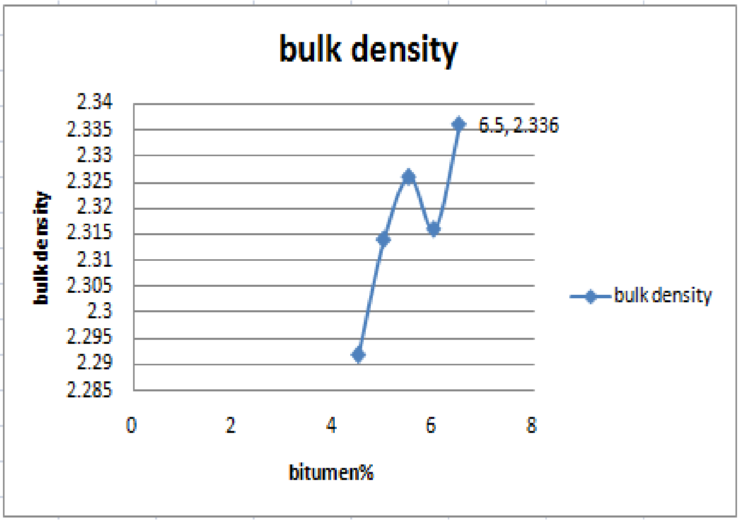
VG-30 bitumen obtained from Mangalore Refineries and Petrochemicals Ltd. (MRPL) was used in the study and physical properties are as shown in the table below.

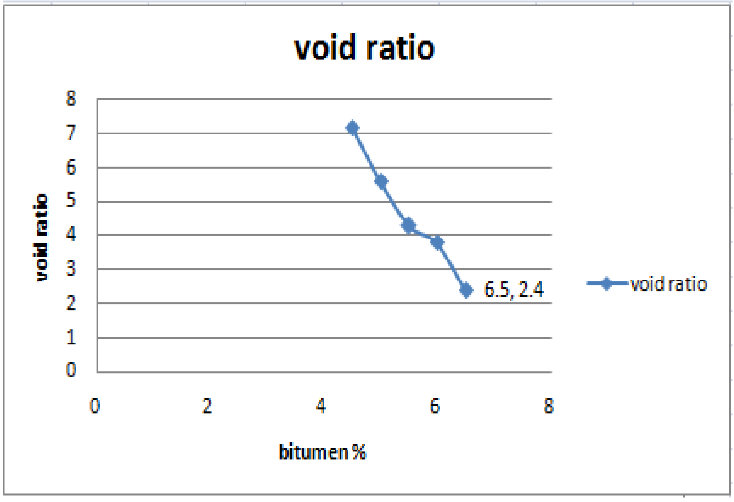
Physical Properties of Binder

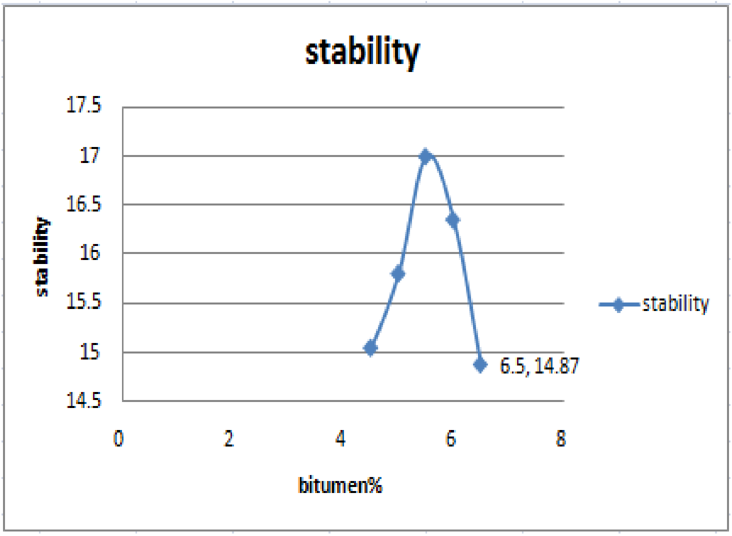
Sl. no	Properties	Result	Specifications	Reference
1	Penetration test (mm)	68.5	60-70	IS 73-2006
2	Softening point (^{0}C)	68°C	Min 47º c	IS 73-2006
3	Ductility test (cm)	100	Min 75	IS 73-2006
4	Flash and Fire point test (°C)	240°C	Min 220º c Min 270º c	IS 73-2006

V. RESULT

Bitumen content	Mould no	Wt in air (g)	Wt in water(g)	SSD Wt (g)	Volume of the mould (cc)	Bulk density (g/cc)	Bulk specific gravity (Gsb)	% Va	%VMA	%VFB	Stability (KN)	Flow (mm)
	1	1262	716	1264	548	2.303					14.40	2.25
4.5	2	1244	700	1244	544	2.287					16.12	2.5
	3	1250	706	1250	544	2.297					15.69	2.5
Avg						2.292	2.650	7.2	17.7	59.3	15.04	
	4	1262	710	1262	552	2.286					15.24	2.5
5	5	1260	718	1262	544	2.316					16.37	2.75
	6	1258	714	1258	544	2.312					16.02	2.5
Avg						2.314	2.650	5.6	17.40	67.81	15.80	
	7	1270	724	1270	546	2.328					17.66	2.75
5.5	8	1268	722	1268	546	2.324					16.35	2.75
	9	1268	718	1270	552	2.297					15.04	2.5
Avg						2.326	2.650	4.3	17.4	75.29	17.00	
	10	1282	726	1286	560	2.290					17.66	2.75
6	11	1274	724	1274	550	2.316					15.04	2.75
	12	1270	724	1272	550	2.310					13.28	2.25
Avg						2.316	2.650	3.8	18.0	78.88	16.35	
	13	1270	724	1270	546	2.326					15.37	2.5
6.5	14	1284	734	1284	550	2.334					13.73	2
	15	1292	740	1294	554	2.332					14.38	2.5
Avg						2.336	2.650	2.4	17.9	86.59	14.87	





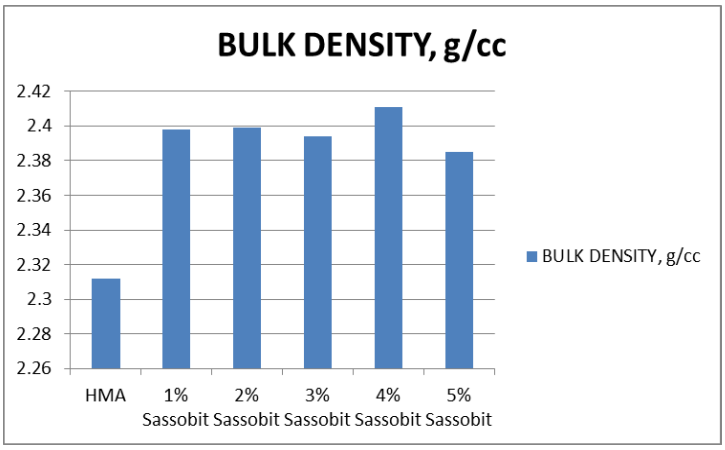


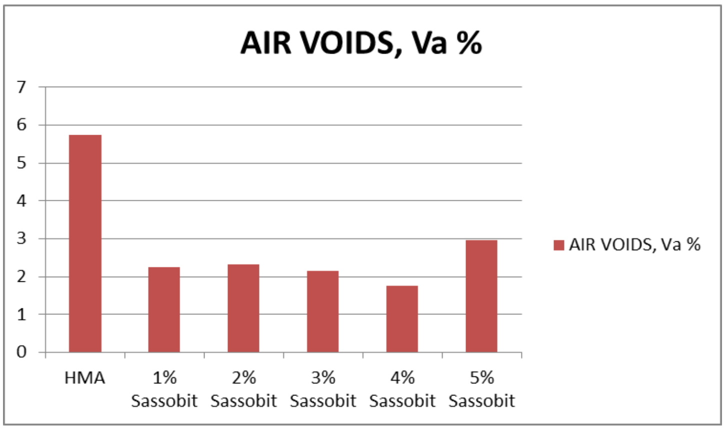
Marshall properties of Hot Mix Asphalt for OBC at standard mixing and compaction temperature

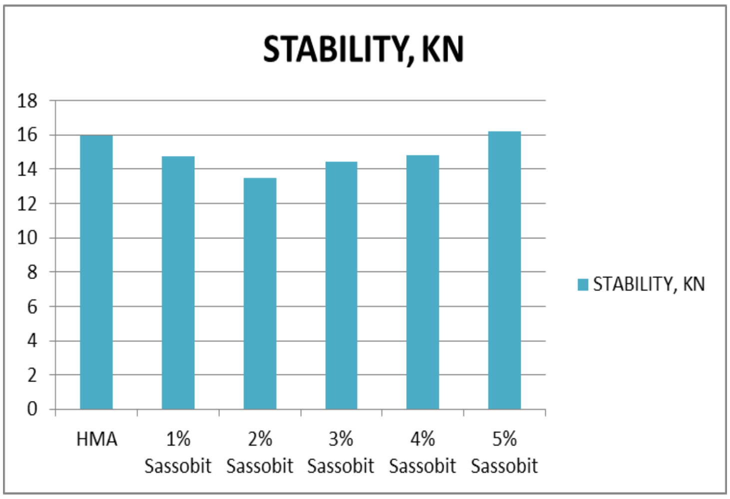
Mould	Bulk density	Flow	Stability	V_a	VFB	VMA
1	2.306	2	14.9	5.997	68.453	19.01
2	2.288	2.25	14.12	6.73	65.738	19.643
3	2.292	2.25	17.65	6.568	66.32	19.502

Marshall property of BC mixes at 5.7 OBC

Specimen	Bulk density	V_a (%)	VMA (%)	VFB (%)	Stability (%)	Flow (mm)
HMA	2.312	5.75	18.80	69.41	15.93	2.63
WMA 1% Sasobit	2.398	2.25	15.78	85.74	14.77	3.73
2%	2.399	2.33	15.75	84.899	13.46	4.566
3%	2.394	2.15	15.70	83.2	14.44	3.833
4%	2.41	1.759	15.35	84.36	14.78	3.16
5%	2.385	2.961	16.42	81.96	16.22	3.66







VI. CONCLUSION

1. The bulk density and stability values shows the sign of improved strength in WMA(Warm mix asphalt) Compared to HMA(Hot mix asphalt).

2. Air voids and Voids in mineral aggregates are comparatively lower in WMA than HMA which helps in achieving good bonding strength.

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