

# Effect of Warm Mix Additive on the Performance of the Bituminous Mix

Darshan P. Joshi<sup>1</sup> Ashraf M. Mathakiya<sup>2</sup>

<sup>1</sup>PG Student <sup>2</sup>Assistant Professor

<sup>1,2</sup>Department of Civil Engineering

<sup>1,2</sup>Atmiya Institute of Technology & Science, Rajkot, India

**Abstract**— Asphalt industries expend a lot of powers and discharge contamination gases into the climate. Warm blend black-top is the most perceived approach to limit these negative effects, which have offered ascend to various issues identified with their execution and the materials utilized. WMA innovation permits the blending, set down, and compaction Asphalt blends at fundamentally bring down temperatures contrasted with Hot Mix Asphalt (HMA). The innovation can lessen creation temperatures by as much as 30 percent. The present examination explores the impacts of two unique sorts of warm blend black-top added substances on the properties of black-top fasteners and blends. In this examination consistency review bitumen VG-30 is considered and two sorts of warm blend added substances Zycotherm with the doses (0.05%, 0.1%, and 0.15%) is utilized. This Research introduces an orderly lab examine With Aggregate covering, Marshall Mix Design for Dense Bituminous Macadam (DBM) grade II for warm blend added substance (WMA) i.e. Zycotherm.

**Key words:** Warm Mix Asphalt (WMA), Bituminous

## I. INTRODUCTION

Warm Mix Asphalt (WMA) is a quick developing innovation, now acknowledged around the world. Use of lower temperatures to create black-top blends isn't new. WMA is characterized as the black-top blend whose blending temperature is from 100°C to 135°C. In this innovation natural added substances, compound added substances and frothing innovation are utilized to fabricate and spread black-top blends at bring down temperature than ordinary Hot Mix Asphalt (HMA) by diminishing the black-top viscosity. WMA is delivered, set and compacted at temperature 10°C to 40°C lower than the customary Hot Mix Asphalt. It is an innovation that permits bringing down of the generation and clearing temperature of Hot Mix Asphalt (HMA) by decreasing the consistency of cover which helps in expanding the workability of blend without trading off the execution of black-top. It lessens vitality utilization, carbon dioxide emanation, oxidative solidifying of Asphalt, overhead and aggregate expenses of the Asphalt business by bringing down the generation temperature in this manner making a superior workplace. Be that as it may, the lower blending temperatures have raised worries on the execution of the blends. So there is have to altogether assess and describe the WMA blends to guarantee satisfactory Performance. Warm blend black-top is created when water, chemicals or different added substances are utilized to deliver black-top at bring down temperatures.

Outflows of ozone depleting substances amid warm blend black-top generation are fundamentally lower than amid hot blend black-top creation. With a decrease of around 40°C in black-top blend creation temperature, around 33% of the CO emanations delivered can be diminished. Lessening in vitality/fuel utilization is likewise an advantage of WMA.

So that for reducing the emission of temperature warm mix additive is used.

## II. OBJECTIVE

To determine the effect on performance of bituminous mix by using Zycotherm as a warm mix additive.

## III. SCOPE

This study works are limited to DBM grade-2 & BC grade- 2 for Bitumen Mix design.

- 1) To conduct the aggregate coating test by using Zycotherm-having 0%, 0.05 %, 0.1%, 0.15% doses.
- 2) To perform marshal stability test by using Zycotherm-having 0%, 0.05 %, 0.1%, 0.15% doses.

## IV. MATERIAL & METHOD

Bitumen VG 30, Zycotherm as a warm blend added substance. Zycotherm is WMA added substance created by Zydex Industries, Gujarat, India. This is a smell free, compound warm blend added substance. It offers bring down generation and compaction temperatures; while on the double alluring the dampness protection of asphalts by filling in as an antistrip. Zycotherm has worked in antistrip instrument that enables it to dually work as an antistrip and additionally a warm blend added substance. The added substance is regularly good with a wide range of altered and in addition unmodified fasteners. It doesn't influence folio evaluating or change some other fastener properties. Zycotherm is WMA added substance created by Zydex Industries, Gujarat, India. This is a smell free, concoction warm blend added substance that has been designed to give essentially improved benefits over current WMA advancements by offering lower creation and compaction temperatures, while at the same time upgrading the dampness protection of asphalts by filling in as an antistrip. Generally speaking, Zycotherm offers temperature decreases relying upon the properties. The methods which is used for the experiment are shown below as a flow chart. It consist the step wise procedure for the all types of test which include aggregate coating and Marshall stability test.

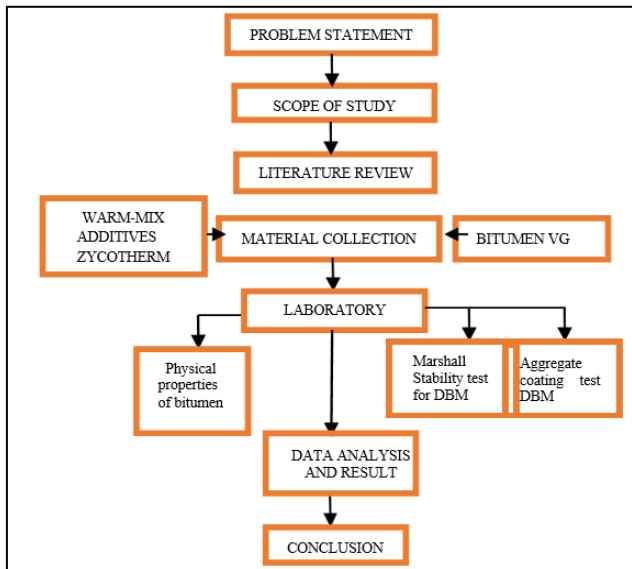


Fig. 1: Flowchart of Experimental Design

V. RESULTS

A. Aggregate Gradation for DBM G-2

The screening analysis test was used to determine the aggregate size of the collected quarry samples. Through this screening test, the ratio of coarse aggregate, fine aggregate and filler is determined to ensure that the aggregate is well mixed within the specified level of concrete grade MORTH.

Sieve Designation	Actual % passing				% Passing proposed mix design				Total Passing, %	Limit as per MoRTH-V rev. Table - 500/10
	20m m	10m m	6m m	Stone dust	20m m	10m m	6m m	Stone dust		
					0.35	0.20	0.20	0.25		Grading 2
37.5	100	100	100	100	35	20	20	25	100	100
26.5	100	100	100	100	35	20	20	25	100.00	90-100
19	65	100	100	100	23	20	20	25	87.75	71-95
13.2	6.78	99.09	100	100	2	20	20	25	67.19	56-80
4.75	0.02	1.59	90.51	100	0	0	18	25	43.43	38-54
2.36	0.02	0.76	50.55	100	0	0	10	25	35.17	28-42
0.3	0.02	0.60	3.52	25.61	0	0	1	6	7.23	7-21
0.075	0.02	0.42	1.95	10.96	0	0	0	3	3.22	2-8

Table 1: Gradation of DBM Grade 2

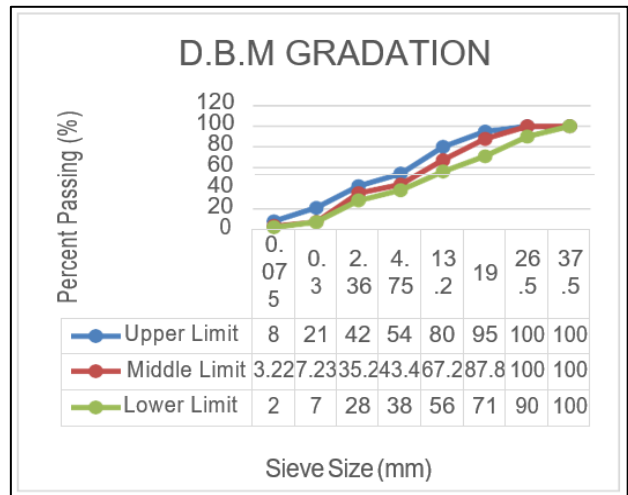


Fig. 2: Gradation of Dense Bituminous Macadam Grade 2

B. Basic Properties of Bitumen

Bitumen test	VG-30	VG-30+ Zycotherm (0.05%)	VG-30+ Zycotherm (0.1%)	VG-30+ Zycotherm (0.15%)	Requirements as per IS 73- 2013
Penetration at 25°C, mm	63	64	65	66	Min 45
Softening point	49	49	49	49	Min 47
Ductility @27°C, cm	82	87	98	90	NA
Specific gravity	1.05	1.00	1.03	1.02	NA

Table 2: Test Results Bitumen Sample

C. Aggregate Coating Test Results With & Without Warm Mix Additive

Coating is only measured on aggregate retained on 9.5 mm sieve. The stripping value of aggregates is determined as the ratio of the uncovered area observed visually to the total area of aggregates, expressed as a percentage. Express the stripping value as the ratio of the uncovered area observed visually to the total area of aggregates in each test.

Additive (Zycotherm)	Aggregate coating value	MORTH Specification (2013)
0%	97%	Minimum 95%
0.05%	95%	
0.1%		
0.15%		

Table 3: Aggregate Coating Results With & Without Warm Mix Additives

D. Marshall Stability Test Results With & Without Warm Mix Additive for Dense Bituminous Macadam Grade II

%Bitumen	Stability(KN)	Flow (mm)	CDM (g/cc)	VMA (%)	Air voids (%)	VFB (%)
4.0	7.45	4.30	2.410	14.690	5.860	60.180
4.5	9.94	4.04	2.430	14.396	4.405	69.401

5.0	11.09	5.51	2.440	14.469	3.366	76.736
5.5	10.24	5.26	2.431	15.206	2.800	81.586

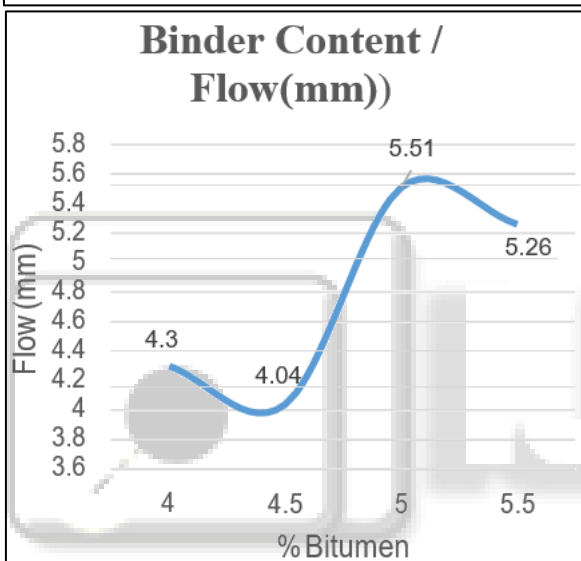
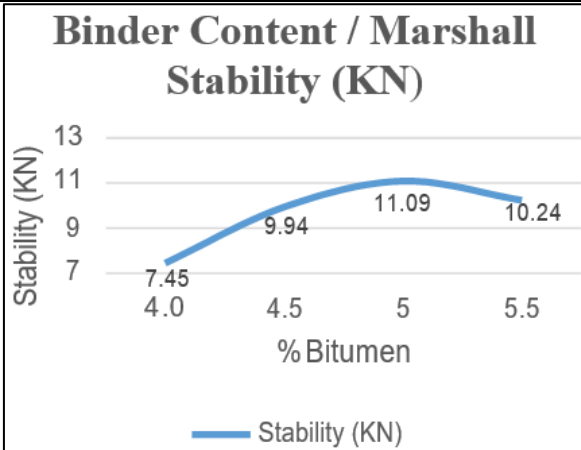


Fig. 3: Marshall Stability & Flow with Different Binder Content

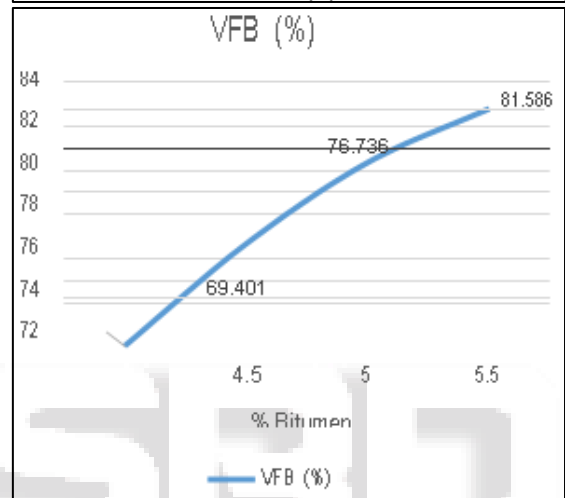
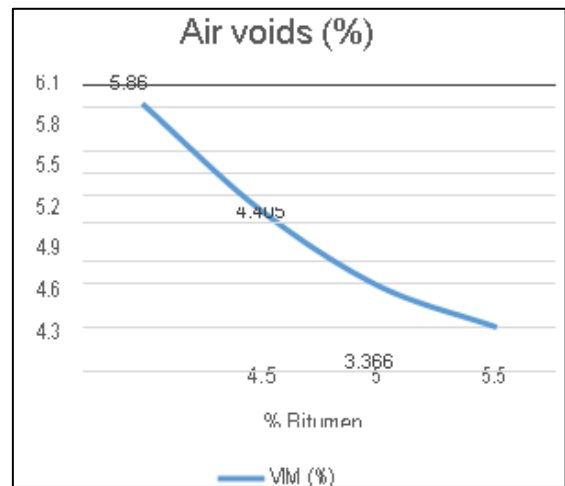
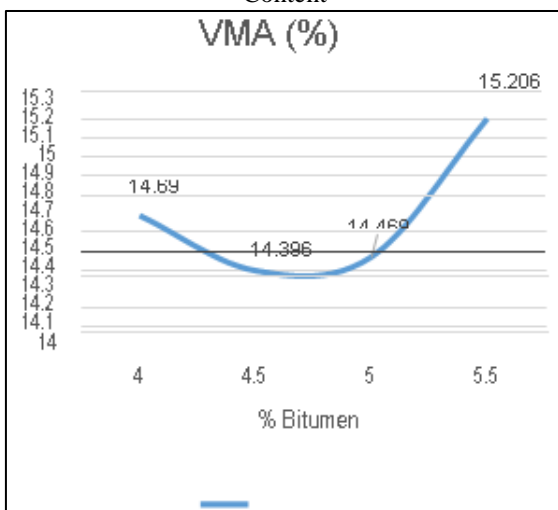


Fig. 4: Air voids VMA & VFB with Different Binder Content

E. Marshall Test Result with Adding Zycotherm as a Warm Mix Additive.

Table 5. Marshall Stability test result with Zycotherm

%Bitumen	Stability(KN)		
	0.05%	0.10%	0.15%
4	8.42	8.57	8.27
4.5	10.01	10.08	10.03
5	10.83	10.91	10.81
5.5	10.42	10.49	10.27

Table 4: Marshall Test result without Warm Mix Additives

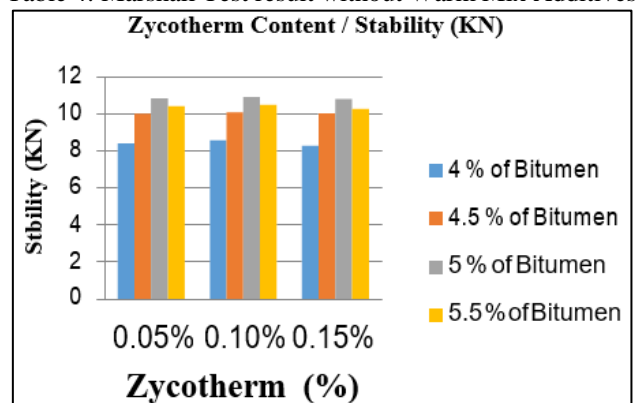


Fig 5. Marshall Stability with different Zycotherm dosage

%Bitumen	Flow (mm)		
	0.05%	0.10%	0.15%
4	4.31	4.28	4.25
4.5	4.08	4.02	4.1
5	5.52	5.43	5.49
5.5	5.29	5.24	5.31

Table 6: Marshall Flow Test Result with Zycotherm

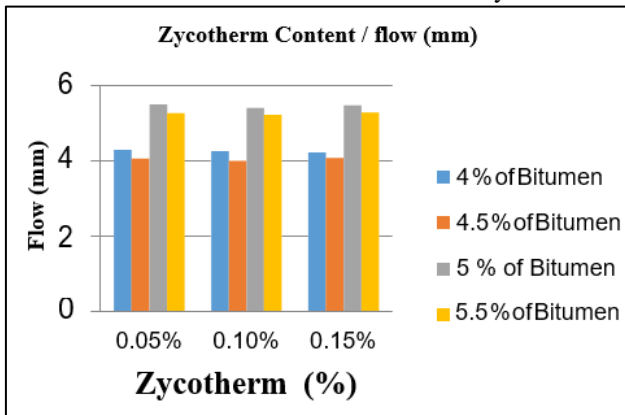


Fig 6. Marshall Flow with different Zycotherm dosage

%Bitumen	Void in Mineral aggregate		
	0.05%	0.10%	0.15%
4	14.72	14.75	14.78
4.5	14.28	14.226	14.29
5	14.43	14.412	14.423
5.5	15.21	15.12	15.18

Table 7: Void in Mineral Aggregate Result with Zycotherm

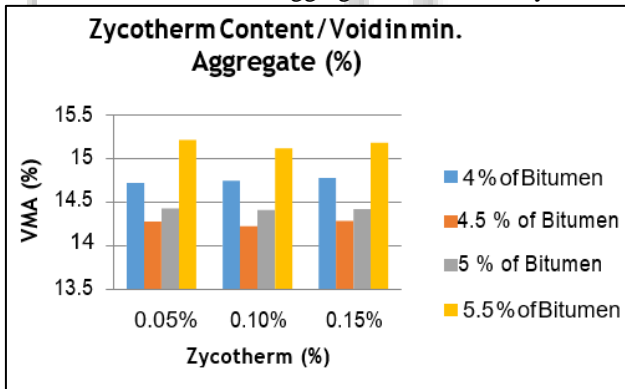


Fig 7: Void in Mineral Aggregate with Different Zycotherm Dosage

%Bitumen	Air voids		
	0.05%	0.10%	0.15%
4	5.73	5.65	5.71
4.5	4.42	4.39	4.45
5	3.41	3.35	3.39
5.5	3.83	3.78	3.69

Table 8: Air Void Percent Result with Zycotherm

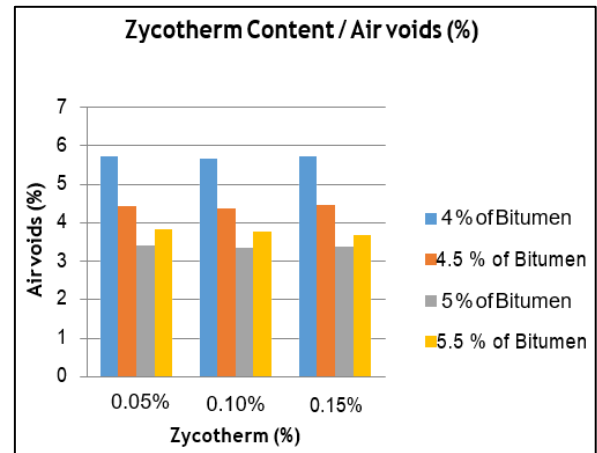


Fig 8. Air Void percent with different Zycotherm dosage

%Bitumen	Void Filled with Bitumen		
	0.05%	0.10%	0.15%
4	60.19	60.26	60.28
4.5	69.41	69.38	69.42
5	76.68	76.71	76.62
5.5	82.39	82.42	82.25

Table 9: Void filled with Bitumen Result with Zycotherm

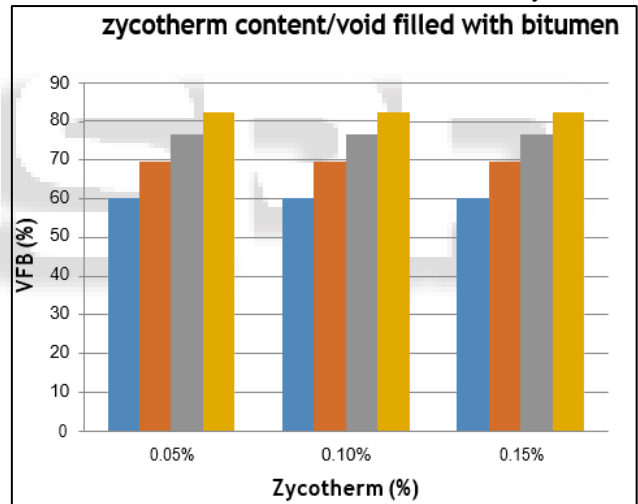


Fig 9: Void filled with bitumen with different Zycotherm dosage

## VI. CONCLUSIONS

Following are the important conclusions that are drawn from the present study:

- It is observed from the experiment result the physical properties of bitumen has improved by adding 0.1% Zycotherm as a warm mix additive.
- By adding 0.1% Zycotherm as a warm mix additive the Marshall parameter like Stability is increased by 33.63%. Flow is minimum. Air void percent, voids in mineral aggregate and void filled with bitumen increased more effective as compare to other percentage of Zycotherm.

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