Alaska Department of Transportation & Public Facilities
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Evaluation of Warm Mix Asphalt for Alaska Conditions

Final Report

Prepared By:
Juanyu Liu, Ph.D., P.E

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Prepared For:

Alaska University Transportation Center
Duckering Building Room 245
P.O. Box 755900
Fairbanks, AK 99775-5900

Alaska Department of Transportation
Research, Development, and Technology Transfer
2301 Peger Road
Fairbanks, AK 99709-5399

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Juanyu Liu, Ph.D, P.E.

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This project developed and tested protocols to determine concrete curing strength during the construction process, so that building under very cold conditions can be performed safely and quickly. Researchers determined the laboratory strength-maturity correlations for concrete mix designs that ADOT&PF construction teams commonly use. Field tests were conducted in spring and summer of 2009. This study produced a guide, with procedures and computations designed to help ADOT&PF personnel use the maturity method to better estimate the strength of concrete poured on-site.

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EXECUTIVE SUMMARY

Warm Mix Asphalt (WMA) technologies, recently developed in Europe, are gaining strong interest in the U. S. Field practices. Studies showed that WMA can reduce the high mixing temperatures of regular hot mix asphalt (HMA), increase the temperature gap between production and cessation (allowing increased haul distances), and decrease the binder viscosity allowing effective compaction, which is beneficial for stiff mixes, paving during extreme weather conditions and reduction in compaction effort. However, previous research has not focused much on how WMA functions in cold weather paving and the performance of the WMA in cold regions.

In line with a field demonstration project of WMA using Sasobit conducted in Southeast Alaska, this study focused on experimentally assess the engineering properties of Sasobit modified WMA binders and mixes. In this study, PG 58-28 binder (consistent with that in the field project) was selected to be modified with Sasobit in four different contents, i.e. 0%, 0.8%, 1.5%, and 3.0%, respectively. Performance tests of binders were conducted according to Superpave specification to assess the correlation between the content of additives, and Superpave performance grade (PG) and stiffness of modified binders. Tests conducted to assess the performance of WMA included 1) permanent deformation (rutting) susceptibility by asphalt pavement analyzer (APA) and flow number F_N by simple performance tester (SPT), 2) low temperature cracking performance including tensile strength and tensile creep compliance properties by indirect tension test (IDT), 3) moisture susceptibility by moisture induced sensitivity tests (MIST), and 4) dynamic modulus |E*| by SPT. Performance tests for field-mixed lab-compacted mixes/field-cored samples were also evaluated in the laboratory to compare with the results of lab-mixed lab-compacted mixes.

Results showed that the addition of Sasobit reduced both mixing and compaction temperatures of mixes. Compared with control binder without Sasobit addition, the addition of 3% Sasobit contributed to a decrease of more than 15ºC in mixing temperature and a decrease of 13ºC in the compaction temperature. The Sasobit addition also significantly impacted the PG of binders. With the increase of Sasobit content from 0% to 3%, the high temperature end of asphalt PG increased from 58 to 76, however, the low temperature end also increased from -28ºC to -16ºC as well.

The SPT results showed that |E*| values of lab-mixed lab-compacted mixtures increased with the increase of Sasobit content. The field-mixed lab-compacted mix presented higher |E*| values than the lab-mixed lab-compacted mix with same content of Sasobit (1.5%) and voids in total mix (VTM, 4%). The F_N results were consistent with those of |E*| values. The improved rutting resistance of lab-mixed lab-compacted mixtures with the addition of Sasobit was also found from APA tests, which conformed to |E*| and F_N results. The MIST results exhibited slightly increased TSR values of lab-mixed lab-compacted mixes with the increase of Sasobit content, and the TSR values of field mix and laboratory mix with the same Sasobit content of 1.5% were very close. Within this study, at least the addition of Sasobit did not contribute to moisture damage of WMA compared with the control mix.

In a summary, laboratory investigation of Sasobit-modified binders and WMAs in this study identified a lot of engineering benefits of WMAs using Sasobit over traditional HMA. WMAs using Sasobit with reduced mixing and compaction temperatures, improved workability and rutting resistance, and insignificant effect on moisture susceptibility favorably indicated the suitability of this WMA technology for Alaska conditions. The IDT results showed degraded resistance to low temperature cracking of WMA using Sasobit in this study. However, additional tests at lower temperatures, along with a more complete thermal cracking analysis for specific environments of interest should be performed to get a more definitive answer regarding the effects of Sasobit on low temperature cracking.

The limited tests of field specimens in this study generally displayed higher variance/ inconsistency in results than those of lab-mixed lab-compacted specimens. Therefore, closer correlation between lab results and field performance data are suggested in the future study. Studies should also include long-term performance and associated life cycle cost analyses.