PublicPolicy Center

Tech Brief

Examination of Curing Criteria for Cold In-place Recycling

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RESEARCH PROJECT TITLE:

Examination of Curing Criteria for Cold In-place Recycling

SPONSOR:

Iowa Highway Research Board (TR-553)

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Objectives

To further Iowa's development of asphalt recycling technology, this study sought to explore technically sound and more effective ways to identify the minimum Cold In-pace Recycling (CIR) properties necessary to permit placement of HMA overlay or chip seal. This research effort focused on procedures to minimize CIR exposure time while preserving the potential for a successful investment. This meant the procedures had to minimize the risk of CIR layer and HMA damage. One of the procedures researched was the moisture loss index of the CIR layer under limited laboratory and field conditions. The research sought to develop a better analysis tool that the industry and owner agencies can apply to monitor the CIR layer in preparation for timely placement of the wearing surface.

Problem Statement

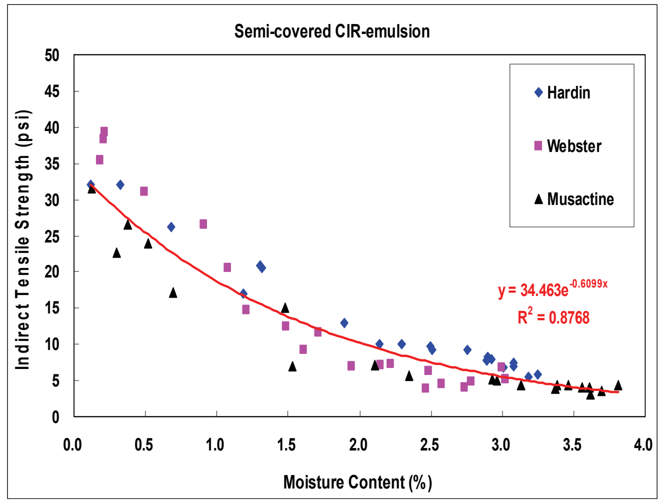
Past laboratory and field test results indicate that method of curing, temperature, and length of the curing significantly affect the properties of CIR mixtures. The current practice simply controls the maximum moisture content of the CIR, keeping it to 1.5 percent. However, numerous CIR projects in unfavorable climates have been overlaid successfully with higher levels of moisture. Questions about the curing criteria generally fall into two categories: 1) When after construction can the CIR layer handle the placement of the wearing surface, and 2) If and how much moisture in the CIR layer is detrimental to a HMA overlay.

Research

To represent the curing process of CIR pavement in field construction, three different laboratory curing procedures were examined: 1) uncovered, 2) semi-covered and 3) covered specimens. Indirect tensile strengths and moisture contents of the specimens cured for various curing periods were measured. To predict the field performance of CIR pavements during the curing process, dynamic creep and dynamic modulus tests were conducted using Superpave simple performance equipment. The CIR-foam and CIR-emulsion specimens for the dynamic creep test were prepared under three different curing conditions. The CIR-foam and CIR-emulsion specimens for the dynamic modulus tests were prepared using six different curing time periods and tested to examine effects on the dynamic modulus when curing time increases and moisture content decreases. In order to develop a better analysis tool to monitor the CIR layer in preparation for timely placement of the wearing surface, the concept of a moisture loss index was explored.

Key Findings

The indirect tensile strength of specimens in all three curing conditions did not increase during the early stage of curing. It did increase during a later stage of curing, usually when the moisture content fell below 1.5%. The figure on the right shows a good correlation between indirect tensile strength and moisture content of gyratory compacted semi-covered (in a plastic mold with no cover) specimens cured in the oven at 25˚C using RAP materials from three different counties. Dynamic modulus and flow number increased as curing time increased and moisture content decreased. For the same curing time, CIR-foam specimens exhibited the higher tensile strength and less moisture content than CIR-emulsion. The laboratory test results concluded that method of curing, temperature, and length of curing significantly affect the properties of the CIR mixtures. The moisture loss index was developed to predict the moisture condition in the field.



Recommended Refinements through Additional Research

These laboratory test results should be validated against field data such as temperature, moisture, indirect tensile strength and deflection of CIR layer. Both CIR-emulsion and CIR-foam project sites will be identified for installation of the moisture meter at the bottom of the CIR layer and continually monitored using a data acquisition device. The area measuring feature of the moisture meter will be very valuable given the inherent variability of moisture within a CIR layer caused by non-uniformity of water application during construction. These field data will be then used to calibrate a set of curing indices, which will accurately determine an optimum timing for an overlay. The validation sections should be evaluated for their initial conditions before and after HMA overlay using FWD and a distress survey vehicle. These conditions should be used as reference points to measure the deterioration levels in the future. The developed curing index based on field measurements will rationalize the way the quality of the CIR layer is inspected for optimum timing of an HMA overlay and will significantly enhance long-term performance of CIR pavements.