PERFORMANCE OF WARM MIX ASPHALT USING VG-30 BINDER FOR BITUMINOUS CONCRETE

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Abstract - *Bituminous mix is a composite material extensively used in road construction, airports and parking lots. It is a mixture of coarse aggregates, fine aggregates, filler together with bitumen as binder at a high temperature resulting in a mix which is workable, strong and durable. There are 4 types of mixes available according to temperature range. Warm mix asphalt is an emerging technology for constructing the asphalt pavement. WMA is a technology that allows producing the asphalt material at 30 to 40°C lower temperatures than conventional HMA. Warm mixes are classified on the basis of technology and additives used for reducing production temperatures. The study is carried out to observe the effect of mixing Warm mix chemical on properties of bituminous mix using VG 30 binder for Bituminous concrete layer. The observations from this research reveals that the performance of warm mix asphalt is better than the conventional hot mix on various parameters.*

Keywords- WMA, HMA.

1. INTRODUCTION

Rigid environmental regulations and present need to reduce emissions, creates a need in asphalt sector to opt for an alternative that reduce amount of energy consumption and results in environmental benefits. Warm mix asphalt is an emerging technology for constructing the asphalt pavement. WMA is a technology that allows producing the asphalt material at 30 to 40°C lower temperatures than conventional HMA. Warm mixes are classified on the basis of technology and additives used for reducing production temperatures.

a) Foaming Technology
b) Organic Additives
c) Chemical Additives
d) Hybrid Technology

There are certain advantages of warm mixes which are mentioned below:

a. *Longer Haul Distance:* viscosity of stiff binder decreases but temperature drop with time is less thus allowing higher haulage distance and better workability and reducing risk of compaction troubles.

b. *Environment Friendly*: it reduces the emission by 20-30% and also reduces emission of volatile organic compounds.

c. *Operational Economy*: It reduces the fuel consumption of burner and the plant wear is also less.

d. *Better working Conditions*: Improve working conditions by reducing exposure to fuel emissions, fumes and heat thus allowing workers to inhale far less smoke, odor and dust at construction site.WMA gives better paving conditions inside tunnels where ventilation is less

e. *Increasing Durability*: due to low production temperatures it eliminates premature binder aging which increases the life of pavement and reduces need of maintenance.

f. *Extended Paving Season*: As the difference between the production and ambient temperature is smaller the paving season can be extended upto colder months of the year.

g. *Ease of Placing and compaction*: WMA additives and processes act as a compaction aid especially at night work.

2. OBJECTIVES OF THE RESEARCH

Following are the objectives of this study:

1. To determine the optimum binder content for control mixes for dense bituminous macadam.
2. To determine the optimum binder content for control mixes for Bituminous concrete.
3. To ascertain the effect of adding different doses of Bitubuild R-1000 on the various properties of mixes
4. To compare the various properties of HMA with WMA by Marshall method.

- Marshall Stability
- Flow value
- Density
- VMA(Voids in Mineral Aggregates)
- VFB(Voids filled with bitumen)
- V_A(Volume of Aggregates)
- V_B(Volume of bitumen)

5. To determine the retained stability of control mix and comparison with that of warm mix.

3. MATERIAL USED

Following materials are used in this study:

Aggregates: Aggregate of size26mm, 19mm, 10mm, Stone dust, cement was used in preparing the mix.

Binder: Bitumen of VG30 grade having specific gravity of 1.01 was used.

Additive: BituBuild-WM an indigenous additive was used for preparing a warm mix.

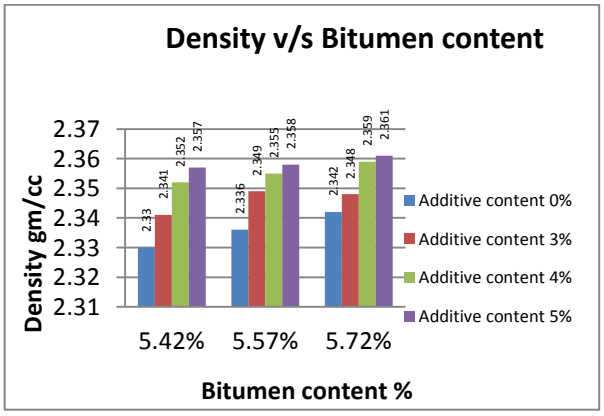
1. PROPORTION OF AGGREGATES TO BE USED

Size of aggregates (mm)	Percentage	Weight of aggregates (gms)
19	17%	204
10	26%	312
Jeeri	45%	540
Stone Dust	10%	120
Cement	2%	24

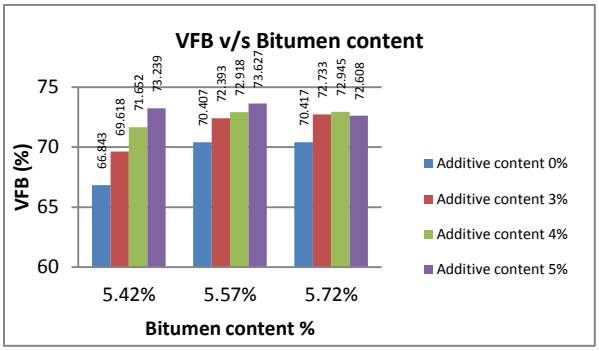
QUANTITY OF BITUMEN TO BE USED

Percentage of Bitumen	Weight of Bitumen (gms)
5.42%	70
5.57%	72
5.72%	74
5.87%	76
6.02%	78

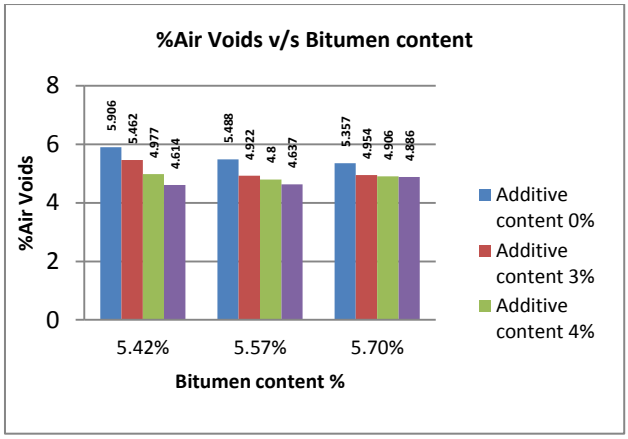
2. RESULTS FROM THE STUDY CARRIED



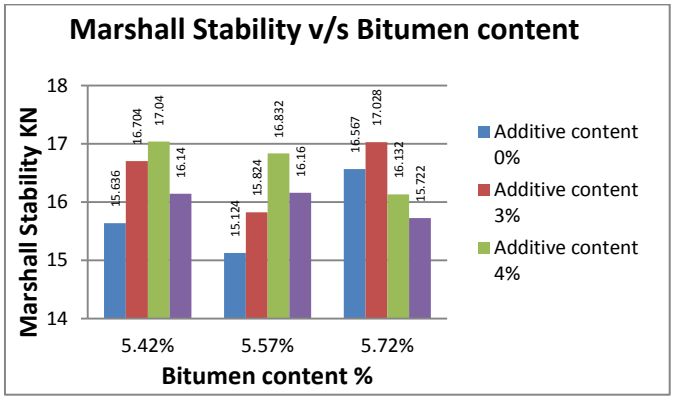
NOTE: It was observed that when the additive is added in the control mix its density starts increasing with increase in additive content for all the binder contents.



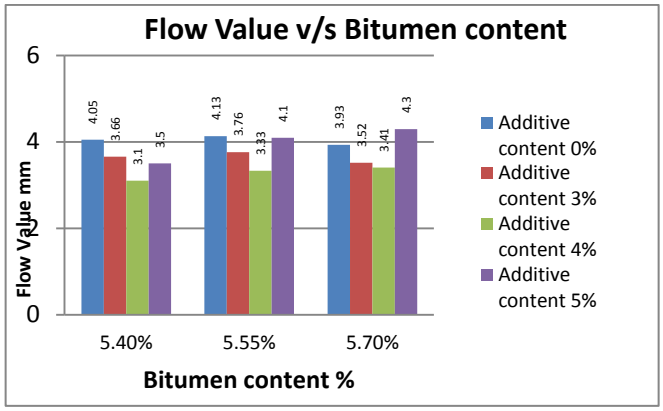
NOTE: With increase in additive content it was observed that voids filed with bitumen increases for binder content 5.42% and 5.57 % but in case of binder content 5.72% voids filled with bitumen first increases upto 4% additive content but further addition of additive content decreases the value of VFB.



NOTE: Air voids in percentage decreases with increase in additive content for all the binder contents and also lowers than the control mix.



NOTE: With increase in additive content the load value of warm mix increases and also greater than the control mix. The load value increases upto addition of 4% additive. Beyond this the load value decreases. Maximum load value is achieved at 4% additive content for all binder contents.



NOTE: Flow value of warm mix starts decreasing with increase in additive content. Minimum flow value is achieved at 4% additive content. But further addition of additive in the mix increases the flow value.

4. CONCLUSIONS

From the study conducted it was inferred that Warm mix asphalt is prepared at a temperature less than 25-30˚C than the conventional hot mix asphalt i.e.130˚C to 140˚C. Also better results were obtained on addition of warm mix additive in the control mix.

Following outcomes were inferred from the study conducted:

1. **Softening point** of binder decreases with addition of warm mix additive i.e. softening of bitumen is achieved at lesser temperature.
2. **Penetration value** of binder increases with increase of additive content.
3. **Density:** Density of mix increases with increase in additive content as compared to control mix.
4. **Optimum Binder Content:** For bituminous concrete the optimum binder content was 5.7% and for dense bituminous macadam it is 4.65%.
5. **Optimum additive content:** For Bituminous Concrete layer the optimum amount of additive content is 4% by weight of bitumen because best and desired results were obtained at this value.
6. **VMA:** Voids in mineral aggregate starts decreasing with addition of warm mix additive but only upto 4% additive. Beyond this value voids again starts increasing. This is because of higher reduction in viscosity of binder which leads to thinner coating of binder on aggregates.
7. **VFB:** Due to decrease in viscosity of binder voids in aggregates starts filling completely. But only up to 4% additive content, because further increase in additive content decreases the viscosity extremely, resulting in lesser coating of aggregates and reducing binding property of bitumen.

5. REFERENCES

1. **Ali Ayman, Abbas Ala, Nazzal Munir, Alhasan Ahmad, Powers David;** " Workability Evaluation of foamed Warm mix asphalt" Journals of materials in civil Engineering, June'2014, Vol.26, No.6.
2. **Cooper B. Samuel, Mohammad N. Louay, Elsifi A. Mustafa;** " Laboratory performance characteristics of sulphur modified warm-mix asphalt" Journals of material in Civil Engineering, September' 2011, Vol. 23, No. 9, pp 1338-1345
3. **Hurley C Graham and Prowell D Brian;** " Evaluation of Aspha-min Zeolites for use in warm mix Asphalt" NCAT report 2005-2006, June 2005
4. **Hurley C Graham and Prowell D Brian;** " Evaluation of Sasobit for use in warm mix Asphalt" NCAT report 2005-06, June 2005
5. **Kandhal P.S.**; "Warm mix asphalt technologies: An Overview" Journal of Indian Road Congress. July-September'2010, pp143-152.
6. **Liu J, Li Peng;** "Low temperature performance of Sasobit-modified warm mix asphalt" Journals of material in civil engineering, January' 2012, vol. 24, No. 1, pp57-63.
7. **Sargand Shad et al;** "Field Evaluation of Warm mix Asphalt technologies" journals of material in civil engineering, November' 2012, pp 1343-1349.
8. **Silva M.R.D. Hugo, Oliveira R.M. Joel;** " Assessment of the performance of warm mix asphalt in road pavements" international journal of pavement research and technology, May 2010, Vol. 3, No. 3, pp 119-127