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New Jersey Department of Transportation
Bureau of Research

Technical Brief

Effect of WMA on RAP in Hot Mix Asphalt

This project evaluated the performance of different WMA technologies when utilized in asphalt mixtures containing RAP and polymer-modified PG64E-22 (i.e. - PG76-22). Polymer degradation was compared between HMA and WMA production temperatures for the PG64E-22 using Gel Permeation Chromatography (GPC). Moisture damage potential was evaluated using prewetted aggregates and varying production temperatures with and without the WMA technologies. Also, the proposed WMA mixture design procedure, developed as part of NCHRP Project 9-43, A Mix Design Procedure for Warm Mix Asphalt, was evaluated using New Jersey materials.

Background

Warm mix asphalt refers to asphalt concrete mixtures that are produced at temperatures approximately 40 to 70°F cooler than typically used in the production of hot mix asphalt. The goal with warm mix asphalt is to produce mixtures with similar strength, durability, and performance characteristics as hot mix asphalt using substantially reduced production temperatures. There are important environmental and health benefits associated with reduced production temperatures including: lower greenhouse gas emissions, lower fuel consumption, and reduced exposure of workers to asphalt fumes. Lower production temperatures can also potentially improve pavement performance by reducing binder aging, providing added time for mixture compaction, and allowing improved compaction during cold weather paving.

Warm mix asphalt technologies were first introduced in Europe in the late 1990's as one measure to reduce greenhouse gas emissions. The National Asphalt Pavement Association has been instrumental in bringing these technologies into the United States with several demonstration projects being constructed since 2004. These projects have demonstrated the feasibility of using warm mix processes in the United States. Pavements have been successfully constructed using various warm mix processes with only minimal changes to equipment and quality control practices. These projects have served the important function of introducing warm mix asphalt to agency and contractor personnel, demonstrating the constructability of warm mix asphalt and providing data on energy usage and emissions.

One of the critical issues facing warm mix asphalt is the lack of a formal mixture design procedure. To date, properly designed hot mix asphalt concrete has served as the design for the warm mix projects constructed in the United Sates. However, the potential inclusion of higher RAP contents and plant systems that utilize foaming techniques may require modifications to the current Superpave procedure used for hot mix asphalt.

Pilot project evaluation should be conducted and compared to HMA companion sections to ensure the laydown and performance of the WMA technologies are identical to that of the HMA

sections. By evaluating sampled materials from the WMA and HMA, performance characteristics of the materials can also be compared.

Research Objectives and Approach

The objectives of this research are to

1) Evaluate possible influence of production temperatures on polymer degradation in polymer-modified asphalt;
2) Evaluate blending potential of RAP in WMA conditions;
3) Moisture susceptibility of WMA using different technologies;
4) Possible mixture design modifications and laboratory performance of WMA technologies and additives; and
5) Comparison of WMA Pilot Study test sections to comparison HMA test sections.

Findings

The following conclusions can be concluded from this study.

- The use of warm mix asphalt (WMA) helps to reduce the degradation of SBS polymers in SBS polymer modified PG76-22 based on Gel Permeation Chromatography (GPC) testing.
- Based on the laboratory mixing process used in the study, it was found that the RAP binder does have some level of blending with the virgin binder at the reduced mixing temperatures. However, the methodology used was not able to determine if the blending was sensitive to mixing time or temperature.
- The moisture damage potential of WMA mixtures were found to be highly dependent on the WMA technology used. Some of the WMA technologies stiffen the asphalt binder or have an anti-strip component to the technology that aids in resisting moisture damage.
- The evaluation of the recommended modifications to AASHTO R35 for Warm Mix Asphalt mixture design showed that for New Jersey's conditions, it is not recommended to conduct a WMA specific mix design when virgin asphalt mixture designs are being conducted.
- Results from the NJDOT WMA Pilot Projects showed that the WMA mixtures are more prone to permanent deformation, while being more resistant to fatigue cracking when compared to companion HMA test sections. Moisture damage potential was found to be a function of the WMA technology used.

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A final report is available online at: http://www.state.nj.us/transportation/refdata/research/. If you would like a copy of the full report, send an e-mail to: Research.Bureau@dot.nj.gov.

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