An Evaluation of the Moisture Susceptibility of Warm Mix Asphalt Mixtures

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Objective:

The objective of this research was to evaluate the moisture and low temperature cracking susceptibility of warm mixes made using Aspha-min and Sasobit additives.

Methods:

Evaluation of moisture susceptibility was accomplished by testing lab specimens, available cores, and field sections using the MMLS3 in the lab. MMLS3 testing was performed under dry and wet testing at a target temperature of 50ºC. Rut depths were measured periodically during loading. TSR values were also measured.

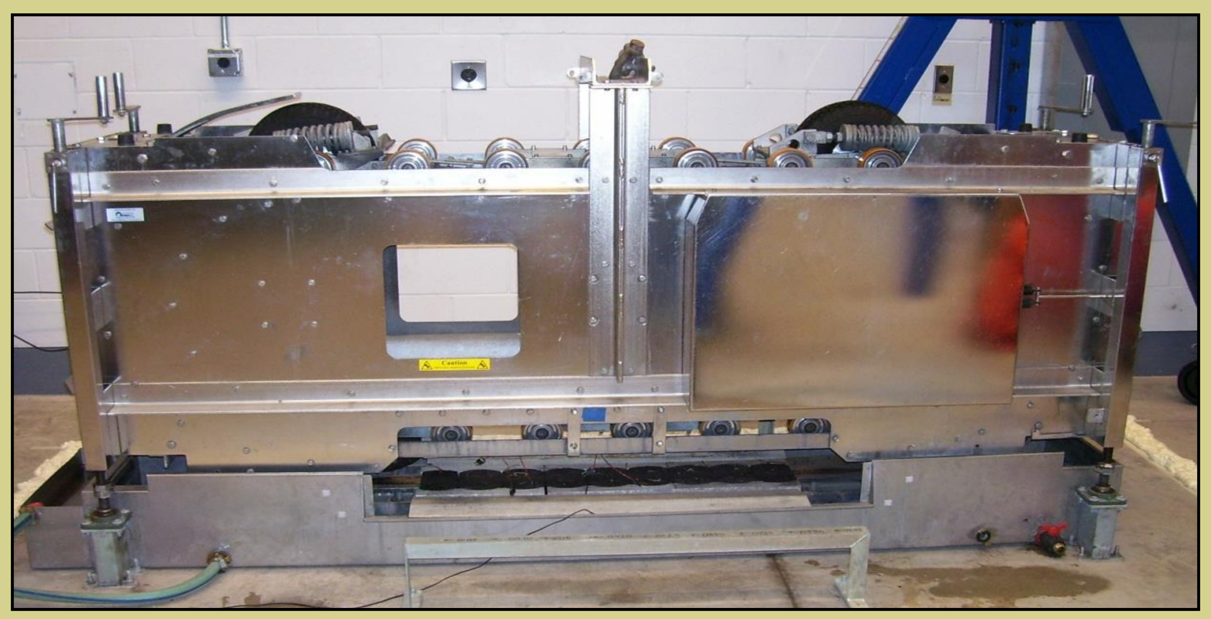

Figure 1: Third Scale Model Mobile Load Simulator

Low temperature cracking performance was evaluated by testing lab specimens using the AASHTO *Standard Test Method for Thermal Stress Restrained Specimen Tensile Strength*

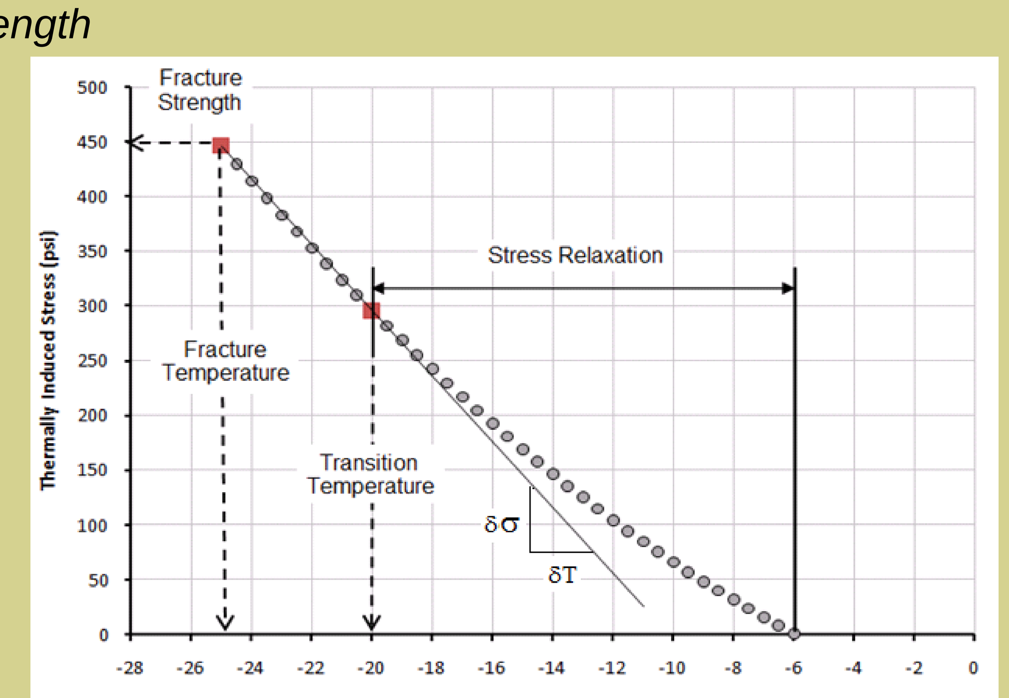

Figure 2: TSRST Testing Schematic

Materials:

Field Cores: Control, European Aspha-min© zeolite, and section containing a domestic Aspha-min zeolite from Hooksett Crushed Stone test strips (constructed Nov 2005)

Gyratory Specimens : Plant mix compacted at the plant during test strip construction

Laboratory Specimens : Fabricated in the laboratory using 12.5 mm NHDOT gradation and PG 64-28 binder. Control, Sasobit (1.5% by wt of binder), and Aspha-min (0.3% by wt of mix) mixtures fabricated at normal (155ºC mix/145ºC compact) and low (115ºC mix/ 100ºC compact) temperatures.

Results:

The average rutting data for the high and low mixing temperature laboratory fabricated specimens are shown in Figures 3 and 4. Figure 5 shows the wet/dry rut ratios for each mixture; a ratio greater than 1 indicates more rutting happened under the wet testing. Figure 6 shows the TSR values for each mixture.

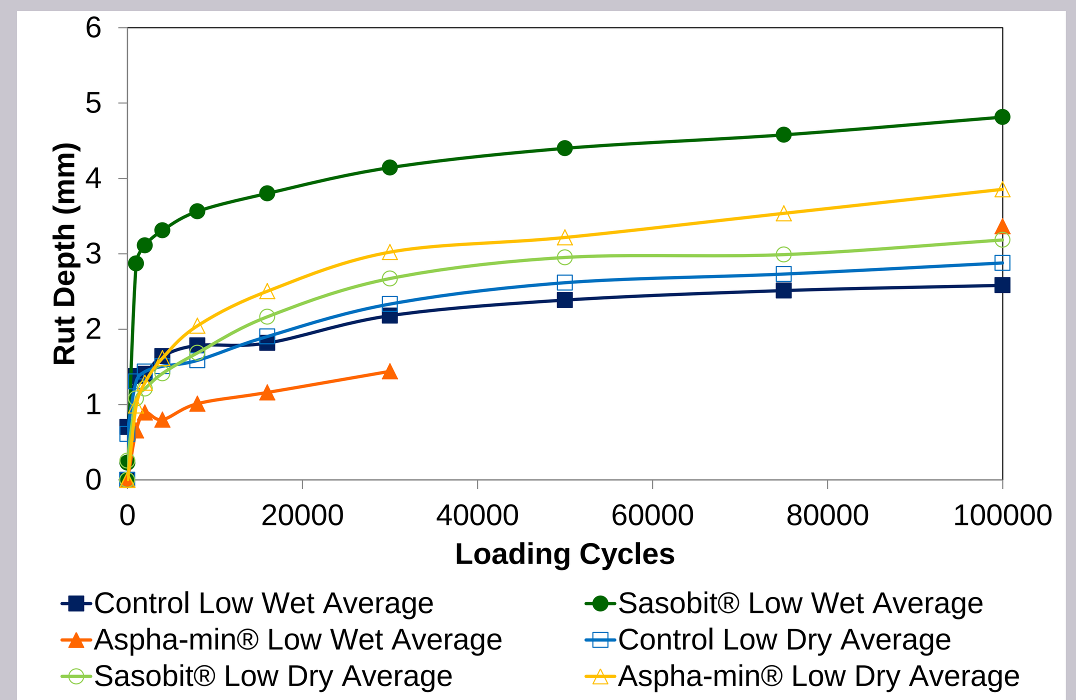

Figure 3: MMLS3 Rutting for Low Mix Temperatures

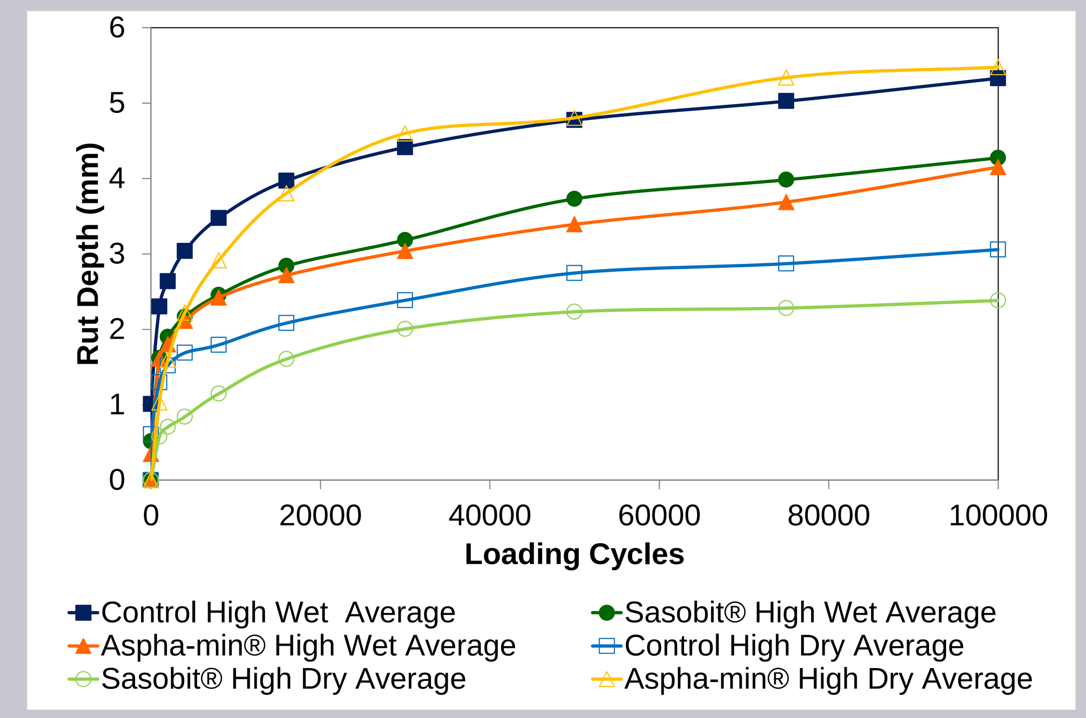

Figure 4: MMLS3 Rutting for High Mix Temperatures

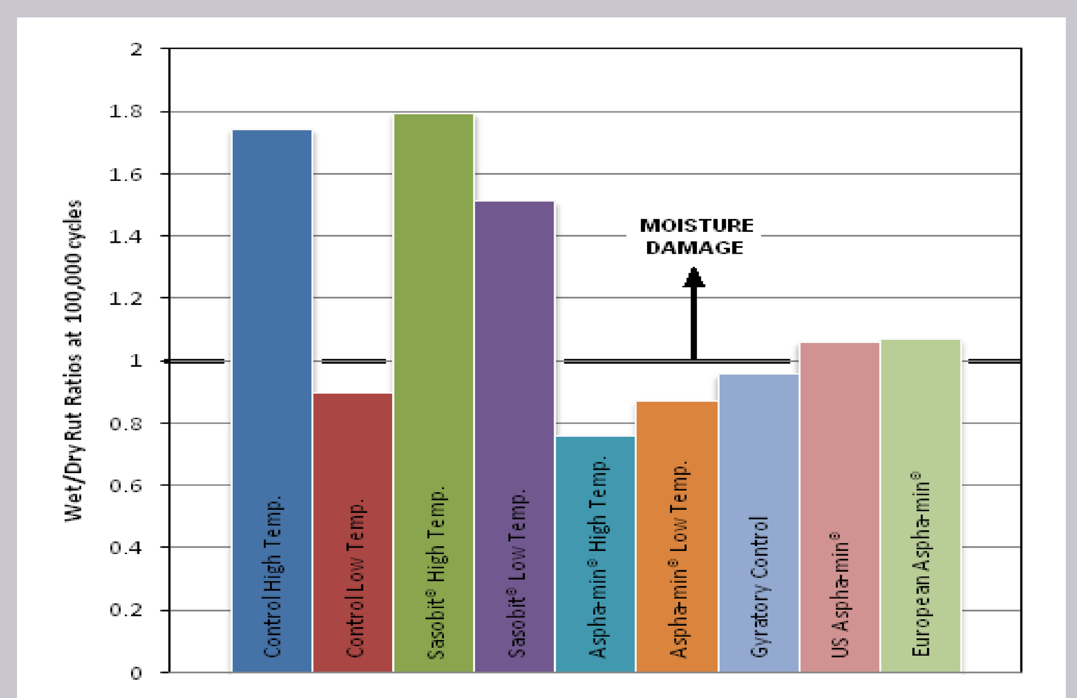

Figure 5: MMLS3 Wet/Dry Rutting Ratios

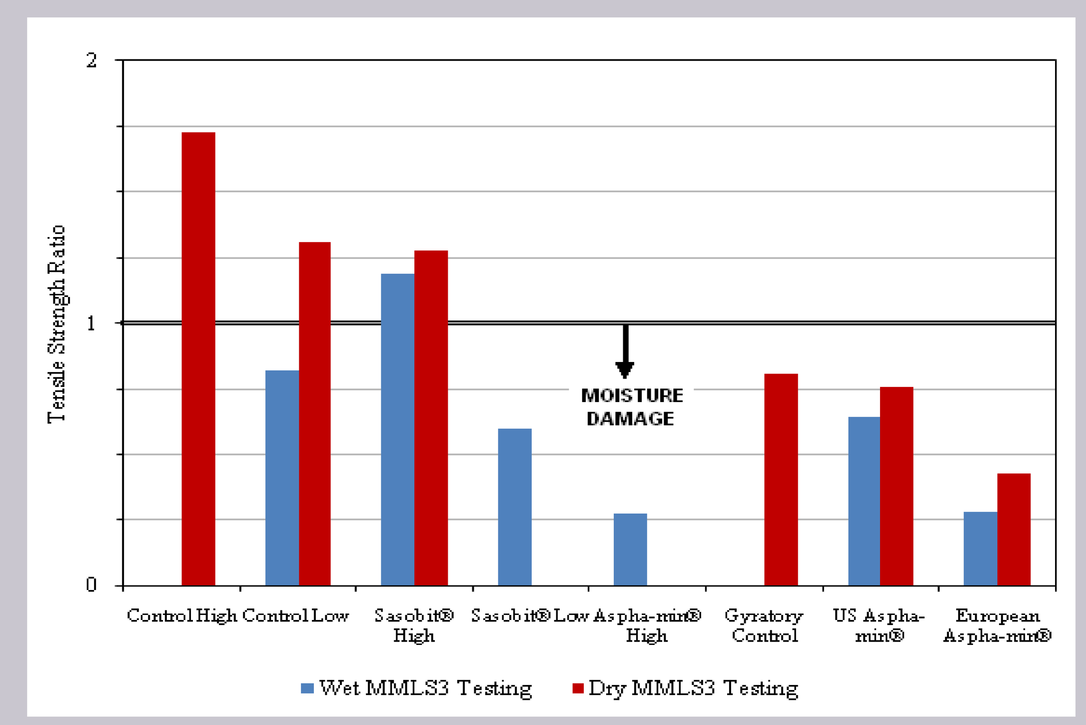

Figure 6: TSR Values from MMLS3 Specimens

The results of the TSRST tests are shown in Figures 7-9. CL and CH are the control mixture at the low and high mixing temperatures, respectively. SH and ZH are the Sasobit and Aspha-min mixtures at the high mixing temperature. The fracture and transition stresses for all mixtures are similar for the high mixing temperature. The two additives have a lower fracture and transition temperature than the control mixture.

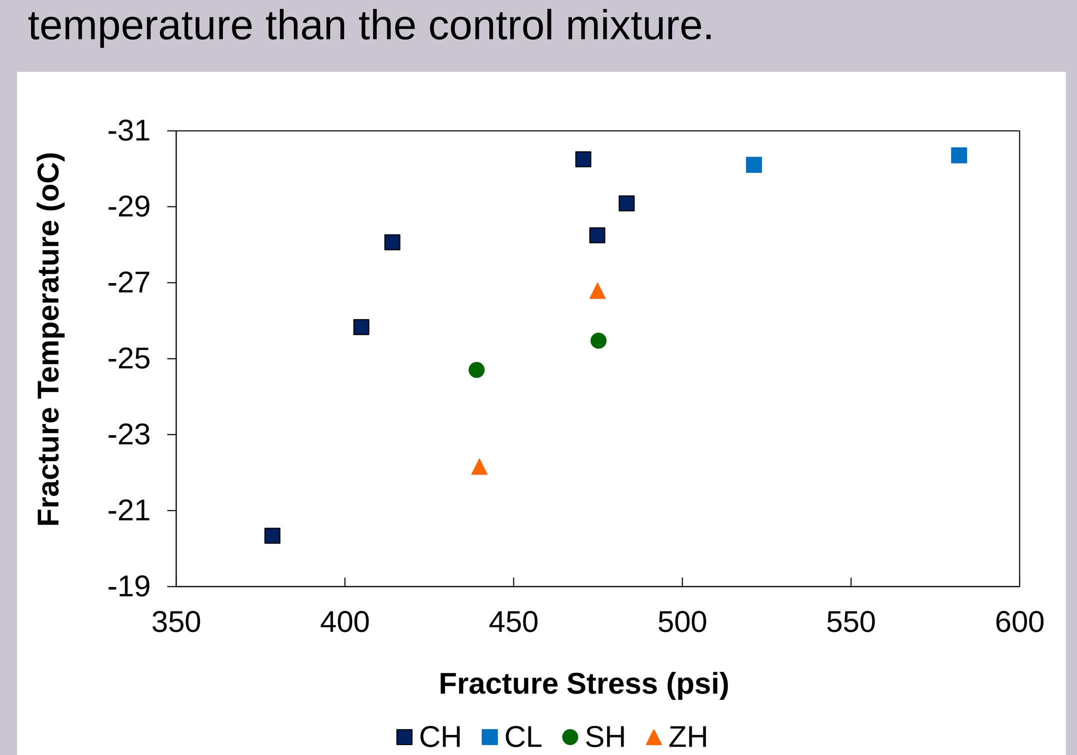

Figure 7: TSRST Testing Results

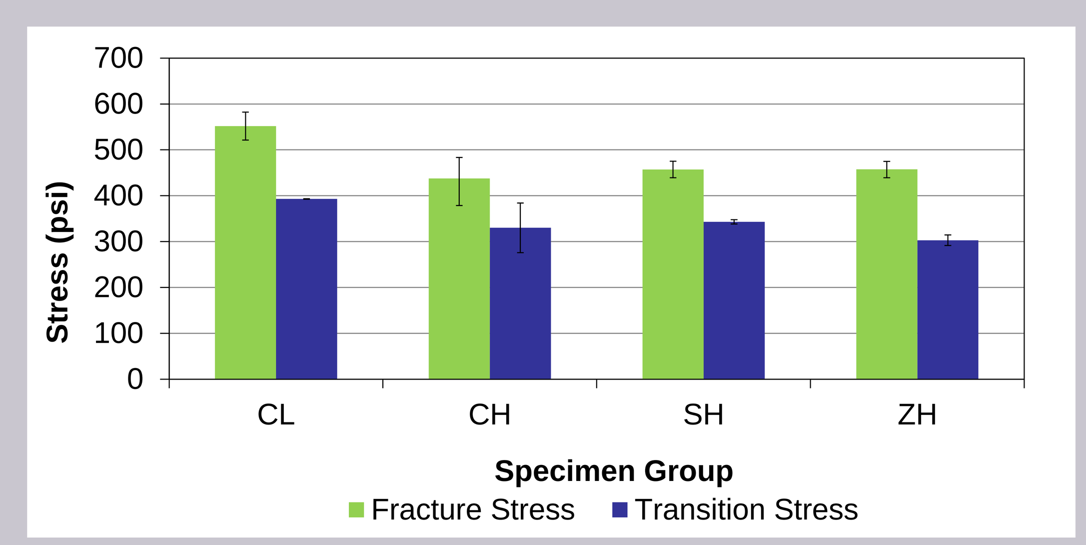

Figure 8: TSRST Fracture and Transition Stresses

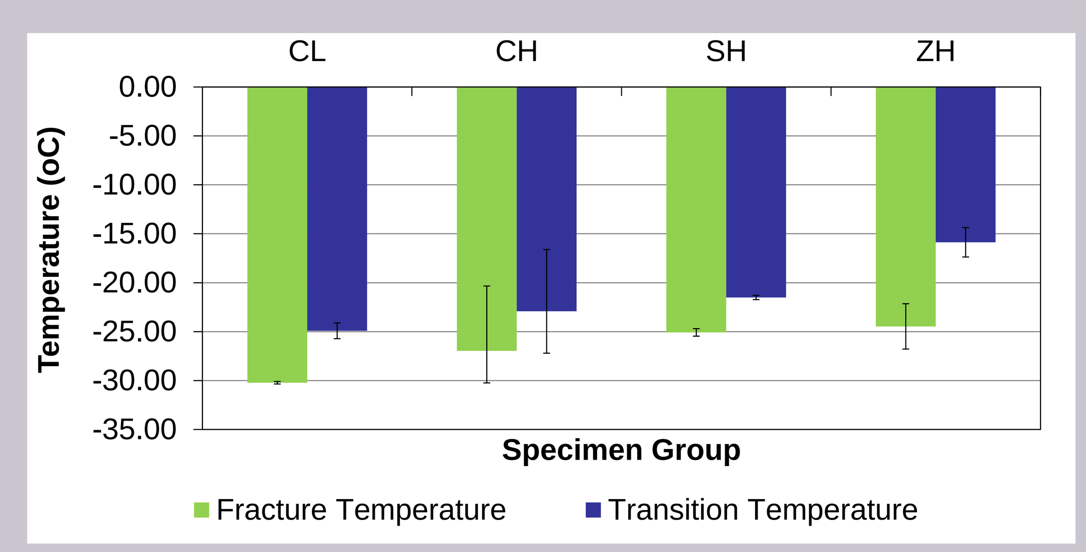

Figure 9: TSRST Fracture and Transition Temp

Conclusions:

The conclusions drawn from this study are listed below according to each type of distress:

Rutting

European Aspha-min exhibited better performance than the US Aspha-min in the field tests, however the difference is not statistically significant.

No difference in performance between WMA and HMA was observed from lab specimen results.

Control specimens had the highest modulus for the high mixing temperature and the Sasobit specimens had the highest modulus for the low mixing temperature. These two mixtures would be expected to have more resistance to rutting in the field than the other mixtures when subjected to the same environmental, structural and loading conditions. However very few specimens were tested and no statistical analysis could be performed.

Thermal Cracking

The results show that the warm mixture additives decrease the thermal cracking performance. More replicate specimens need to be tested in order to verify this behavior.

Moisture Susceptibility

Wet/Dry Rut ratios from MMLS3 testing indicate that Aspha-min mixtures are more susceptible to moisture damage as compared to control specimens, although TSR results from the same specimens didn't show the same trend.

The Sasobit mixtures did not exhibit moisture susceptibility.

Overall

The overall analysis of the data showed that mixtures fabricated with Aspha-min have potential for moisture susceptibility and both Aspha-min and Sasobit have potential for thermal cracking when compared to the control mixture.

Future Work:

Recommendations for future work include the testing of plant mixed materials and evaluation and testing of field test sections that include these and other warm mix technologies.

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