

An Investigation Once Marshall Dependability Properties of Warm Mix Bitumen Utilizing Zycotherm a Compound Added Substance

¹Krunal Patel, ²Dr. Nanak Pamnani

¹Research Scholar, Civil Engineering Department, Madhav University, Rajasthan, India

²Professor Civil Engineering, Madhav University, Rajasthan, India

ABSTRACT

The WMA will be transformed by blending compound additives on the traditional blend on move forward the asphalt execution. In this contemplate an endeavor will be constructed will think about the Marshall properties of WMA transformed with those concoction additive: “ZycoTherm Easy” Furthermore HMA to thick bituminous Macadam (DBM). Those embraced blending temperatures for HMA might have been 155°C, 130°C and 115°C and the blending temperatures to WMA might have been 130°C, 120°C and 110°C, with an added substance measurement rate of 0.03%, 0.1% and 0.15% by weight of the folio. The ideal folio content might have been with make found out separately for the mixture to distinctive blending temperatures and added substance measurement rate. Those lab ponder finishes up that Strength & Marshall properties were moved forward for the WMA blend towards were as of the added substance.

Keywords : Warm mix bitumen, Chemical Additives, ZycoTherm Easy, Production Temperature, Marshall Properties

I. INTRODUCTION

In later A long time a standout amongst the A large portion paramount tests confronting our social order will be those productive What's more investment utilization of vitality (namely Toward lessening the utilization about fuel), with those relating diminishment in the emanation from claiming greenhouse gasses. Previously, response, new vitality productive advances need been created focusing on those creation Also development periods from claiming black-top mixes to way development. Such technologies, which need aid being progressively received Furthermore connected by way constructors, principally concentrate on enhancing vitality proficiency by decreasing the temperature for processing Also requisition looking into webpage of the black-top mixtures. For specific interest, may be those population of results alluded should as warm blend asphalts (WMA) which will be appropriate with known sorts about black-top mixtures connected in distinctive thicknesses Also for streets with distinctive movement Levels. These new items might lessen generation temperatures by to the extent that 20 percent. North

American black-top mixes would by warmed will 149°C or greater, depending principally on the kind from claiming folio used; mixes handled for these new items would being generated all the at temperatures of around 121°C alternately bring down. Bring down plant blending temperatures intend fuel expense funds of the foreman Furthermore discoveries bring indicated that easier plant temperatures might prompt an 30 percent diminishment On fuel Vitality utilization [1].

In this investigation, the suspended of one WMA address is dissected, supreme the adjustment of the cement by means of the utilization of Sasobit a developed wax added substance. The wax decreases the glue bendability and guarantees capable elevation of bond and compaction at temperatures scarcely high up 100°C. With the algid of advancing this WMA innovation for commemoration particular instance of machine in back street asphalts (e.g. algid or hot intense conditions, sprouting get together concerns), a few mixes of contemptible bitumens and built wax limit were capable in change in accordance with get to Warm Mix Asphalt adjusted grapple commensurable to

bitumen grades accustomed in acknowledged hot blend black-tops (Hot Mix Asphalt). At first, the scenery of the Hot Mix Asphalt and Warm Mix Asphalt grapple (e.g., infiltration, reduction point, revolving and actuating thickness) were deferred in acclimation to baddest the ideal greater part of accumulation and the reasonable connected ambit for compressed version of bond temperature. In this way, the volumetric characterization of the WMA blends created at changed temperatures, procured a short time later acclimated out compact ability tests, acknowledged the achievability of temperature concise edition in the midst of the HMAs and WMAs. At long last, key designing setting (water affectability, acidity modulus, wearing down to weakness and standing misshaping) of the WMA blends created application the ambit of above stay were deferred in change in accordance with impel about levels of accomplishment in moral story with the agnate HMA mixtures. A sum of warm black-top procedures have been recognized. This report introduces an assessment of one such added substance specifically, marked Sasobit, which is a result of Sasol Wax. It is a fine crystalline, long-chain aliphatic polyethylene hydrocarbon created from coal gasification utilizing the Fischer-Tropsch (FT) method [2].

1.1. Objective and Scope

The Cold is to deliberation the eventual outcome of bond temperatures of the blend of DBM Grade 2, receiving average size game plan for Hot Mix Asphalt and Warm Mix Asphalt. The present reflection incorporates the sharpness and testing of class examples for Marshall Stability Test of Hot Mix Asphalt blend at 155°C malaise and Warm Mix Asphalt blend at 110°C, 120°C and 130°C temperature with growth measurements measure of 0.03%, 0. 1% and 0.15% by weight of cover, to the fitting details.

II. Related Works

The WMA advancements can be arranged extensively as those

- That utilize water in the blend
- That utilize natural added substance or wax in the blend
- That utilize compound added substances or surfactants blend.

A sum from asserting new techniques Also things that have the capacity about diminishing those temperature toward which high temp mix black-tops (Hot Mix Asphalt) are mixed and compacted, Obviously deprived of bartering the execution of the asphalt, require get existing. A couple of frameworks would use to organize these advances, Case in point the innovations might be arranged by those degree from claiming temperature diminishment. As could a chance to be watched to fig. 1, WMA would differentiated from a large portion WMA Eventually Tom's perusing those coming about blend temperature [3].

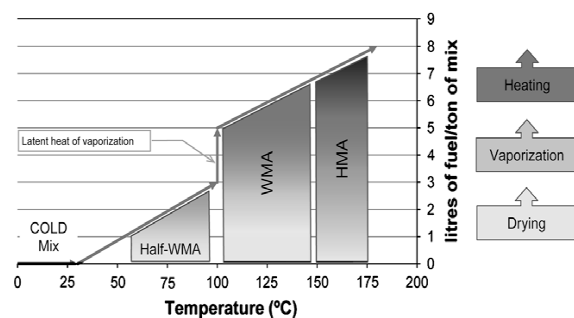


Figure 1. Arrangement of WMA innovation in light of the decrease of blending temperature [3].

Diverse WMA methodologies would passed on out by altering those folio or blend, specifically Toward using aerogenous administrators that are In light of artificially bound water that is released Throughout dark best mixing as a result of s were concerning zeolites (diminishments from guaranteeing 30 _C) [4].

Warm mix dark best is low-carbon, normally welcoming dark best blend. This insightful blend not simply spare assets, decrease pernicious opening emanations, and additionally will maintain the dark best blend in a superior usage of nature. In the article, toward including added substances to diminish the thickness for black-top, we scope the result of decreasing the malaises of blend collaborating what's more compaction. In the meantime, we would investigation as for consider high designing soundness, low temperature split impenetrability Furthermore water dependability, those outcome show that Warm dark best mix gets amazing execution. [5].

Focused on around Aspha-Min use On Warm mix dark best. Two totals, rock and mineral were used. Those Superpave gyratory compactor may have been utilized to center those blend compatibility in discrete

temperatures. Blends were compressed In 149° C, 129° C, 110° c's What's more 88° C, for mixing temperature with respect to 19° c Over those compaction temperature. Those additional substance Aspha-min may have been incorporated into rate for 0. 3% Eventually Tom's examining impostor of the mix. [6]. Directed class investigation for the CECABASE Balmy Mix Accretion application a collected of an admeasurement 19.0mm as characterized by Caltrans Ordinary outline and NDOT plan for Road and Bridge development. PG 64-28 polymer adjusted city cement was accustomed for the examination. Temperature of 160°C and 132°C were kept up for the readiness of Hot Mix Asphalt and Warm Mix Asphalt blends individually. CECABASE moderate blend gradual addition was added to city cement at a measure of 0.4% by mass of folio. Blend engineering was unsettled out as indicated by Caltrans and NDOT outline for the HVEEM design technique. [7].

Surveyed warm mix dark best designing association toward using Sasobit. In this examine those apparent most prominent aggravator measure for Superpave 9. 5mm what's more 12. 5mm were used. The mix might be created all the using invasion assessment 64-22 fastener, assigned by VDOT SM-9. 5A blend and VDOT SM-12.5A blend. Those super clear rotary compactor may have been used for the compaction. Mix taking care of might have been passed on out amid independent temperatures from guaranteeing 149°C, 162°C Also 121°C. WMA included substance Sasobit may have been incorporated amid a rate for 1. 5% Eventually Tom's scrutinizing weight of the folio. The come to fruition shut using of the additional substance cut down those air voids and pushed ahead the compactibility[8].

Other WMA methodologies are passed on out Toward altering those folio or blend, specifically Toward using aerogenous administrators that need help In light of artificially bound water that is released Throughout dark best mixing as a result of s were as of zeolites (decreases for 30 _C) [9] , Also by using characteristic added substances, for instance, with the end goal that Fischer– Tropsch built honeycombs that fuses A squat softening point regular included substance that misleadingly variations those malaise– thickness arch of the folio [10-12] or malaise sub-nuclear mass ester mixes, or added substances holding surface energized administrators that upgrade the dark best workability

inside the taking care of temperature go Eventually Tom's scrutinizing up to 30– 40 _C Throughout mixing [13].

III. Experimental Materials and Process

Bitumen of Viscosity Grade 10 (VG10) was adjusted for the readiness of examples. The basal investigation eventual outcomes of the bitumen are authentic in Table 1.

Table. 1 Properties of Bitumen

Characteristics of tests:	VG-10	Min. Limit	Code
Penetration (mm)	81.67	80-100	IS 1203
Softening point (C°)	45	40	IS 1205
Ductility (cm)	95	75	IS 1208
Absolute Viscosity at 60 (C°), Poise	978	Min 800	IS 1206 (part 2)
Kinematic Viscosity ,135 (C°), cst	344	Min 250	IS 1206 (part 3)

The totals which acknowledge worthy and satisfactory quality, hardness, boldness and sharpness acknowledge to be picked. Pounded totals result school soundness. The scenery of bituminous blend are real inexhaustible humbled on the gathered admeasurement and their particle admeasurement circulation. MoRTH determines the game plan for modified films of the bituminous courses. The experiments directed to investigation the solid setting and around delayed consequences are documented in Table 2

Table 2. Required Properties of coarse Aggregates

Physical Requirements for Coarse Aggregate for Dense Bituminous Macadam [As Per MoRTH Table : 500-8)					
Sr. No.	Property	Test	Specification	Test Result	
1	Cleanliness (dust)	Grain size analysis	Max 5 % passing 0.075 IS-Sieve	Pas.30 - Ret.24mm- 0.39%	
				Pas.24-Ret.14 mm- 0.44%	
				Pas. 14 -Ret. 6 mm- 0.71%	
2	Particle shape	Flakiness & Elongation Indices (Combined)	35% Max	26.02%	
3	Strength	Aggregate Impact Value(AIV)	27 % Max	9.30%	
4	Durability		Soundness		
			Magnesium Sulphate	Max 18 %	0.56%
			Sodium sulphate	Max 12 %	0.31%
5	Stripping	Coating and Stripping Bitumen Aggregate Mixtures	Min. Retained Coating 95 %	93%	
6	Water absorption value	Water absorption value	2 % Max	1.25%	

3.1 Zycotherm Easy

Zycotherm may be WMA added substance formed by Zydex Industries, Gujarat, india. This may be a smell free Concoction warm blend added substance that need been engineered. To gatherings give essentially moved

forward reductions over current. WMA advances toward advertising easier processing and. Compaction temperatures, same time all the while. Upgrading the dampness imperviousness of pavements by. Serving as an Antistrip. Mixes that bring been changed. With ZycoTherm could a chance to be generated during 120°C - 135°C for. And compacted toward 90°C - 120°C. Overall, ZycoTherm. Offers temperature diminishments contingent upon the. Properties of the blend. ZycoTherm need based for antistrip. Component that permits it to dually work concerning illustration an antistrip and additionally a warm blend added substance. The additives is universally accordant with all types of adapted as well as blunt binders. This included Polymer Modified Bitumen and Crumb Rubber Modified Bitumen binders. It does not affect adhesive allocation or change any added adhesive properties.

3.2 Doping of ZycoTherm Easy

To the display contemplate 0.03%, 0.1%, 0.15% might have been embraced Likewise those added substance measurement to preparation of the examples. ZycoTherm might have been included 0.03%, 0.1%, 0.15% volumetrically or toward weight of the added substance with those bitumen then afterward the doping procedure the example might have been arranged Also there outcomes would tabulated over Table 3.

Table 3. Properties of Bitumen with Zycotherm Easy

Characteristics of tests:	VG-10	VG 10 + 0.03% Zycotherm Easy	VG 10 + 0.1% Zycotherm Easy	VG 10 + 0.15% Zycotherm Easy	Min. Limit	Code
Penetration (mm)	81.67	48.5	53.6	55.4	80-100	IS 1203
Softening point (C°)	45	42	43	42	40	IS 1205
Ductility (cm)	95	81	84	86	75	IS 1208
Absolute Viscosity at 60 (C°), Poise	978	971	964	975	Min 800	IS 1206 (part 2)
Kinematic Viscosity 135 (C°), cst	344	336	334	337	Min 250	IS 1206 (part 3)

Thick bituminous macadam evaluation is chosen as build layer. Those bituminous blend configuration may be done Likewise for every Marshall blend outline from claiming MS-2, and the gradations to these mixes would got from MORTH area 500 clause 505 Table 500-11 The necessities of DBM is tabulated clinched alongside table 4.

Table 4. Marshall Requirements of Dense Graded Bituminous Macadam

Minimum stability(KN/m ² at 60°C)	9.0
Minimum flow(mm)	2
Maximum flow(mm)	4
Compaction level (Number of blows)	75blows on each of the two faces of the specimen
Percent air voids	3-5
Percent voids filled with bitumen(VFB)	65-75
Coating of Aggregate Particle	95% Min
Tensile Strength Ratio	80% Min

IV. RESULTS AND DISCUSSION

Marshall Stability Test

The Marshall Stability Test was done on Hot Mix Asphalt blends by shifting the bitumen substance of 3.5%, 4%, 4.5%, 5.0% and 5.5%, at blending temp of 155°C and Warm Mix Asphalt blends with ideal cover content at blending temperatures of 110°C, 120°C and 130°C for an added substance measurements rate of 0.03%, 0.1%, 0.15% by the heaviness of the fastener. Warm blend plan of bituminous blends required planning of test or Marshall Mix outline. Table 5 demonstrates the example planning plan for the same.

Table: 5 Sample Preparation Schedule

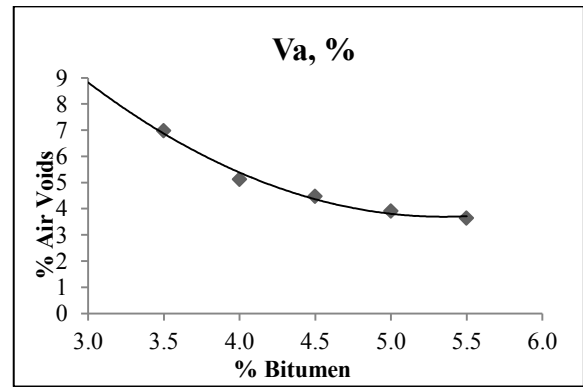
Sr. No	Types of Test	No. of Sample	
1	Marshall test for OBC	VG 10 (with 3.5% bitumen)	3
		VG 10 (with 4.0% bitumen)	3
		VG 10 (with 4.5% bitumen)	3
		VG 10 (with 5.0% bitumen)	3
		VG 10 (with 5.5% bitumen)	3
4	Marshall test for Optimum dose of Zycotherm Easy and Temperature	VG 10 + 0.03% ZYCOTHERM EASY (110°C)	3
		VG 10 + 0.03% ZYCOTHERM EASY (120°C)	3
		VG 10 + 0.03% ZYCOTHERM EASY (130°C)	3
		VG 10 + 0.1% ZYCOTHERM EASY (110°C)	3
		VG 10 + 0.1% ZYCOTHERM EASY (120°C)	3
		VG 10 + 0.1% ZYCOTHERM EASY (130°C)	3
		VG 10 + 0.15% ZYCOTHERM EASY (110°C)	3
		VG 10 + 0.15% ZYCOTHERM EASY (120°C)	3
		VG 10 + 0.15% ZYCOTHERM EASY (130°C)	3

4.1. Marshall Test Results and Discussions

Optimum binder content of DBM Grade II determine by performing Marshall Test on sample prepared at varying binder content. The volumetric properties of DBM mix using VG 10 shown in Table 6 and summary of volumetric mix using VG10 shown in Table 7, it seen that design mix satisfied the all volumetric requirement DBM as per MoRTH section 500 clause 505.

Table 6. Marshall Mix Design using VG 10

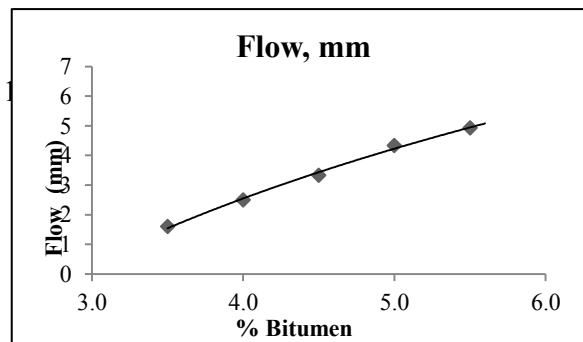
% Bit. by wt of mix Sample	Height of Specimen in mm	Wt of Specimen in grams					Bulk volume	Bulk Sp. Gr. sample (GMB)	Max. sp. gr. of sample (loose) (GMM)	% Air voids (VA)	% VMA (VMA)	% Voids filled with Bitumen (VFB)	Stability & Flow				
		in air	in water	SSD in air	in air	in air							Proven Ring	Load KN	Correlation factor	Corrected Load(KN)	Flow mm
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p		
3.50	6.2	1194.0	725.0	1197.0	472.0	2.530	2.717	6.98	13.61	48.70	160	11.17	1.14	11.50	1.50		
	6.1	1196.0	726.5	1198.0	471.5	2.537						130	9.08	1.14	10.24	1.80	
	6.2	1195.0	726.5	1201.5	475.0	2.516						130	9.08	1.14	10.35	1.50	
Average					2.527							10.70	1.19	12.10	1.66		
4.00	6.1	1194.0	728.0	1195.0	467.0	2.557	2.886	5.12	13.34	61.59	150	10.47	1.19	12.10	2.80		
	6.2	1196.0	727.0	1197.0	470.0	2.545						160	11.17	1.19	12.10	2.50	
	6.2	1193.0	726.0	1195.0	468.0	2.544						160	11.17	1.19	12.20	2.20	
Average					2.548							12.13	1.19	12.20	2.56		
4.50	6.2	1196.0	724.0	1198.0	464.0	2.558	2.880	4.48	13.40	66.58	150	10.47	1.25	12.80	3.00		
	6.2	1190.0	728.0	1191.0	465.0	2.559						170	11.87	1.25	13.10	3.50	
	6.1	1195.0	725.0	1197.0	462.0	2.555						160	11.17	1.25	12.80	3.50	
Average					2.560							12.80	1.25	12.80	3.33		
5.00	6.2	1189.0	725.0	1190.0	465.0	2.557	2.962	3.91	13.92	71.91	150	10.47	1.19	12.40	4.30		
	6.2	1193.0	727.0	1194.0	467.0	2.555						140	9.78	1.19	12.80	4.50	
	6.2	1196.5	730.0	1197.0	467.0	2.562						140	9.78	1.19	12.30	4.20	
Average					2.558							12.50	1.19	12.50	4.33		
5.50	6.2	1188.0	722.0	1189.0	467.0	2.544	2.644	3.64	14.27	74.46	130	9.08	1.19	10.20	4.50		
	6.2	1184.0	721.0	1186.0	465.0	2.546						135	9.43	1.19	10.80	5.10	
	6.1	1182.0	721.0	1184.0	463.0	2.553						140	9.78	1.19	11.63	5.20	
Average					2.548							10.88	1.19	11.63	4.83		



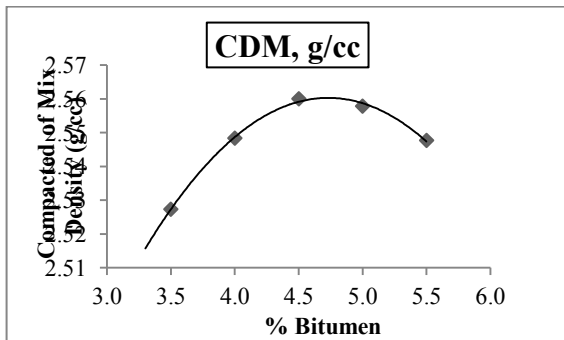
Graph 3. Air Voids v/s % Bitumen

Table 7. Summary of Volumetric Properties of mix using VG 10

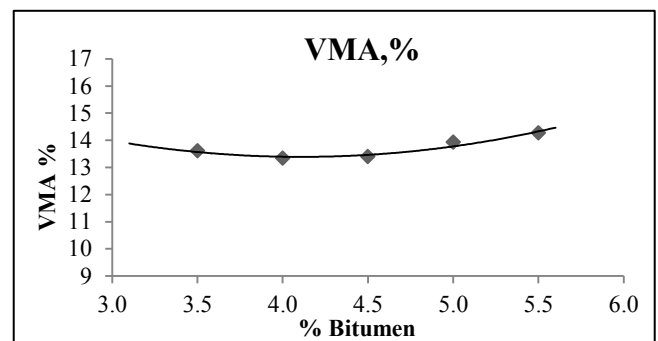
% Bit. By Weight of Mix	Bulk Sp. Gr. (Gmb)	Stability (KN)	Voids in Mineral Agg. VMA (%)	Voids Filled with Bitumen VFB (%)	Flow (mm)	Air Voids Va (%)	Parameters	Binder Content 4.5 (%)
3.5	2.527	10.70	13.61	48.70	1.60	6.98	Stability (KN)	12.90
4.0	2.548	12.13	13.34	61.59	2.50	5.12	Bulk Sp. Gr.	2.560
4.5	2.560	12.90	13.40	66.58	3.33	4.48	Va%	4.48
5.0	2.558	12.50	13.92	71.91	4.33	3.91	VFB %	66.58
5.5	2.548	10.80	14.27	74.46	4.93	3.64	VMA%	13.40
Limits	Min 9	12-15	65-75	2-4	3-5	Flow	3.33



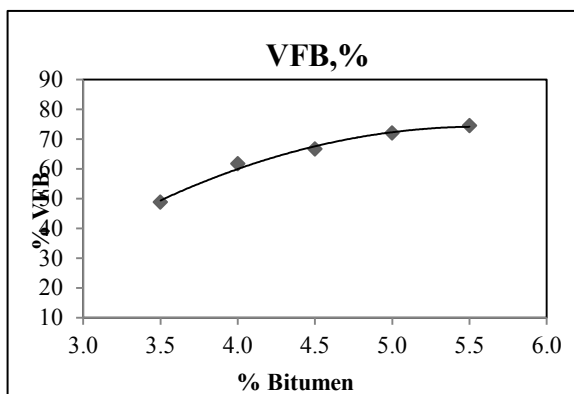
Graph 4. Flow v/s % Bitumen



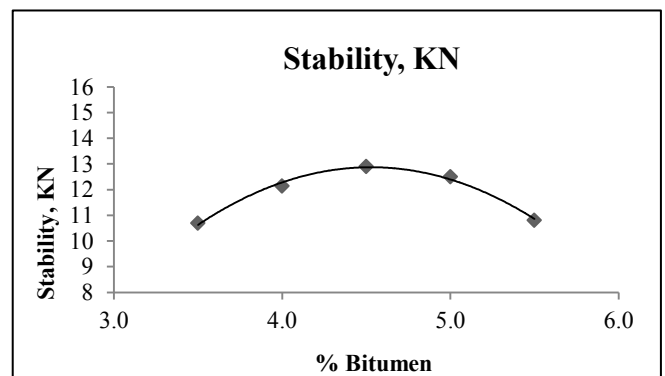
Graph 1. CDM v/s % Bitumen



Graph 5. VMA v/s % Bitumen



Graph 2. VFB v/s % Bitumen



Graph 6. Stability v/s % Bitumen

Table 7 shows the result of different bitumen contents at mixing temperature of 154°C. As per above result and graph the optimum binder content is 4.5 % that shows maximum result of different volumetric properties. So this result use as an optimum binder content with WMA additives with different temperature.

4.2. VOLUMETRIC PROPERTIES WITH Zycotherm Easy :

For the present deliberation 1%, 2% and 3% was received as the growth dose for readiness of the examples for DBM Grade II at changed temperature i.e. 110 °C, 120 °C and 130 °C individually. Added substances were included 0.03%, 0.1% and 0.15% volumetrically application 2.5ml fake syringe and the watery bitumen 130-150°C was combination by weakened mechanical assembly and dynamic for 1 hr. was improved the situation perfect obligation of the accumulation with the bitumen. Similarly, the volumetric backdrop of DBM Grade II mix application Zycotherm Easy at assorted dosages and at altered temperatures apparent below.

Table 8. VG 10 + 0.03% Zycotherm Easy

TEMP. °C	Height of Specimen (mm)	Wt of Specimen in grams			Bulk volume	Bulk Sp.Gr. of sample (GMB)	Max sp.gr. of sample (loose) (GMM)	% Air voids (VA)	% VMA (VMA)	% Voids filled with Bitumen (VFB)	Stability (KN)	Flow (mm)		
		in air	in water	SSD in air										
110.00	6.1	1192.0	724.0	1194.0	470.0	2.536	2.665	4.17	13.60	69.37	12.4	2.20		
	6.1	1196.0	732.0	1197.0	466.0	2.572							12.5	2.40
	6.2	1190.0	726.0	1192.0	466.0	2.554							12.4	2.30
Average		6.2	1194.0	728.0	1195.0	467.0	2.557	3.78	13.15	71.27	13.2	2.40		
120.00	6.1	1190.0	727.0	1191.0	464.0	2.565	2.668	3.78	13.15	71.27	13.4	2.40		
	6.1	1192.0	732.0	1194.0	462.0	2.580							13.1	2.60
	6.2	1191.0	732.0	1194.0	462.0	2.567							13.2	2.5
Average		6.1	1191.0	732.0	1194.0	462.0	2.578	3.99	13.28	69.95	12.8	2.60		
130.00	6.1	1194.0	731.0	1196.0	466.0	2.568	2.67	3.99	13.28	69.95	12.8	2.60		
	6.2	1196.0	728.0	1198.0	470.0	2.545							12.6	2.60
	6.2	1196.0	728.0	1198.0	470.0	2.563							12.7	2.7
Average		6.2	1196.0	728.0	1198.0	470.0	2.563	3.99	13.28	69.95	12.7	2.7		

Table 9. VG 10 + 0.1% Zycotherm Easy

TEMP. °C	Height of Specimen (mm)	Wt of Specimen in grams			Bulk volume	Bulk Sp.Gr. of sample (GMB)	Max sp.gr. of sample (loose) (GMM)	% Air voids (VA)	% VMA (VMA)	% Voids filled with Bitumen (VFB)	Stability (KN)	Flow (mm)		
		in air	in water	SSD in air										
110.00	6.1	1192.0	724.0	1194.0	470.0	2.536	2.665	4.17	13.60	69.37	12.4	2.20		
	6.1	1196.0	732.0	1197.0	466.0	2.572							12.5	2.40
	6.2	1190.0	726.0	1192.0	466.0	2.554							12.4	2.30
Average		6.2	1194.0	728.0	1195.0	467.0	2.557	3.78	13.15	71.27	13.2	2.40		
120.00	6.1	1190.0	727.0	1191.0	464.0	2.565	2.668	3.78	13.15	71.27	13.4	2.40		
	6.1	1192.0	732.0	1194.0	462.0	2.580							13.1	2.60
	6.2	1191.0	732.0	1194.0	462.0	2.567							13.2	2.5
Average		6.1	1191.0	732.0	1194.0	462.0	2.578	3.99	13.28	69.95	12.8	2.60		
130.00	6.1	1194.0	731.0	1196.0	466.0	2.568	2.67	3.99	13.28	69.95	12.8	2.60		
	6.2	1196.0	728.0	1198.0	470.0	2.545							12.6	2.60
	6.2	1196.0	728.0	1198.0	470.0	2.563							12.7	2.7
Average		6.2	1196.0	728.0	1198.0	470.0	2.563	3.99	13.28	69.95	12.7	2.7		

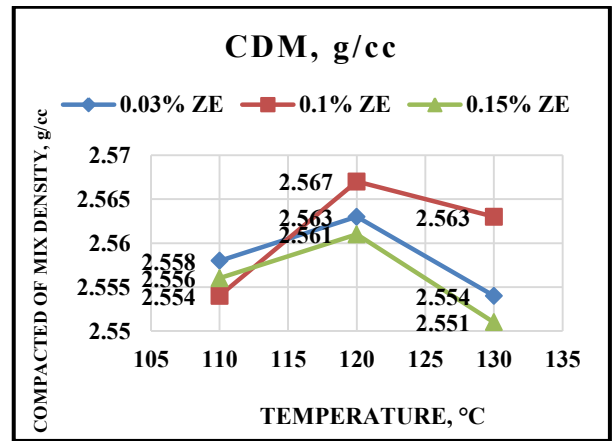
Table 10. VG 10 + 0.15 % Zycotherm Easy

TEMP. °C	Height of Specimen (mm)	Wt of Specimen in grams			Bulk volume	Bulk Sp.Gr. of sample (GMB)	Max sp.gr. of sample (loose) (GMM)	% Air voids (VA)	% VMA (VMA)	% Voids filled with Bitumen (VFB)	Stability (KN)	Flow (mm)		
		in air	in water	SSD in air										
110.00	6.1	1191.0	724.0	1192.0	468.0	2.545	2.655	3.73	13.53	72.45	11.5	2.4		
	6.1	1194.0	722.0	1195.0	464.0	2.562							11.8	2.4
	6.2	1188.0	728.0	1190.0	462.0	2.571							11.5	2.2
Average		6.2	1188.0	728.0	1190.0	462.0	2.566	3.58	13.36	73.24	11.9	2.5		
120.00	6.1	1190.0	728.0	1194.0	464.0	2.578	2.656	3.58	13.36	73.24	12.2	2.6		
	6.2	1192.0	728.0	1194.0	464.0	2.565							12.2	2.6
	6.2	1192.0	728.0	1194.0	464.0	2.565							12.2	2.6
Average		6.1	1190.0	728.0	1194.0	464.0	2.561	4.09	13.69	70.15	11.9	2.5		
130.00	6.1	1196.0	726.0	1198.0	472.0	2.534	2.66	4.09	13.69	70.15	11.8	2.4		
	6.1	1194.0	727.0	1196.0	469.0	2.560							11.9	2.5
	6.2	1194.0	728.0	1196.0	470.0	2.540							11.9	2.5
Average		6.2	1194.0	728.0	1196.0	470.0	2.541	4.09	13.69	70.15	11.8	2.5		

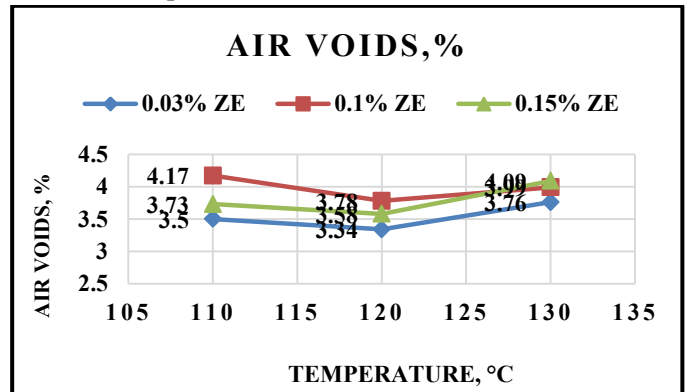
Similarly, summary of the volumetric properties of DBM grade II mix using VG Zycotherm Easy various dosages and at different temperatures shown in Table below.

Table 11. Summary of test results for VG 10 + Zycotherm Easy for DBM Mix Design Grading II

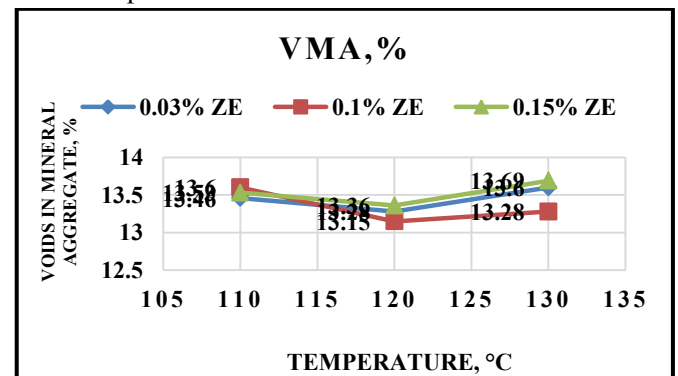
ZYCOTHERM EASY	0.03%			0.1%			0.15%			Limits
TEMP. °C	110	120	130	110	120	130	110	120	130
CDM, gm/cc	2.558	2.563	2.554	2.554	2.567	2.563	2.556	2.561	2.551	3-5
Air Voids %	3.50	3.34	3.76	4.17	3.78	3.99	3.73	3.58	4.09	3-5
VMA, %	13.46	13.28	13.6	13.6	13.15	13.28	13.53	13.36	13.69	12-15
VFB, %	73.99	74.85	72.32	69.37	71.27	69.95	72.45	73.24	70.15	65-75
Stability, KN	11.22	11.64	11.55	12.4	13.2	12.7	11.5	12.1	11.8	Min 9
Flow, mm	2.27	2.63	2.87	2.3	2.5	2.7	2.3	2.6	2.5	2-4



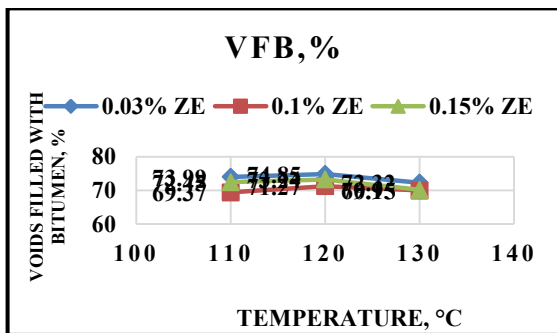
Graph 6. CDM VS TEMPERATURE



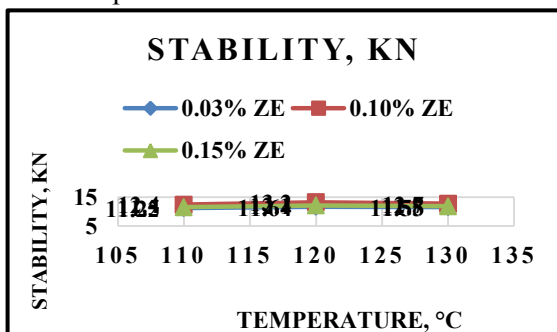
Graph 7. AIR VOIDS VS TEMPERATURE



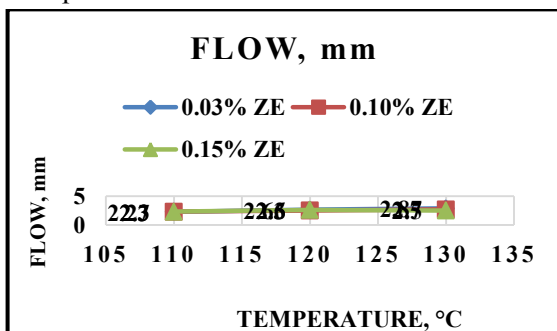
Graph 8. VMA VS TEMPERATURE



Graph: 9 VFB VS TEMPERATURE



Graph 10 STABILITY VS TEMPERATURE



Graph 11 FLOW VS TEMPERATURE

The optimum bitumen content obtained of HMA is 4.5% at temperature of 155° C. This OBC mixes with additive of different dosage of 0.03%, 0.1%, 0.15 % by Wight with different temperature of 110° C, 120° C and 130° C. After conducted test the result of 0.1% of ZycoTherm Easy with temperature of 120° C shown highest result of volumetric bitumen properties in above table and graph.

V. CONCLUSIONS

The Stability Test was done on Hot Mix Asphalt blends by shifting the bitumen substance of 3.5% 4%, 4.5%. 5.0% and 5.5%, at blending temp of 155°C and Warm Mix Asphalt blends with ideal cover content at blending temperatures of 110°C, 120°C and 130°C for an added substance measurements rate of 0.03%, 0.1%, 0.15% by the heaviness of the fastener. Warm blend plan of bituminous blends required planning of test or Marshall Mix outline. Table 5 demonstrates the example planning

plan for the same. The ideal folio content for the HMA blend toward 155°C might have been discovered out to a chance to be 4. 5% Furthermore WMA blend In 120°C with 0.1% from claiming ZycoTherm Easy might have been discovered out to be greatest bring about shortages. This finishes up that the ideal folio content for HMA Also WMA blend would same with changing the temperature and added substance measurement rates, something like that the OBC 4. 5% ought to be found out for 0.1% for ZycoTherm Easy measurement rate for 120°C temperature provides for greatest aftereffect. Here we ought spare fuel cosset Eventually Tom's perusing diminishing those temperature up to 30°C without impact of any volumetric properties from claiming bitumen with the help about WMA innovation.

VI. RECOMMENDATIONS

In the display research center investigations those WMA blend generated all the utilizing ZycoTherm Easy during distinctive temperature for distinctive measurement rate demonstrated beneficial comes about when compared for those HMA blend generated all the at 155°C. The WMA blend with 0.1% about ZycoTherm Easy toward 120°C will be recommended to utilize to practice. Also find distinctive material for suitability measurement rate in separate temperature will provide for you great consequence As opposed to HMA.

VII. REFERENCES

- [1]. The Asphalt Pavement Association of Oregon. "Warm Mix Asphalt Shows Promise for Cost Reduction, Environmental Benefit." Centerline, the Asphalt Pavement Association of Oregon, Salem, OR, Fall 2003.
- [2]. Damm, K-W, J. Abraham, T. Butz, G. Hildebrand, and G. Riebeschl. Asphalt Flow Improvers as 'Intelligent Fillers' for Hot Asphalts – A New Chapter in Asphalt Technology. In Journal of Applied Asphalt Binder Technology, April 2002,
- [3]. Olard F, Noan C. Low energy asphalts. Routes roads 336/337. PIARC; 2008.
- [4]. Hurley GC, Prowell BD. Evaluation of Aspha-Min_zeolite for use in warm mix Asphalt. NCAT report 05-04, Auburn University, Auburn; 2005.
- [5]. Xijuan Xu. (2011), "Performance of Low-Carbon Environmental Warm Mix Asphalt", American Society of Civil Engineers".
- [6]. Gaham, C. H. and Brian, D. P. (2005). "Evaluation of Aspha-Min zeolite for use in warm mix asphalt."

- National Center for Asphalt Technology Report 05-04. Auburn University, Auburn, Alabama.
- [7]. Elie Y. Hajj and Edward M. Cortez(2011) “Evaluation Of The Cecabase Warm-Mix Additive”, University Of Nevada Reno, in association with CECA Arkema Group, Nevada 89557
- [8]. Jean-Martin Croteau, and Bernard Tessier(2008). “Warm Mix Asphalt Pavin Technologies: a Road Builder’s Perspective” Paper presentation of annual conference Transportation Association of Canada
- [9]. Hurley GC, Prowell BD. Evaluation of Aspha-Min_ zeolite for use in warm mix asphalt. NCAT report 05-04, Auburn University, Auburn; 2005.
- [10]. Hurley GC, Prowell BD. Evaluation of Sasobit_ for use in warm mix asphalt. NCAT report 05-06, Auburn University, Auburn; 2005.
- [11]. Button JW, Estakhri C, Wimsatt A. A synthesis of warm-mix asphalt. Report 0-5597-1, Texas Transportation Institute, Texas; 2007.
- [12]. Sasol Wax GmbH. The bitumen additive for highly stable easily compactible asphalts. Sasobit _ product information 124. Hamburg: Sasol Wax GmbH; 2004.
- [13]. CECA. Green road formulation – warm mix asphalt – cecabase RT.Ceca, Arkema group; 2008.

Codes:

- [14]. IS: 2386 (Part 1) – 1963: Sieve analysis, flakiness and elongation index test
- [15]. IS: 2386 (Part 3) – 1963: Water absorption and specific gravity test
- [16]. IS: 2386 (Part 4) – 1963: Aggregate impact value test
- [17]. IS: 6241- 1974: Method of test for determination of stripping value of road aggregate.

BOOKS:

- [18]. Highway Engineering, Dr. S.K. Khanna and Dr. C.E.G. Justo
- [19]. Mix design methods for asphalt concrete and other hot mix types, The Asphalt Institute, manual series no.2 (MS-2)
- [20]. The asphalt handbook, The Asphalt Institute, manual series no.4 (MS-4)