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Moisture Resistant Pavements by using Zycotherm

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ABSTRACT

Warm Mix Asphalt (WMA) is a fast emerging technology which has a potential of revolutionizing the production of Asphalt Mixes due to its advantages over Hot Mix Asphalt(HMA) in mixing, laydown and compaction at lower temperatures.The concept of WMA evolved around the year 2000 in Europe and Australia [2, 6], and by the year 2004 it attracted considerable attention of the highway engineering community [7, 8]. It consumes 30% less energy, reduces carbon dioxide emission by 30%, and reduces dust emission by 50-60% compared to hot mix asphalt [4].Air pollution caused due to emission and fumes is very because of WMA production temperature which ranges from 100 to 140^{0}C.These reductions have the obvious benefits of cutting fuel consumption and decreasing the production of greenhouse gases.The WMA is produced by mixing chemical additives to the conventional mix to improve the pavement performance. In this study "Zycotherm" is used as chemical additive at a rate of 0.1% by weight of binder and there by increasing stability and workability of bituminous concrete mix by reducing OBC

Keywords- Wet Mix Asphalt, Hot Mix Asphalt, Zycotherm.

I. INTRODUCTION AND LITERATURE REVIEW

Warm Mix asphalt (WMA) is an exciting development in the recent years, permitting production and placement of asphalt paving at temperatures lesser than Hot Mix Asphalt (HMA). It is made possible by utilizing an additive which thins or reduces the viscosity of the asphalt binder at lower temperatures allowing sufficient coating of aggregates while maintaining workability. The composition of the WMA is same as that of HMA except for the chemical additive which lowers the viscosity of the bitumen.

Rohith N. (2013)

Marshall properties of WMA produced with Zycotherm and HMA for Dense Bituminous Macadam for Grade 2 at temperature 1550 C,1300 C are compared. The adopted mixing temperatures for HMA was 155°C, 130°C and 115°C and the mixing temperatures for WMA was 130°C and 115°C, with an additive dosage rate of 0.1% by weight of the binder The laboratory study concludes that Stability & Marshall properties were improved for the WMA mix by the addition of the additive.

Colbert_et al.(2011) evaluated that low-temperature performance of energy-efficient and environmentally friendly hot-mix asphalt paving materials. The materials used as modifiers in typical HMA to enhance low-temperature field performances in the asphalt pavement industry include warm mix asphalt, recycled asphalt shingle, reclaimed asphalt pavement, and bioasphalt. Sasobit compounds added by weight of performance grade (PG) 52-34 asphalt binder are used to design the WMA. RAS were also added to a PG 52-34 asphalt binder. By using the Superpave bending beam rheometer and the new asphalt binder cracking device method, the thermal cracking performance of the samples were tested. The results concluded that the ABCD method can be used alongside or as a confirmation test for the BBR in evaluating the low-temperature cracking resistance behavior

of asphalt binders. Adding WMA beyond a certain percentage could potentially reduce the low-temperature cracking performance of the asphalt binder and swine waste bioasphalt can enhance low-temperature asphalt binder performance.

Arabani_et al.(2012)

Two types of aggregates, limestone and granite, and two types of WMA additives, namely Sasobit and aspha-min, in addition to Zycosoil as an antistrip additive was evaluated in this study. The effects of these additives on the moisture susceptibility of asphalt mixture are still not fully understood, the primary goal of this research was to decrease the moisture damage in WMA. The results concluded that WMA additives cause an increase in the acid component and a reduction in the SFE base components of asphalt binder which causes decreased adhesion between acidic aggregate that is more moisture damage and asphalt binder. Zycosoil additives cause an increase in the adhesion SFE between asphalt binder, modified with WMA additives and aggregates in the presence of water.

Liu_Peng_(2012)

Engineering properties of Sasobit-modified WMA binders and mixes were experimentally evaluated, and the effects of Sasobit addition to the WMA performance in terms of low temperature behavior, rutting resistance, and moisture susceptibility were investigated. Research results identified a number of engineering benefits of Sasobit-modified WMAs over conventional HMA. Sasobit modified WMAs reduced mixing and compaction temperatures, improved workability and rutting resistance, and had an insignificant effect on moisture susceptibility. These effects indicated the suitability of this WMA technology for central and southeastern regions of the Alaska Department of Transportation and Public Facilities.The indirect tension test results showed a decrease of WMAs tensile strength at low temperatures.

Cheng_et al. (2011)

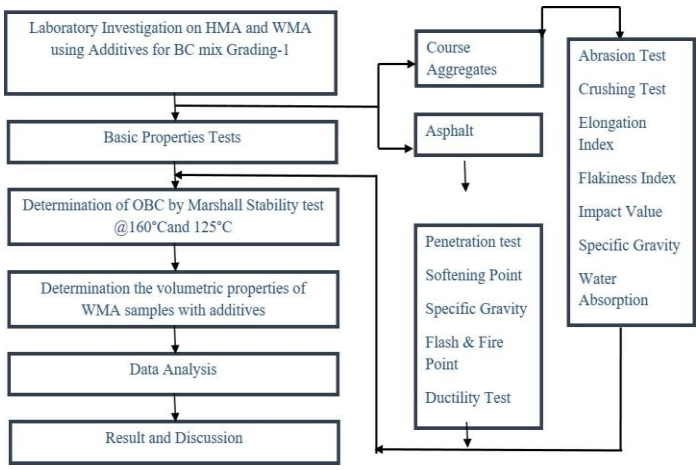
Investigated the size effect of hydrated lime on the moisture susceptibility of warm-mix-asphalt mixtures with selected additives. Experiments for antistripping properties, such as indirect tensile strength, tensile strength ratio, flow, and toughness were conducted on WMA mixtures containing SNHL and RHL as control samples. A total of 18 mixtures and 108 specimens were prepared from three types of aggregate, three WMA additives, and two types of lime. Cheng concluded that the microstructures of the SNHL and RHL are irregular: the lime particles have fractured and rough surfaces with sharp angles and some small spherical particles in the nano size were found in SNHL but not in RHL. WMA mixtures using SNHL have greater ITS and TSR than those using RHL; an increase in ITS and TSR by using SNHL over RHL were observed for the WMA mixtures investigated

Alonso_et al. (2012) evaluated the effect of type of compaction (impact and gyratory compaction) on the mechanical properties (water sensitivity and stiffness modulus) in warm-mix asphalts. Moreover, the manufacture and laying temperatures and the use of additives for warm-mix asphalts have been taken into account. The mix tested have a semi-dense aggregate gradation with a B-60/70 penetration binder and different types of warm-mix additives added. The mixtures compacted by gyratory compactor at different temperatures all displayed good behavior of water sensitivity; in contrast, not all mixtures compacted by impact achieved this. On reducing the manufacturing temperature, the stiffness moduli decreased in all mixtures for both types of compaction, this reduction being less pronounced in the mixes manufactured with the gyratory compactor. The results have been evaluated statistically Quantification of Oxidative Aging of Polymer-Modified.

Warm Mix Additive (Zycotherm)

Zydex Industries, India has recently developed a polymer-based Warm Mix additive that is Zycotherm. A Zydex WMA additive resolves the issue of moisture susceptibility with improved strength and compatibility at economical cost. The additive combinations of Zycotherm works synergistically to micro-reinforce the binder and make the aggregates asphalt loving. Zycotherm eliminates moisture / snow (salt) damage of bitumen concrete layers (60-65% cost of the road) by chemical bonding of aggregates. It neutralizes variability of aggregates and bitumen binder. It also eliminates damage due to water migration from top, sideways ingress or capillary rise. ZYCOTHERM reduces the stickiness on trucks and compaction roller upto 90 degrees which captures sticky asphaltenes in nano cages of zycotherm for improved free flow and reduced stickiness to trucks or paver and compaction roller, it eliminates the stripping whereas the residual water in aggregate at lower mix temperature helps to promote reactivity with aggregate to withstand six boil test with 95% retained coating.

II. METHODOLOGY



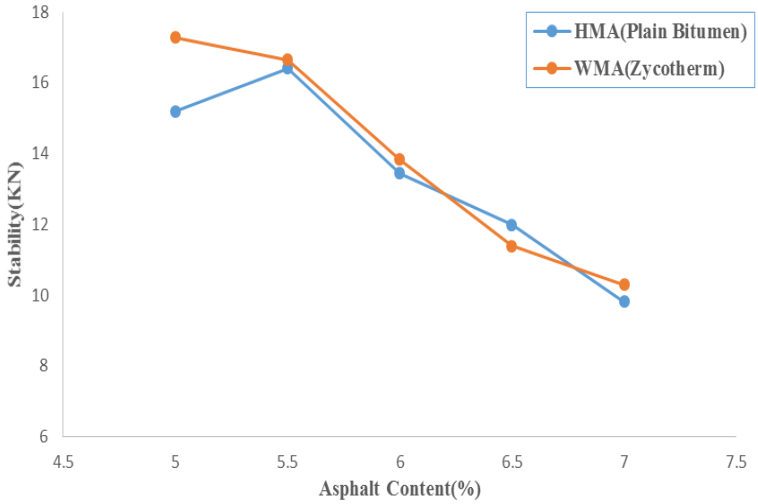
Doping of Zycotherm

For the present study 0.1% was adopted as the additive dosage for preparation of the specimens. ZycoTherm was added 0.1% volumetrically or by weight (ZycoTherm density: 1.01 gm/cc) using 2.5ml plastic syringe and the molten bitumen 1550C (3110F) was stirred manually using a glass rod while adding ZycoTherm and additional stirring for 10 minutes was done for uniform mixing of the additive with the bitumen. The doping of additive with thebinder is shown in Fig. i

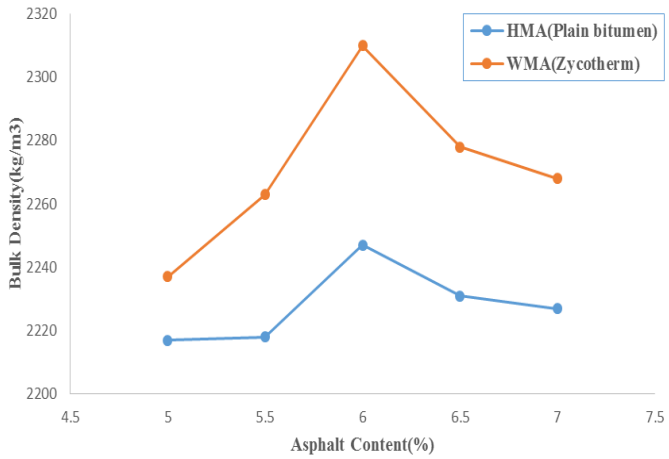
Fig.i: Zycotherm

III. RESULTS

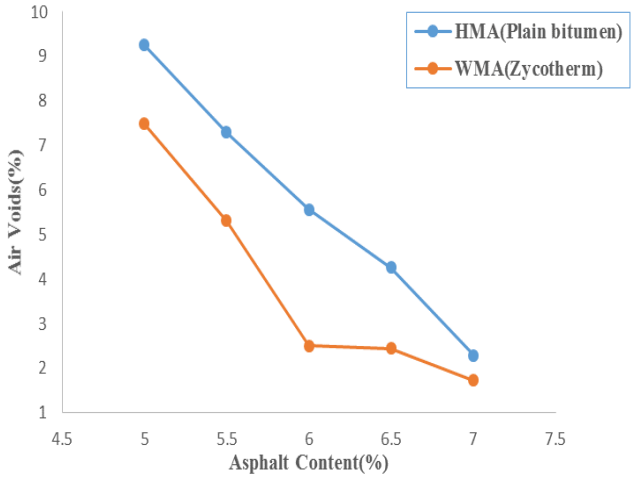
Test was conducted on bituminous concrete (grade -1) mixes without additives and with additives of Zycotherm with dosage of 0.1% temperature range of 125°C.



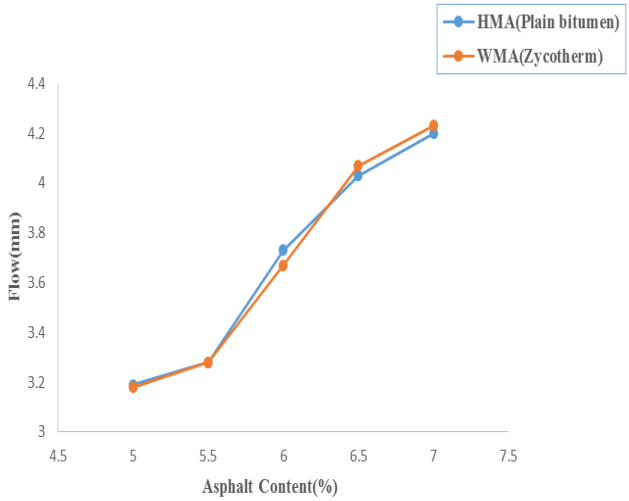
Comparison of Stability values Vs asphalt content with and without additives for grading-1



Comparison of bulk density values Vs asphalt content with and without additives for grading -1



Comparison of air voids values Vs asphalt content with and without additives for grading-1



Comparison of flow values Vs asphalt content with and without additives for grading-1

IV. CONCLUSION

In the present study, the importance was to add the warm mix additives to bituminous concrete (BC) mix and to evaluate the various mix properties like Marshall Stability, flow, bulk density, voids in the mix and VFB.

1. The maximum stability at 80/100 bitumen is achieved with WMA at different temperature which meets the HMA hence it can be used as the alternative for HMA
2. The addition of wma additive improves the bulk density hence WMA with additive shows better and maximum density.
3. Air voids of bituminous concrete mix with WMA additive was lowest when compared to mix with HMA which indicates that the WMA additives are effective in compacting mixtures at a lower temperature.
4. The additives reduces the mixing and the compacting temperature with improves workability and insignificant effect on moisture susceptibility at low temperature.
5. The additive reduced the optimum bitumen content from 6% to 5.58%.

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