Executive Summary, Research Readiness Level Assessment, and Technology Transfer

Research on High-RAP Mixtures with Rejuvenator- Field Implementation

Research Objectives

The objective of this research is to implement the findings from Phase-I and II into field-level and investigate the performance of the high-RAP mixture treated with optimal dosage of selected rejuvenators. Plant production parameters that influence blending of rejuvenators, RAP, and virgin materials will also be investigated. More specifically, we will collect and evaluate plant-produced and field-implemented mixtures where high-RAP (e.g., 50% RAP) was modified by optimal treatment of rejuvenators to evaluate variability, producibility, properties, and performance of AC mixtures placed in pavements.

Research Benefits

Research findings will significantly affect field-level asphaltic pavement practice using recycled materials. Laboratory evaluation of plant-produced and field-implemented mixtures following the recommended treatment of rejuvenating agents will be used to provide useful guidelines of using high-RAP mixtures in actual field projects. This research would bring clear benefits in cost savings and sustainability by expanding the use of recycling materials into pavement engineering.

Principal Investigator

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NDOT Lead TAC Members

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Background

The use of reclaimed asphalt pavement (RAP) materials has been increasing quite rapidly over the past few decades, and many Departments of Transportation (DOTs) have been consistently interested in increasing the amount of RAP in their asphalt concrete (AC) mixtures. Currently, Nebraska DOT allows RAP materials in some plant mixtures for asphalt pavements up to about 50%. The major motivation for the utilizing of high-RAP content mixes for the pavement is due to the advantage of lowering the use of expensive virgin aggregates and binders, recycling of construction materials and environmental preservation. The use of high-RAP mixture is typically incorporated with softening agents (usually referred to as rejuvenators) to improve AC mixture properties. This inherently induces various complexities such as: (1) the interaction of the aged RAP materials with the virgin materials and their influence on the overall performance of the AC mixture, and (2) the interaction of the softening or rejuvenating agent with the aged RAP and virgin binder. Another important factor that affects the performance of the high-RAP pavements in the field is the methods and technologies adopted by the plants or manufacturers producing mixtures. Although many studies have investigated the influence of rejuvenators on the laboratory performance of high-RAP AC mixtures, the laboratory-level investigation is not sufficient to address how production parameters affect blending of rejuvenators, RAP and virgin materials and eventually their influence on the field performance of the rejuvenator treated high-RAP AC mixtures.

Conclusion

The use of Rejuvenating Agents (RAs), as Recycled Asphalt Pavement (RAP) modifiers, has been increasing over the past years. However, the field performance of asphalt mixtures containing high-RAP materials and modified with RAs has raised some concerns regarding the long-term performance of RAs. This study evaluated the laboratory and field performance of high-RAP mixtures with and without bio-oil RA. Three sets of plant-produced specimens were collected: 1) laboratory-compacted; 2) field-compacted and cored after paving; and 3) field-compacted and cored after one and two years. The Hamburg Wheel Tracking (HWT) test was used to evaluate the specimens' resistance to rutting and moisture damage. The Semi-Circular Bending (SCB) fracture test was performed to examine the specimens' resistance to cracking. The results showed that using the bio-oil RA resulted in an increase in cracking resistance and a decrease in rutting and moisture damage resistance of the RAP-blended mixtures compacted in the laboratory. However, after one and two years of exposure to the environmental conditions and traffic loads, the effect of RA on moisture and rutting susceptibility of the mixtures reduced. The cracking resistance of specimens, estimated by Flexibility Index (FI) and Cracking Resistance Index (CRI), and Tukey's Honestly Significant Difference (HSD) test results implied that the bio-oil RA used in this study could not provide long-term improvement for the RAP-blended mixtures in the laboratory-aging and field-aging conditions. The field performance observations showed that the use of the bio-oil RA in the second layer might have indirectly resulted in more cracks (fatigue and thermal) and ruts in the surface layer.

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NDOT Research Website

NDOT Recommendations Based of Completed Research Project

This study focused on the field and laboratory performance of the asphalt mixtures containing a high percentage of RAP materials with and without bio-oil RA. Although different performances were observed from different mixtures, a limited number of field cores were taken from each section, and the sections were monitored for just two years. Materials & Research recommends that the sections are monitored for a longer time. In addition, only one type of RA was used in this study, and the use of different RAs may result in different performance observations. Materials & Research will monitor The International Roughness Index (IRI), cracking index and rutting index.

As provided by Robert Rea and Bruce Barrett – TAC Lead Members

Research Readiness Level (RRL) Assessment

RRL 4

Level 4: Implementation–

Research/Technology refined and adopted by the Department. Benefits of the implementation will be evaluated for a time frame of 5 years.

Technology Transfer

Principal Investigator did not have any technology transfer for this research project.

This brief summarizes Project SPR-P1 (20) M115
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