



Warm mix Design of Bituminous Concrete using Rediset WMX

Mr. Bhargav N. Gautam

M.E. Student, Civil Engineering Department, Government Engineering College, Modasa

ABSTRACT

The purpose of this study is mainly to find out the optimum temperature by which the bituminous concrete mix temperature is reduced through the warm mix asphalt technology. Warm mixing with additive is becoming popular because of mixing at lower temperature which reduces the fuel usage and emission of hazardous gases consequently decreases the mixing as well as compaction temperature of mix. Reduction of 20° C to 40° C have documented, such reduction have the obvious benefits of cutting fuel consumption and decreasing the production of green house gases. Also, there will improvement on performance of pavement.

In present study, warm mix design of Bituminous Concrete, Rediset-organic additive is used as adhesion with used as a binder viscosity grade-30(VG-30). The Optimum Bitumen Content (OBC) using a binder will obtained by the Marshall Test. Then after Optimum dosage of Rediset and Temperature are found i.e., the temperature at which Rediset perform effectively. Also, comparative study is make to know the stability of Rediset with Binder.

KEYWORDS:

I. INTRODUCTION

The area of work covers laboratory study on bitumen with additive. Various studies are under taken to improve the strength characteristics of bituminous surfaces by different bitumen grades by adding different additives to the bitumen. Such binders also improve temperature susceptibility and help eliminating some common Problems like bleeding in peak summer temperature.

As per MoRTH - Section 509, bituminous concrete for wearing course should be made with bitumen of **viscosity grade-30 (VG-30)** for nominal aggregate size 19mm with bitumen content 5-6% having layer thickness 50-65mm. Bitumen VG-30 improves the performance of the binder to minimize the stress cracking that occurs at low temperature and plastic deformation at high temperature. This enhances durability of existing road surfacing which results in reducing maintenance and surfacing operations. The use of **Warm mix additive - Rediset** in bitumen VG-30 is to reduce the mixing and compaction temperature of Bituminous Concrete.

Typically, the mixing temperatures of 150 to 160°C for Hot mix causes Rising energy prices, global warming, and more stringent environmental regulations have resulted in an interest in Warm mix technologies as a mean to decrease the energy consumption and emissions associated with conventional hot mix production. This is not only costly but also generates a large amount of emissions. Rediset dose 1-2% enables the production of Warm mix 30-40°C lower temperature than hot mix and this will reduce fuel consumption by at least 20% and significantly lower emissions not only at the hot-mix plant but also at the paving site.

II. METHODOLOGY

1. The Bitumen test for VG-30 with 1.5%, 2.0% & 2.5% of Rediset and without Rediset has been done including

- Penetration test, IS: 1203-1978
- Softening Point test, IS: 1205-1978
- Ductility test, IS: 1208-1978
- Viscosity test, IS: 1206-1978
- Specific Gravity test, IS: 1202-1978

which all satisfied the requirement of IS: 73-2006 "VG-30 Bitumen-Specification".

2. The gradation of aggregate

3. Marshall Stability Test for

Determination of Optimum Binder Content & Determination of Optimum Temperature and Optimum Dosage of Rediset

MATERIALS -

1. Rediset WMX

Rediset WMX which is organic additives in the pellet form and does not contain water. Rediset is a combination of organic additives and

surfactants that is developed to enhance the adhesion between asphalt and aggregates. The manufacturer of Rediset, AkzoNobel India Chemistry Ltd. claims that the surfactants improve the wetting ability of the asphalt binder for better coating with the aggregates, and the organic additives provide a reduction of the viscosity of the binder and a lubricating effect for easier coating and compaction. It is supplied in a pellet form that can be added at a dose rate of 1.5% to 2.5% by weight of binder. According to the recommendation of the manufacturer, a dosage of 2% by weight of asphalt is used for preparing the specimens.



Figure 1. Photograph of Rediset Additive

Advantages of Rediset WMX :

- Easy to incorporate with existing equipment.
- Warm mix additive with adhesion promoting properties.
- Does not change VG grading of the bitumen.
- Moisture not introduced into the mix.
- Formulated to suit a wide range of mix types and aggregates.

2. Viscosity Grade-30(VG-30)

VG-30 is primarily used to construct extra heavy duty Bitumen pavements that need to endure substantial traffic loads. It can be used in lieu of 60/70 Penetration grade.

Advantages are :- VG-30 has excellent adhesive and bonding properties with aggregates.

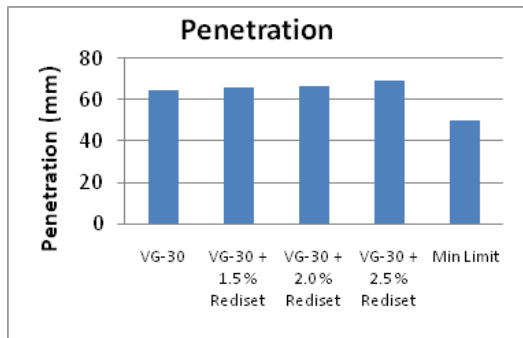
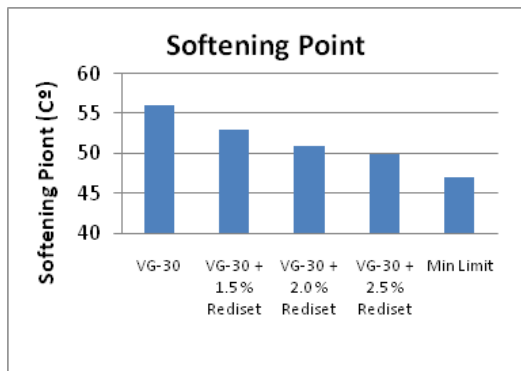
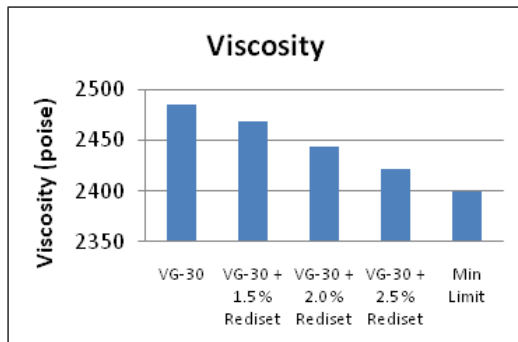
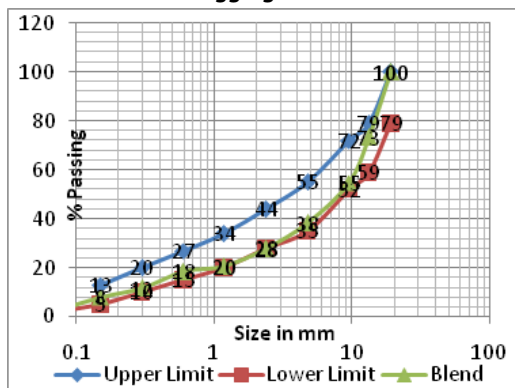
- It has excellent waterproofing properties.
- It also has resistance to mild acids and alkalis.

III. LABORATORY TESTS

1. Bitumen Test Results

	VG-30	VG-30 + 1.5 % Rediset	VG-30 + 2.0 % Rediset	VG-30 + 2.5 % Rediset	Min Limit
Penetration (mm)	65	66	67	69	50
Softening Point (C°)	56	53	51	50	47

Ductility (cm)	85	82	78	80	40
Viscosity (poise)	2485	2468	2444	2421	2400
Specific gravity	1.026	1.01	0.99	0.98	

Table 1. Bitumen test result**Figure 2. Penetration test result****Figure 3. Softening Point test result****Figure 4. Viscosity test result****2. The Gradation of aggregate****Figure 5. Gradation of aggregate Chart**

	Specific gravity of Sample	Weight of Sample	% of Sample
20 mm Aggregates	2.69	540 gm	45
6 mm Aggregates	2.64	312 gm	26
stone dust	2.61	312 gm	26
Lime	2.26	36 gm	3
Total		1200	100

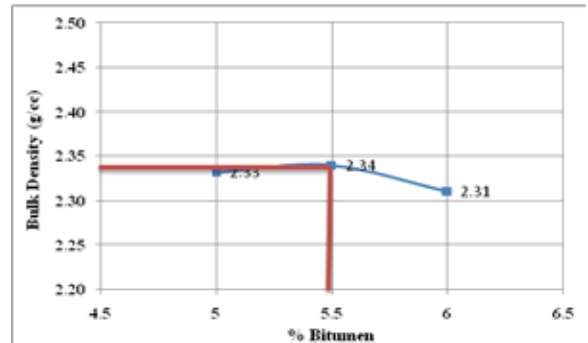
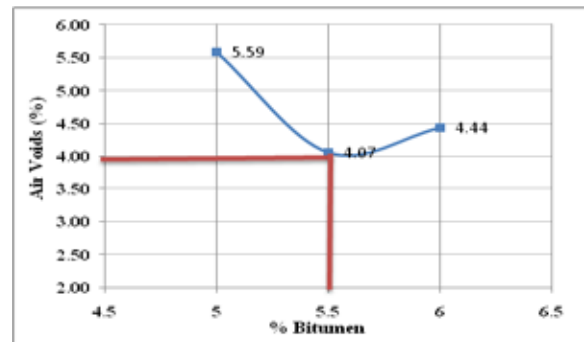
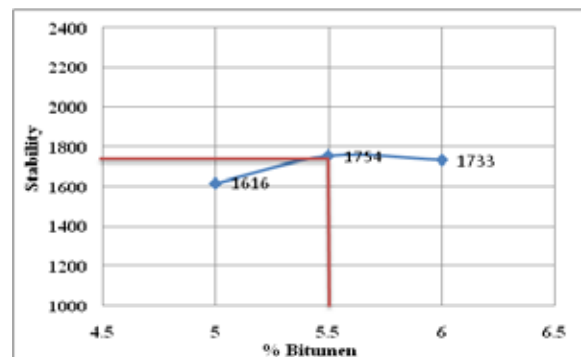
Table 2. % Distribution of sample**3. Marshall Mix design for**

Marshall Results of Optimum Binder Content

Bitumen Content	Stability	Flow Value	Bulk Sp. Gravity	Vv	VFB	VMA
5	1616	3.37	2.33	5.59	65.87	16.37
5.5	1754	4.10	2.34	4.07	74.48	15.91
6	1733	5.23	2.31	4.44	73.58	17.14

Table 3. Marshall Results of OBC

The volumetric properties of BC mix using VG 30 shown in Table 3 and it seen that design mix satisfied the all volumetric requirement of BC as per MORTH section 500 clause 509.

**Figure 6. Bulk Density Vs % Bitumen****Figure 7. Air Voids Vs % Bitumen****Figure 8. Stability Vs % Bitumen**

Particulars	% Bitumen
Maximum Stability	5.5
Maximum Unit Weight	5.5
Bitumen at 4.0 % Volume of Voids	5.5
OBC	5.5

Table 4. Average OBC

Marshall Results of Optimum Temperature and Optimum Dosage of Rediset

With added 1.5 % Rediset						
Temperature	Stability	Flow Value	Bulk Sp. Gravity	Vv	VFB	VMA
110° C	883	3.6	2.30	5.70	67.17	17.36
120° C	1056	4.7	2.34	4.16	73.99	16.00
130° C	991	4.7	2.32	4.93	70.47	16.68

Table 5. Marshall result for 1.5 % Rediset

With added 2.0 % Rediset						
Temperature	Stability	Flow Value	Bulk Sp. Gravity	Vv	VFB	VMA
110° C	1124	4.1	2.31	5.50	68.06	17.20
120° C	1656	3.6	2.33	4.45	72.70	16.25
130° C	1487	3.9	2.32	5.21	69.31	16.69

Table 6. Marshall result for 2.0 % Rediset

With added 2.5 % Rediset						
Temperature	Stability	Flow Value	Bulk Sp. Gravity	Vv	VFB	VMA
110° C	1067	3.8	2.30	5.44	68.16	17.09
120° C	1272	4.8	2.33	4.63	71.79	16.42
130° C	1146	3.6	2.32	4.75	71.24	16.52

Table 7. Marshall result for 2.5 % Rediset

Test results of BC mix using VG 30 by addition of 1.5, 2 and 2.5% Rediset at temperature 110°C, 120°C and 130°C along with their volumetric properties shown in Table 5, 6 and 7 respectively.

Temperature	Stability	Air voids	Bulk Density	Dose(%)
110	883	5.70	2.30	1.5
120	1056	4.16	2.33	
130	991	4.93	2.32	
110	1124	5.50	2.31	2.0
120	1656	4.45	2.34	
130	1487	5.21	2.32	
110	1067	5.44	2.30	2.5
120	1272	4.63	2.33	
130	1146	4.75	2.32	

Table 8. Summary of Results

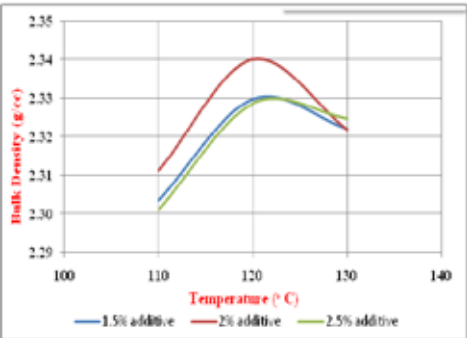


Figure 9. Bulk Density Vs % Temperature

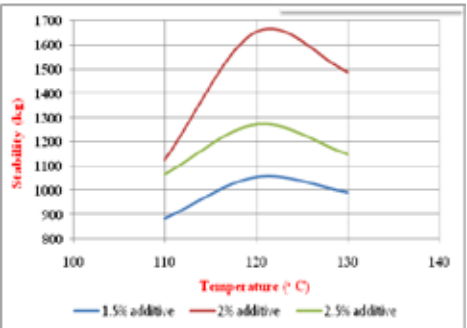


Figure 10. Stability Vs % Temperature

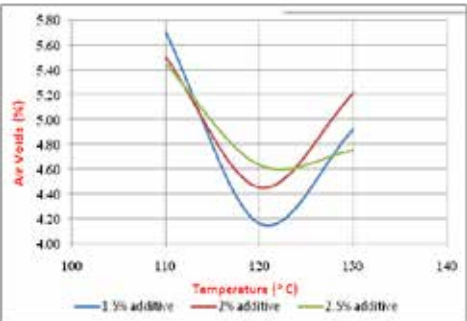


Figure 11. Air Voids Vs % Temperature

Based on the volumetric properties of mix using VG 30 graph has been plotted as shown in Figure 9, 10 and 11. It is clearly seen that optimum temperature for warm mix design at 2% addition of Rediset is 120°C. Addition of 1.5% Rediset cause reduction in stability which obviously higher than the MoRTH requirement except at 110°C temperature. There has been also increase in air voids which clearly mean that there is not proper compaction of mix at temperature 110°C, 120°C and 130°C. Similarly, addition of 2.5% Rediset cause reduction in stability which obviously higher than the MoRTH requirement. There has been also increase in air voids which clearly mean that there is not proper compaction of mix at temperature 110°C, 120°C and 130°C.

IV. CONCLUSION

There has been 30-40°C reduction in mixing and compaction temperature of bituminous mixes by adding 2% additive and satisfied all volumetric requirement for both the binders resulting in better performance of bituminous mixes at lower temperature.

REFERENCES

1) Dr. Sunil Bose, Mr. M.N.Nagabhushna, Mrs. Ambika Behl, Mr. Gajendra Kumar, Mr. Girish Sharma, Mrs. R. Uma Devi- Laboratory Evaluation of Evotherm Additive in Warm Mixes (2011) | 2) Kakade, V. Das, D. Reddy, M. A. Pandey B. B. " Low Energy sphalt Mixes, Proceedings of International Seminar on Reducing Carbon Foot Print in Road Constructor New Delhi (2011) page 31-37 | 3) Shivangi Gupta & A. Veeraragavan, "Fatigue Behaviour of Polymer Modified bituminous concrete Mixtures" Journal of the Indian Roads ongress, January-March 2009 | 4) www.surfactants.akzonobel.com/asphalt. | STANDARDS | 1. IS: 1202- 1978, Methods for testing tar and bituminous materials: determination of specific gravity. | 2. IS: 1203- 1978, Methods for testing tar and bituminous materials: determination of penetration. | 3. IS: 1205- 1978, Methods for testing tar and bituminous materials: determination softening point. | 4. IS: 1206- 1978, Methods for testing tar and bituminous materials: determination of viscosity. | 5. Ministry of Road Transport and Highways (MoRTH) section 500 Design of Bituminous Concrete. |