Tech Brief

DEVELOPMENT OF QUALITY STANDARDS FOR INCLUSION OF HIGH RECYCLED ASPHALT PAVEMENT CONTENT IN ASPHALT MIXTURES-Phase II

March 2015

RESEARCH PROJECT TITLE:
Development of Quality Standards For Inclusion of High Recycled Asphalt Pavement Content in Asphalt Mixtures

SPONSOR:
Iowa Highway Research Board (TR-658)

PRINCIPAL INVESTIGATOR:
Hosin "David" Lee, Ph.D., P.E.
Public Policy Center
Professor of Civil and Environmental Engineering
University of Iowa
hlee@engineering.uiowa.edu

Co-PRINCIPAL INVESTIGATOR:
Chris Williams, Ph.D., P.E.
Institute for Transportation
Professor of Civil, Construction and Environmental Engineering
Iowa State University
rwilliam@iastate.edu

TECH ADVISORY COMM:

Scott Schram, Iowa DOT
Jeffrey Schmitt, Iowa DOT
John Hinrichsen, Consultant
Bill Rosener, APAI
Larry Mattusch, APAI
Marla Kilburg, Flint Hills
Chuck Finnegan, L.L. Pelling

PUBLIC POLICY CENTER:

The University of Iowa's Public Policy Center was formed in 1987 to facilitate interdisciplinary academic research on public policy issues.

MORE INFORMATION
ppc.uiowa.edu

Objectives

The objective of this research is to 1) build a test section utilizing HMA mix designs with up to 40% RAP materials, 2) evaluate the moisture sensitivity of High-RAP mixtures, 3) characterize the low-temperature fracture behavior of High-RAP mixtures, and 4) monitor the condition of the field test section in one year after the construction.

Problem Statement

Agencies have been successful in utilizing high contents of fractionated RAP (FRAP) with a PG binder that is softer in comparison with the original PG binder grade. It is critical to evaluate the use of high FRAP content mixes in the field test section that could reduce the cost of HMA mixtures, yet maintaining performance expectations of standard mixes. Experiences gained from the field implementation of high-FRAP mixtures on Iowa's state highway can help contractors use the higher percentages of RAP materials up to 40% by weight.

Research

This research is focused on evaluating both laboratory and field performance of high-RAP mixtures implemented in Iowa state highway with FRAP amounts of 30.0%, 35.5% and 39.2% by weight. Field mixtures were tested for the moisture sensitivity using a Hamburg Wheel Tracking (HWT) device and the low-temperature cracking using Semi-Circular Bending (SCB) test. Binder was extracted from the field mixtures to determine the performance grade with varying RAP contents. A condition survey of three test sections was performed in one year after the construction.

Benefits

Increasing the amount of RAP materials used on Iowa's state highways will substantially improve the long-term sustainability of the transportation network in Iowa. Laboratory tests and field performance of asphalt mixtures with High-RAP contents will help pavement engineers design asphalt mixtures with optimum RAP contents and increase the use of RAP materials while enhancing the long-term performance of pavements in Iowa.

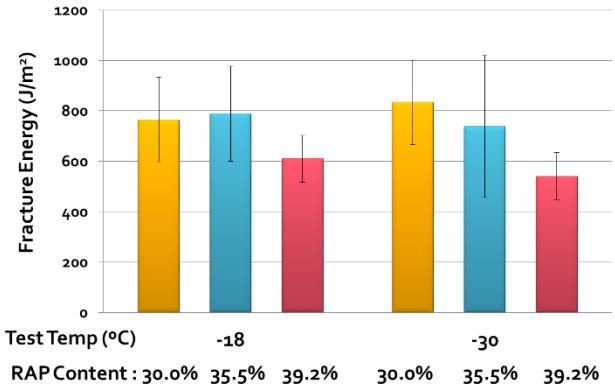
Key Findings

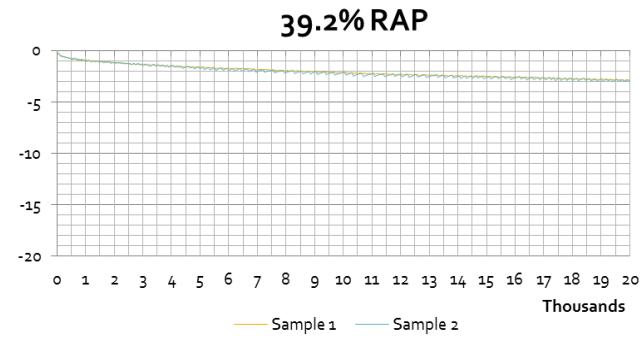
Based on the limited laboratory experiment, the following conclusions are derived:

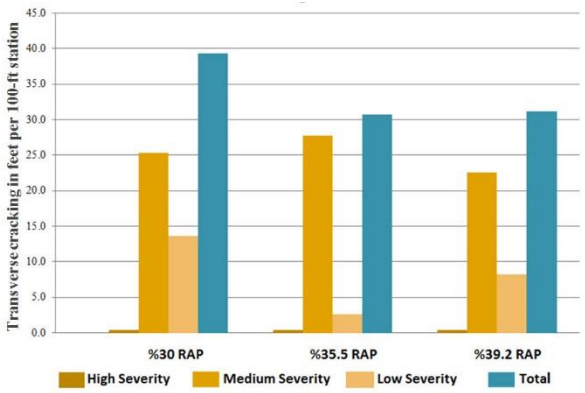
1. RAP materials were fractionated by removing fine RAP materials passing the 5/16" sieve. Mix designs with FRAP amounts of 30%, 35% and 40% by weight passed all volumetric design criteria except VMA.
2. Fractionation was effective in improving volumetric properties of HMA mixtures with a high RAP content.
3. Three test sections with actual amounts of 30.0%, 35.5% and 39.2% FRAP were constructed on Highway 6 in Iowa City, Iowa and the average field densities measured from the cores were 95.3%, 94.0%, and 94.3%, respectively
4. As the FRAP material is increased, both high and low temperatures of performance grade of the asphalt binder are also increased.
5. Rut depths after HWT 20,000 passes were less than 3mm for mixtures collected from all three test sections.
6. Stiffness increased and fracture energy decreased as FRAP content was increased.
7. Transverse cracking did not increase as the FRAP amount was increased

Additional Studies (Phase 3)

1. Analytical evaluation of rejuvenator's diffusion in hardened asphalt using tools such as X-ray Florescent (XRF), Fourier Transform Infrared Spectroscopy (FTIR) and Atomic Force Microscopy (AFM).
2. Rheological evaluation of hardened asphalt with various rejuvenators using a complete set of Superpave binder tests including Multiple Stress Creep Recovery (MSCR).
3. Evaluation of high RAP mixtures with various rejuvenators using Disc-shaped Compact Tension (DCT), Asphalt Material Performance Tester (AMPT), and Hamburg Wheel Tracking (HWT) equipment.
4. Construction of test section and testing of field samples and a condition survey.







Tech Brief:

DEVELOPMENT OF QUALITY STANDARDS FOR INCLUSION OF HIGH RECYCLED ASPHALT PAVEMENT CONTENT IN ASPHALT – PHASE II