

Elimination of Empirical, Ineffective, and Expensive PG Plus Tests to Characterize Modified Binders

Developing a simple and effective test method to evaluate modified asphalt binders

State departments of transportation (DOTs) use different time consuming and empirical Performance Grade (PG) Plus tests to characterize polymer modified binders. These PG Plus tests are not useful when binders are modified with chemicals such as polyphosphoric acid (PPA). The main goal of this research is to investigate alternative test methods that can be conducted using a Dynamic Shear Rheometer (DSR). Test procedures (Multiple Stress Creep and Recovery (MSCR), ER-DSR, Frequency Sweep, Linear Amplitude Sweep (LAS), and Binder Yield Energy Test (BYET)) are being explored to determine their effectiveness. Three PG binders (PG 64-22, PG 70-22 and PG 76-22) certified in Arkansas have been selected. Chemical tests such as SARA (Saturate, Aromatic, Resin, and Asphaltene) and FTIR (Fourier-Transform Infrared Spectroscopy) are also being explored in this study.

accomplished by testing asphalt binder samples modified with different additives such as polymers, ground tire rubber, and acid. Rutting and fatigue resistance of these binders will be evaluated so that empirical tests can be eliminated.

Status Update

Conventional Superpave tests have been conducted. The MSCR tests have been conducted on binders collected from two sources (S1 and S2) (Figures 1 and 2). The Elastic Recovery test using a DSR (ER-DSR) was conducted for unaged binders and the test results are shown in Figure 3. The ER-DSR test results are comparable with the MSCR test results. The ER values were found higher for high PG binders except PPA modified binders (S1B2 and S2B2). The maximum ER was found for S1B4 and S2B4 binders. For PPA modified binders, chemical tests (pH, SAR, and FTIR) are currently being conducted.

Background

AASHTO T 315 is not adequate to capture the properties of polymer modified asphalt binders. Thus, "PG Plus" tests (e.g., elastic recovery) are routinely being utilized to ascertain their quality. The MSCR test (AASHTO T 350) is believed to supplement the AASHTO T 315 at high temperatures, but it is not appropriate for chemically modified binders. Thus, research is needed to find the appropriate test methods to characterize polymer and chemically modified binders.

Project Summary

The main objective of the study is to develop new test methods to evaluate modified binders as a replacement to the ER test. Specific objectives are: (i) test Arkansas DOT (ArDOT) certified binders with respect to local service conditions by following MSCR and Elastic Recovery test methods, (ii) develop guidelines for ARDOT toward adopting AASHTO T 350, (iii) perform chemical analyses and other mechanistic tests, and (iv) propose simple and effective test method(s) for characterizing non-polymeric high PG grade binders. These objectives will be

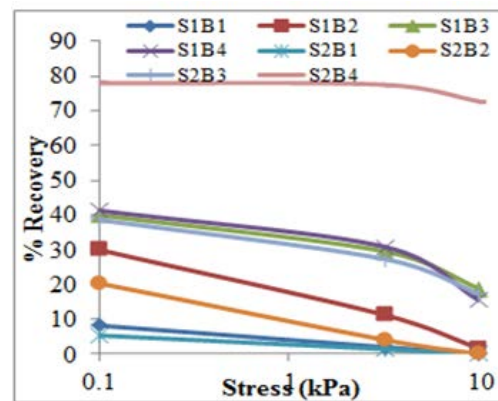


Figure 1. Percent recovery for S1 and S2 asphalt binders.

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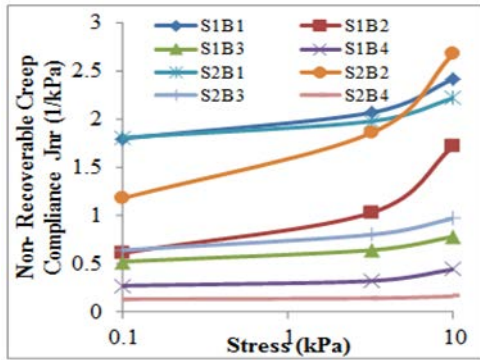


Figure 2. J_{nr} versus stress for S1 and S2 asphalt binders.

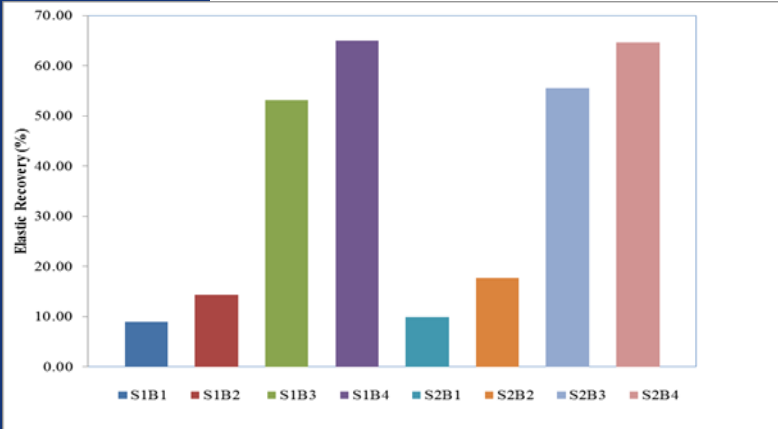


Figure 3. ER-DSR test results for various binders.

Impacts

The main deliverables from this study are: (1) a report containing recommendations for adopting simple and effective test methods for characterizing rutting and fatigue properties of asphalt binders; (2) a webinar to disseminate the findings of this study to a broad audience (including DOT engineers, asphalt professionals, and researchers); and (3) two presentations at the annual meetings organized by the ArDOT Technical Research and Tran-SET.

Most importantly, this study will aid ArDOT and other state DOTs in the region to adopt simple and effective test methods to characterize modified binders. It is expected to lead to a significant cost savings to asphalt industries and highway agencies, as no new testing equipment will be needed.

Tran-SET

Tran-SET is Region 6's University Transportation Center. It is a collaborative partnership between 11 institutions (see below) across 5 states (AR, LA, NM, OK, and TX). Tran-SET is led by Louisiana State University. It was established in late November 2016 "to address the accelerated deterioration of transportation infrastructure through the development, evaluation, and implementation of cutting-edge technologies, novel materials, and innovative construction management processes".

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