RESEARCH PROJECT CAPSULE [19-4B]

January 2020

TECHNOLOGY TRANSFER PROGRAM

Implementation of Semi-circular Bend (SCB) Test for QC/QA of Asphalt Mixtures

JUST THE FACTS:

Start Date:
May 1, 2019

Duration:
36 months

End Date:
April 30, 2022

Funding:
SPR: TT-Fed/TT-Reg 6

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Sponsored jointly by the Louisiana Department of Transportation and Development and Louisiana State University

POINTS OF INTEREST:

Problem Addressed / Objective of Research / Methodology Used / Implementation Potential

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PROBLEM

Conventional asphalt mixture design methodologies are used to determine the optimum asphalt binder content by means of physical and volumetric laboratory measurements. These procedures ensure that material proportions and quantity of asphalt binder are adequate to meet stability and durability concerns.

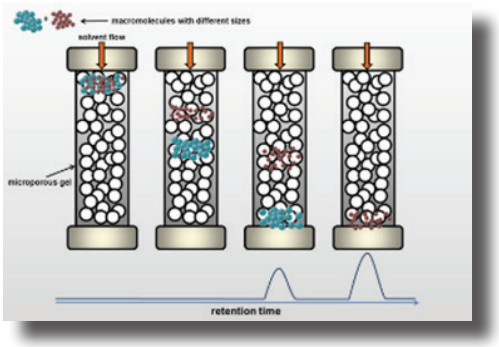

Figure 1
Gel permeation chromatography (GPC) test

Successful mixture design requires a balance between volumetric composition and material compatibility to achieve anticipated performance. With increased use of recycled materials, there is a need to develop laboratory mechanical tests for evaluation of the quality of the asphalt binder.

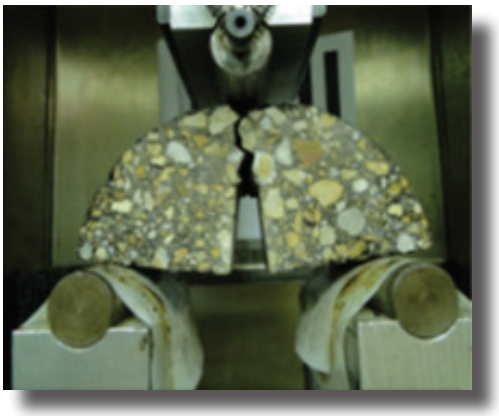

Figure 2
Semi-circular Bend test - ASTM D 8044

The 2016 *Louisiana DOTD Specifications for Roads and Bridges* include a balanced mixture design concept that complements volumetric criteria with semi-circular bend (SCB) tests for evaluating intermediate temperature performance of asphalt mixtures. The specifications contain a criterion for the SCB-determined critical strain energy release rate (J_c) at different traffic levels.

However, existing QC/QA specifications and practices have not been updated accordingly; only volumetric properties are considered to ensure that mixtures are produced as designed and perform as expected in the field.

This research will develop a methodology for performance tests that address cracking concerns during the DOTD QC/QA phases of asphalt mixture design. Specifically, this study will address the development of a practical specification for implementation of the SCB test.

OBJECTIVE

The objective of this study is to develop a specification for implementation of the SCB test during the field QC/QA phases of asphalt mixture production and construction.

In this process, the research team will explore and determine the relationship between J_c and the state of aging for an asphalt mixture as traced by a set of rheological and chemical aging indices.

METHODOLOGY

A minimum of 15 field projects from throughout Louisiana using asphalt plants with a record of mixture consistency will be identified. Selected projects are expected to encompass a range of volumetrics and material types (virgin/recycled aggregates, modified/unmodified asphalt binders, limestone/gravel, etc.).

Plant-produced loose mixtures as well as extracted cores from field-compacted layers will be collected and evaluated in this study. Laboratory-compacted (LC) and field-compacted (FC) samples will be conditioned to obtain a series of progressive aging intensities. For each mixture (both LC and FC) at each aging condition, the asphalt binder will be extracted and evaluated with respect to its rheological and chemical characteristics. Table 1 presents a test matrix for each mixture and extracted binder.

Aging Period (85°C), days	Mixture Test	Asphalt Binder Tests	
		Rheological	Chemical
0, 2, 5, 7, 10	SCB ASTM D8044	Performance grading (AASHTO R 29) Viscosity (AASHTO T 316) Frequency sweep LAS (AASHTO TP 101) MSCR (AASHTO T 350)	GPC (ASTM D6579) SARA (ASTM D4124) FTIR

Table 1
Candidate aging conditions and testing matrix

LAS = Linear Amplitude Sweep, MSCR = Multiple Stress Creep and Recovery, GPC = Gel Permeation Chromotography, SARA = Saturate, Aromatic, Resin and Asphaltene analysis, FTIR = Fourrier Transform Infrared spectroscopy

Typically, the SCB test is performed on compacted samples that are conditioned for 5 days at 850 C (AASHTO R 30). The purpose of this conditioning process is to simulate long-term aging (LTA) of the mixture that occurs during the pavement's field service life. Since it is impractical to include LTA samples during QC/QA testing, this research will develop a scaling scheme to translate J_c of unconditioned samples to J_c of LTA samples. This approach requires no conditioning procedure for plant-produced asphalt mixture samples, which makes it practical for implementation of SCB in QC/QA testing.

IMPLEMENTATION POTENTIAL

An implementable specification for the use of the SCB test in DOTD's QC/QA practiceswill be provided. This will complement current DOTD specifications, and ensure that asphalt mixtures are produced and compacted as expected for extended pavement service life against cracking.