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Research Article

Gauging the properties of CRMB 60 in Mix Design with Zycotherm as warm mix additive

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Abstract

The engines of economic growth depend on good infrastructural facilities, as good roads are the life line of country to meet ever increasing demand of users. In India, the sustained efforts need to be made with respect to quality and quantity of roads in terms of load carrying capacity; performance of pavement, durability, length and economy is needed. The construction of roads using hot mix asphalt increases pollution, hence the dire need to come out with a fruitful solution is utilizing warm mix asphalt which is a fast emerging new technology and has potential to reduce the energy consumption i.e. lowering the mixing and compaction temperatures. Warm mix asphalt can reduce production temperatures by about 30º C to 40º C. Hot mix asphalt mixtures are generally prepared at 160°C or greater temperatures depending mainly on the type of binder used. Study of literature shows very few experimental laboratory research done in the area of warm mix asphalt technologies. In this study, an attempt is made to evaluate the changes in engineering properties of the CRMB 60 with and without warm mix adhesion (zycotherm). Also Marshall Mix design is carried out on CRMB 60 with and without warm mix adhesion in suitable dosages of 0.125% and 0.15% at lower temperature as per the provisions of codal practice, without any compromise with quality. The impression of tests proposes the powerful urge to move WMA into the standard of clearing items as the creation temperature is brought down profiting the asphalt development proficiency and bringing down pollution levels as well.

Keywords: *Zycotherm, Marshall Stability, warm mix asphalt, Hot mix asphalt, CRMB 60.*

1. Introduction

Warm Mix Asphalt (WMA) is a quick rising new innovation which has a capability of upsetting the creation of black-top mixtures. Expanding concerns on environment, rising vitality costs, a worldwide temperature alteration, and nursery impact, coupled with expanded development costs prompted the advancement of new advancements by the Asphalt business to create Asphalt Concrete (AC) asphalts. Broad examination is being carried out to assess the effect and execution of these new innovations. Warm blend added substances specifically Zycotherm measurements in 0.125% and 0.15% is utilized with CRMB 60 to lessen the blending and compaction temperature is a sensible, temperate way to deal with meet execution standard for asphalt today. The innovation can decrease creation temperatures by as much as 30 percent, this will diminish fuel utilization by no less than 20% and essentially lower discharges at the hot-blend plant as well as at the clearing site, yet it delays the administration life of the road by enhancing the execution and sturdiness of the bitumen asphalt down, and compaction of asphalt mixes at significantly lower temperatures compared to Hot Mix Asphalt (HMA).

2. Literature Review

Rohith N. & J.Ranjitha (2013) uncovered that The Warm Mix Asphalts (WMA) is adjusted Hot Mix Asphalt (HMA) which is delivered, laid and compacted in temperature which is lower than traditional HMA. The WMA is created by blending synthetic added substances to the ordinary blend to enhance the asphalt execution. In this study an endeavor is made to compare the Marshall properties of WMA created with the concoction added substance: ZycoTherm and HMA for Dense Bituminous Macadam (DBM) Grade 2. The received blending temperatures for HMA was 155°C,130°C and 115°C and the blending temperatures for WMA was 130°C and 115°C, with an added substance measurement rate of 0.1% by weight of the cover. The ideal fastener substance was to be figured out exclusively for the mixture for diverse blending temperatures and added substance measurements

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rate. The research center study reasons that The Warm Mix Asphalts (WMA) is altered Hot Mix Asphalt (HMA) which is delivered, laid and compacted in temperature which is lower than customary HMA

Xijuan Xu, (2011) Warm Mix Asphalt is low-carbon, naturally agreeable black-top mixture. These kind mixture spare assets diminish unsafe crevice outflows, as well as to keep up the black-top mixture in a superior utilization of value. In the article, by adding added substances to lessen the thickness of black-top, we achieve the impact of decreasing the temperatures of mixture blending and compaction. In the meantime, we do probe mull over high temperature solidness, low temperature break resistance and water steadiness, the outcome demonstrate that Warm Asphalt Mix gets great execution.

Elie and Edward (2011) led lab test for the CECABASE Warm Mix Additive utilizing a total of a size 19.0mm as indicated by Caltrans Standard particular and NDOT detail for Road and Bridge development. PG 64-28 polymer altered black-top fastener was utilized for the study. Temperature of 160ºC and 132°C were kept up for the arrangement of HMA and WMA blends individually. CECABASE warm blend added substance was added to black-top cover at a rate of 0.4% by weight of folio. Blend configuration was completed by and NDOT particular for the HVEEM design method.

3. Materials

Aggregates: The coarse totals are squashed by utilizing crusher to get changing size of totals from 20 mm, 10 mm and 6 mm. The totals needed for the example ought to be clean, cubic formed and harsh surface to oppose rutting and developments and hardness which can oppose breaking under substantial movement loads.

Stone Dust Fillers: Mineral fillers have critical effect over the properties blend outline. Fillers have a tendency to build the firmness of the black-top and mortar network. It enhances imperviousness to dampness, enhances workability, keeps up sufficient measure of void in the blend and upgrades the strength of blend.

Crumb Rubber Modified Binder (CRMB 60): Scrap Rubber Based Type-D CRMB 60 is softening point based bitumen adjusted with Crumb Rubber powder got from discarded truck tires. Morsel elastic is added to hot bitumen and the mixture is mechanically stirred until there is a response between the bitumen and scrap elastic. At the point when Crumb Rubber Modified Bitumen is consolidated with mineral aggregates it gives higher union and better attachment contrasted with ordinary and clearing bitumen grades. CRMB additionally offers extraordinary flexible recuperation, diminished level of rutting, enhances hostile to stripping properties and high maturing resistance. In amazing hot climatic conditions and summer months the CRMB prevents the black-top from softening, when road surface temperatures may and motorways with overwhelming movement stream, higher slide resistance, better road hold and cover vehicle break application, which diminishes mishap.

Warm Mix Additive – Zycotherm: It is WMA added substance grew by Zydex Businesses, Gujarat, India. This is a smell free, concoction warm blend added substance that has been built to give essentially enhanced profits over current WMA advancements by offering lower creation and compaction temperatures, while at the same time improving the dampness resistance of asphalts by serving as an antistrip. Generally speaking, ZycoTherm offers temperature decreases relying upon the properties of the blend. ZycoTherm has constructed in antistrip instrument that permits it to dually work as an antistrip and in addition a warm blend added substance. The added substance is all around good with a wide range of adjusted and unmodified covers. This included Polymer Modified Bitumen and Crumb Rubber Modified. Bitumen covers. It doesn't influence cover evaluating or change whatever other folio properties

4. Methodology

In this study above all else investigation of physical properties of total sizes 20 mm,10mm and 6mm got from quarry of Tuva, Savali, Baroda district is done. Degree meeting MoRTH segment 508, ostensible total size is brought with stone tidy as filler material to meet the suitable blends for bituminous blends outline. The Bitumen utilized for this study is instant CRMB 60 acquired from Hincol Company, GIDC Savli, Baroda local. Important tests to focus the properties on CRMB 60 with and without Zycotherm synthetic as an added substance are done.

At long last specimens are arranged for Mix Design (Marshall Test) to focus the Optimum Bitumen Content of CRMB 60. In the wake of getting ideal bitumen, changed extents of 0.125% and 0.15% of zycotherm chemical additive at distinctive temperature like 115°, 130°, 150° C is included by weight of CRMB 60 to focus ideal temperature and ideal dose of zycotherm to meet the obliged quality by fulfilling the suggestion and necessities of MoRTH Section.

Table 1: Physical properties of Aggregate

Sr No	Property	Test	Result	Recommended Value as per MoRTH 500 section- 509	
1	Cleanliness (dust)	Grain size	0.50%	Max 5% Passing	
2	Toughness	Aggregate Impact value	8.20%	24% Max	
3	Particle Shape	Flakiness and elongation Index (combined)	24.60%	30% Max	
4	Water absorption	Water absorption	20 mm Agg 0.00401 6 mm Agg 0.00797	2% Max	
5	Specific Gravity & Gradation	Aggregate size	Sp. Gr	Wt. of sample	% of sample
		20 mm Agg 10 mm Agg 6 mm Agg Stone dust Total	2.874 2.843 2.665 2.635	408 228 108 456 1200	34 19 9 38 100

Table 2: Test result of CRMB 60

Sr. No	Tests	Results			Recommendation as per IS 15462- 2004
		CRMB-60	CRMB-60+ Zycotherm (0.125%)	CRMB-60+ Zycotherm (0.15%)	
1	Penetration at 25°C, 0.1 mm, 5 sec	55	50	48	<50 (IS:1203)
2	Softening Point, °C, in	63.65	62.55	60.9	60 (IS:1205)
3	Specific Gravity	1.030	1.031	1.029	--
5	Elastic recovery, 25°C, percent (min)	73	72	69	Min 35

Laboratory investigations to determine physical properties of aggregates (See Table 1)

Gradation of aggregate meeting MoRTH section 508

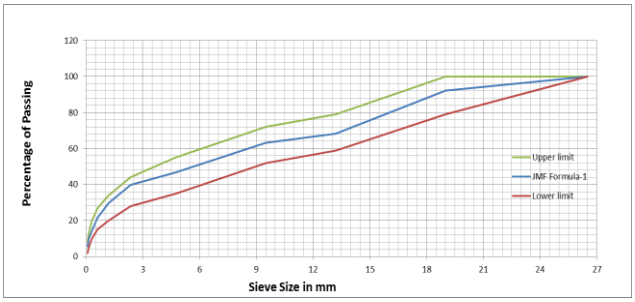

Fig. 1: Gradation of aggregate chart

From the plot of aggregate gradation chart as shown in figure 1, it shows specifically the obtained gradation line nearly the average proportion of aggregate which is useful for paving mix.

Laboratory investigations to determine physical properties of CRMB 60 with and without Zycotherm (see Table 2)

Marshall Mix design for optimum binder content using CRMB 60

For deciding the Optimum Bitumen Content, 5 specimens are arranged of bitumen substance at4.5, 4.75, 5.0, 5.25, and 5.50% of degree blend weight at blending temperature 160° C according to the system and prerequisites of MoRTH segment 508

Table 3: Marshall results showing properties of mix satisfying MoRTH section

Sr. No	Bitumen Content	Stability Kg.	Flow Value mm	Bulk Sp. Gravity	Va	VFB	VMA
1	4.5	1121.0	2.20	2.404	6.66	59.99	16.66
2	4.75	1196.3	2.57	2.415	5.82	64.65	16.48
3	5.0	1271.1	3.20	2.428	4.91	69.76	16.24
4	5.25	1328.2	3.70	2.441	4.00	75.00	16.01
5	5.50	1293.3	4.13	2.433	3.96	76.06	16.52

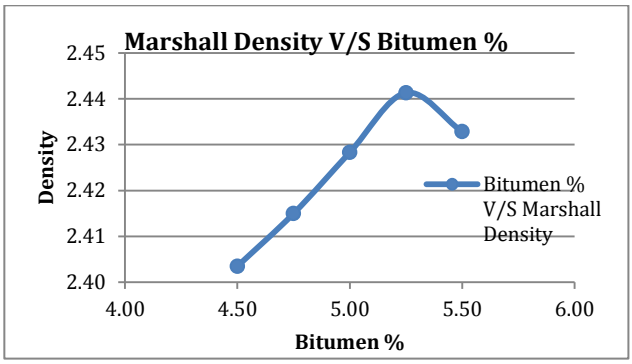

Fig. 2: Marshall Density V/S Bitumen %

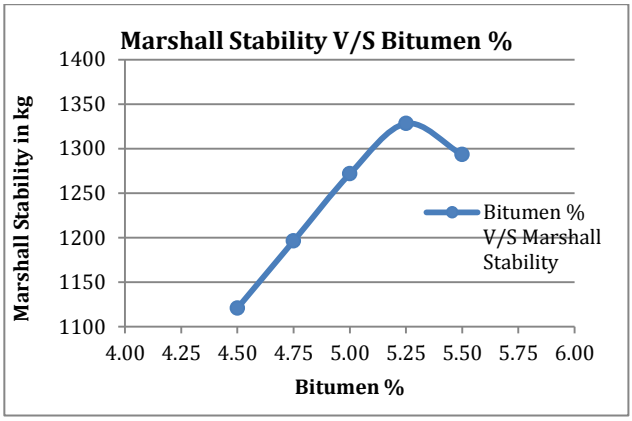

Fig. 3: Marshall Stability V/S Bitumen %

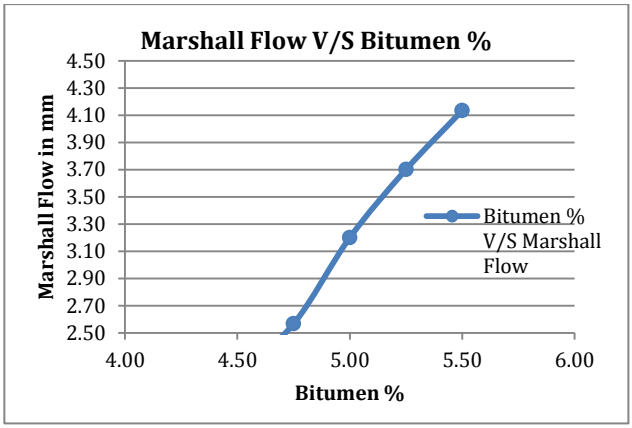

Fig. 4: Marshall Flow V/S Bitumen %

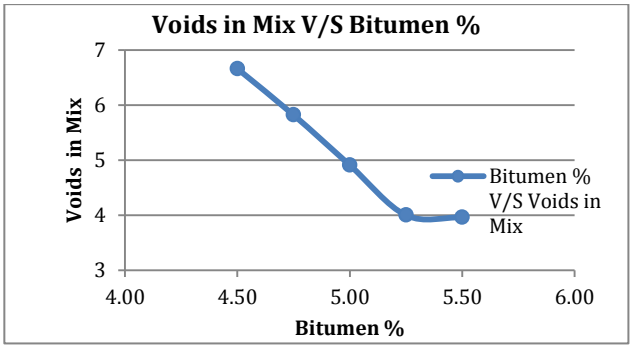

Fig. 5: Voids in Mix V/S Bitumen %

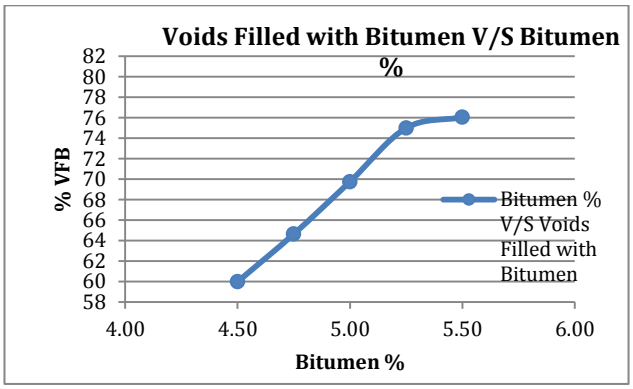

Fig. 6: Voids Filled with Bitumen V/S Bitumen %

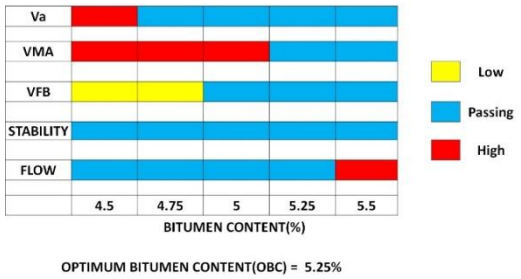

Fig. 7: Optimum bitumen content

Looking to the figure 2, 3, 4, 5, 6 and 7 the ideal cover substance 5.25% fulfils the point of confinement set down in MoRTH segment 509 regarding greatest steadiness, maximum stability, Marshall Flow value, bulk specific gravity, percentage air voids in compacted mix and voids filled with bitumen.

Marshall Mix design for CRMB 60 (5.25 % optimum binder content) plus Zycotherm with optimum dosage and optimum temperature

Test after effects of Bituminous Concrete blend utilizing CRMB 60 with 5.25% ideal bitumen substance is looked into for blend plan by expansion of 0.125% and 0.15% dose of Zycotherm at temperature 115°C, 130°C and 150°C by weight of CRMB 60 to acquire homogeneous blend to assess the volumetric properties meeting the obliged benchmarks for satisfaction of road construction work.

Graphs of all properties of each mix are plotted as shown in figure:

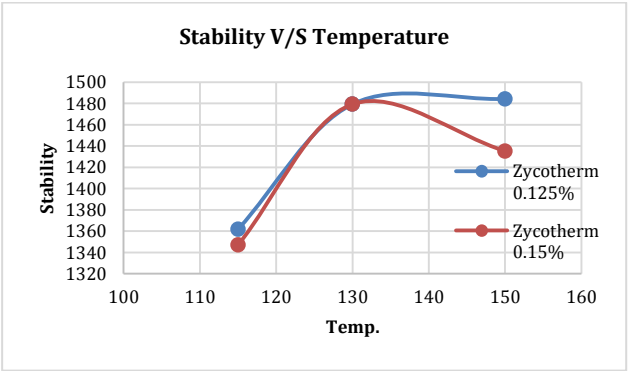

Fig. 7: Stability V/S Temperature

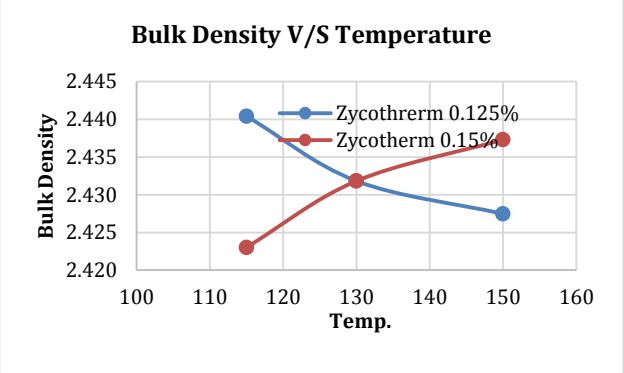

Fig. 8: Bulk Density V/S Temperature

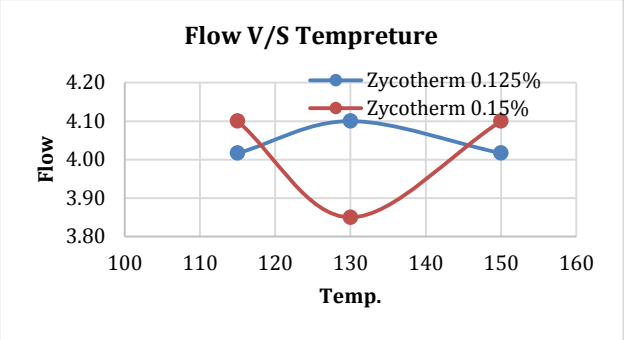

Fig. 9: Flow V/S Temperature

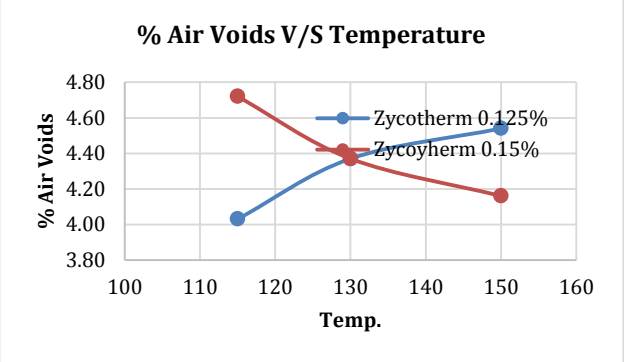

Fig. 10: % Air Voids V/S Temperature

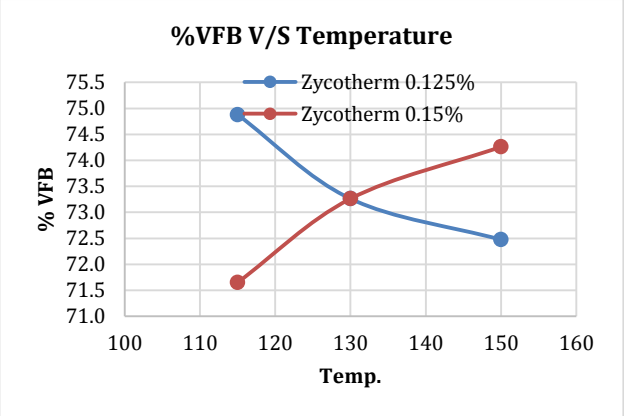

Fig. 11: %VFB V/S Temperature

Conclusion

From the different examinations completed in the laboratory taking after, conclusions are drawn:

- From the figures 2 to 6, Volumetric and mechanical properties of Marshall examples, acquired at different cover substance demonstrates ideal bitumen substance of 5.25% (by weight of aggregates) fulfils the Marshall blend cut off set down in MoRTH segment 508 concerning maximum stability, flow value, bulk specific gravity, percentage air voids in compacted mix and voids filled with bitumen.
- Lab Investigations to focus physical properties of CRMB 60 level bitumen with and without zycotherm fulfil codal practice likewise it is seen that measurement of 0.15% by weight of black-top is satisfactory for road development as all properties are closer to those of CRMB 60 level aside from viscosity test which hints at an impression of the nature of bond that is liable to be shaped with the aggregate at lower temperature.
- Stability test for 0.15% measurement of Zycotherm as warm blend added substance is higher noted at 130°C, air voids; voids loaded with bitumen and stream worth are fulfilling the norms criteria's. The critical thing about warm blend as added substance is huge decrease in temperature is noted with no trade off with nature of execution for adaptable asphalt. A diminishment in the temperature of generation of black-top blends gives vitality reserve funds, diminishes black-top oxidation and can likewise diminish emanations at the blend along these lines diminishing the effect on nature. Likewise decrease in clearing temperatures expands the clearing season decreases presentation of specialists to destructive exhaust and grows the geographical territory that every hot blend plant can serve.

Thus, it is clearly reflected that utilization of 0.15% expansion of Zycotherm as Warm blend at 130°C temperature in development of Bituminous Concrete is eco-accommodating, cost effective and useful under precise supervision.

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