CENTER FOR TRANSPORTATION RESEARCH

PROJECT SUMMARY

Texas Department of Transportation

0-6925: Improving the Performance-Graded Asphalt Binder Specification

Background

Over the last two decades, the state of Texas, and many other parts of the world, have used the Performance Grading (PG) specification as a purchase specification and performance criteria for asphalt binders. This specification was created in the mid-1990s as an improvement upon existing penetration and viscosity-based specifications for asphalt binders. The current version of the specification is designed to measure an asphalt binder's resistance to different types of pavement distresses. In recent years, new innovations in binder production and modification have led to production of binders with considerably improved performance characteristics. However, in some cases this has also resulted in binders that meet the current PG specification but result in premature binder-triggered failure in the field. A host of new tests have been proposed by various researchers around the world to more accurately predict a binder's resistance to the three main distress types: rutting, fatigue cracking, and thermal cracking. This study specifically focuses on evaluating these test methods to determine their effectiveness in predicting a binder's resistance to these distresses.

What the Researchers Did

In order to achieve the goals of this study, a comprehensive review of the existing literature was conducted to evaluate the test methods that have been proposed in previous studies. The existing tests were carefully reviewed and narrowed down to create a list of viable tests that can be used for performance-based specification. A suite of tests was finalized for evaluating the various binder properties. Material sampling was performed with an emphasis on three types of binders: binders from existing pavement sections with known performance characteristics, binder samples from new construction projects, and laboratory modified binders. For the latter, a base binder was obtained directly from a producer, and different modifiers were added to the binder to create two sets of binders with very similar PG, but different compositions. The first set comprised of 10 binders with average PG 64-28 and the second set comprised of 6 binders with average PG 70-22. The control and two sets of binders were then subjected to a wide array of binder testing which included the current PG specification tests and new test methods and parameters. Finally, the binders were then used to create asphalt mixtures so that their performance in the Hamburg Wheel Tracking Device and Overlay test could be evaluated. In addition, repeatability between operators and between labs was evaluated for a few of the tests. Finally, correlations between the binder testing methods and mixture test results were examined, and final recommendations were presented.

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What They Found

The majority of the tests that were evaluated did not show a good correlation with mixture testing, and therefore were not deemed to be very promising for future implementation. However, a few tests showed good relationships with mixture testing. The Multiple Stress Creep and Recovery test and concomitant parameters showed a good correlation with permanent deformation in the Hamburg Wheel Tracking Device. This test is recommended for implementation into the specification for use in determining the rutting resistance and elastic recovery of a binder. It was also discovered that polymer modification does not guarantee a good elastic recovery, so a specification based on polymer content measurement may not be effective, instead specifications should be based on elastic recovery when desired. The poker chip test showed good correlation with fatigue cracking in the Overlay test, because both tests, as well as field cracking, rely on the non-linear fracture performance of a binder. In addition, a 4 mm plate geometry for Dynamic Shear Rheometer testing was shown to be reliable and viable for producing similar results to the Bending Beam Rheometer, which can improve the testing efficiency and testing time for low temperature testing within the Performance Grading criteria.

What This Means

This study puts forth the following recommendations: (i) implement the Multiple Stress Creep and Recovery test as described in existing specifications, (ii) adopt and collect more data with regard to the 4 mm geometry DSR test, which can facilitate future testing of recycled binders, field extracted binders, and emulsion residues, and (iii) adopt and collect more data for the poker chip test as an indicator for cracking performance. Two draft standards are provided in the full report detailing how these two tests can be performed in the laboratory.

For More Information

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