Benchmarking Delta Tc (ΔTc) for Wisconsin Materials

Objectives

- Evaluate the ΔTc parameter to help predict the non-load related cracking susceptibility of Wisconsin asphalt mixtures
- Standardize, validate and recommend an aging procedure prior to the measurement of ΔTc
- Recommend a plan for implementing ΔTc as a preferred performance measure for cracking susceptibility

Benefit

- Helps state agencies establish methods to evaluate asphalt binders used in roadways

Background

WisDOT is interested in looking at the potential use of the Delta Tc (ΔTc) parameter as a means of benchmarking the asphalt binders currently supplied to the state and is encouraged by previous work under WHRP project 0092-19-04, Recycled Asphalt Binder Study, that successfully used ΔTc to evaluate the cracking susceptibility of high recycled mixtures. This study evaluates whether ΔTc is appropriate for use with conventional asphalt binders supplied to WisDOT, and if so, what type of criteria should exist to differentiate between good and poor performing asphalt binders. Currently, WisDOT relies on the intermediate temperature PG grade as a means of capturing poor intermediate temperature cracking performance, even though it is well known intermediate temperature PG grade has its limitations.

Methodology

The research encompassed a literature review and extensive laboratory program consisting of both asphalt binder and mixture testing. Early in the literature review, as well as during the laboratory evaluation, it was evident that ΔTc may not be the best parameter for WisDOT implementation. Issues with testing variability and poor ability to rank polymer modified binders made the ΔTc parameter a less than desirable candidate for future specifications. The proposed methodology uses a similar approach to the intermediate temperature PG grade but only requires a single test temperature and loading frequency.

Field Cores recovered from FHWA Accelerated Loading Facility for asphalt mixture and binder testing

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"The chemical and physical properties of asphalt binders used in construction are changing. This research provided valuable insight on how state agencies can better quantify the quality of asphalt binders used in Wisconsin roadways."

– Erik Lyngdal

Results

Using the information and data collected, it was determined that ΔTc should not be selected as an asphalt binder cracking parameter due to variability issues, as well as its difficulty to properly rank polymer modified asphalt binder performance. Instead, the study provided two parameters that can be determined at a single test temperature and loading frequency; Glover-Rowe Parameter at 15°C (GRP_{15C}) and R-value at 15C. Criteria for the parameters were calibrated against an IDEAL-CT Index value of 30 after WisDOT long-term mixture aging. The parameters were found to be sensitive to asphalt binder supplier, different PG grades, inclusion of recycled asphalt binder and aging.

Currently approved WisDOT asphalt binders were found to meet the requirements of the procedure after 20-hour PAV conditioning, but many had issues meeting the requirements after 40-hour PAV conditioning. When blended with typical RAP binder from Wisconsin, the test parameters would limit most asphalt binders to 35% asphalt binder replacement before failing the proposed criteria. Lastly, the criteria was compared to recovered asphalt binder from the WisDOT BMD Implementation test sections and could identify Test Section #4, which was the only section designed and produced to have an IDEAL-CT Index less than 30.

Recommendations for Implementation

Based on the findings, the research team recommends the following:

- The combined use of the GRP_{15C} and 10 radians per second and the Rheological Index at 15°C provide the best means to characterize the asphalt binders in this study
- Intermediate temperature for the asphalt binder testing should be revised to 15°C for the entire state based on the in-situ climate temperatures
- Continue assessment for potential use of the GRP_{15C} correlation to the low temperature PG grade as determined using the BBR m-value
- Further research should include a larger database of asphalt mixtures across the state and evaluate their respective fatigue cracking mixture and binder properties

Interested in finding out more?
Final report is available at:
WisDOT Research website

This brief summarizes Project 0092-23-01
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Wisconsin Highway Research Program