Florida Department of Transportation Research

Evaluation of the Cracking Performance of Asphalt Binders at Intermediate Temperatures

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Current Situation

Considering the stresses that roadways endure on a daily basis from constant streams of traffic and the various weather elements, they are remarkably resilient. Yet, over time, pavements still develop cracks, form ruts, or experience other damage. As a result, research continues to seek improved roadway durability and performance. Load-induced fatigue cracking is a common form of damage that results from the repeated stresses caused by vehicular loads. To understand why this happens, it is important to know what measurable property of asphalt mixes can reveal the likelihood of load-induced fatigue cracking.

Load-induced fatigue damage appears as a network of cracks that become denser, leading to loss of asphalt.

Research Objectives

University of Florida researchers conducted studies of asphalt binders to determine what parameter(s) would best characterize the binder's effectiveness in resisting load-induced fatigue cracking.

Project Activities

The researchers developed an experimental plan using twelve asphalt mixtures based on six asphalt binders and two aggregate types. The binders were selected from those commonly used in Florida, including three unmodified binders, one polymer-modified binder, one hybrid binder composed of polymer and rubber, and a high polymer modified binder. Aggregates were Georgia granite and Florida limestone. Mixtures designed using the Superpave system were formulated to isolate binder effects on mixture performance.

Two tests were selected for evaluation of the asphalt mixtures: a modified linear amplitude sweep (LAS) test and the binder fracture energy (BFE) test. The LAS test is a nationally known test, which was chosen because it is effective at introducing sufficient fatigue damage in asphalt binder and has been shown to be promising in other national level research. The BFE test, recently developed by the University of Florida, determines the binder fracture energy density (FED), damage rate, and the number of cycles to failure of asphalt binder at intermediate temperatures. The Superpave Indirect Tension Test was also performed to determine mixture fracture properties, which the binder tests were compared to.

Unlike the Superpave Indirect Tension Test, both binder tests could easily differentiate between the different binder types. Both tests also correlated well to expected trends, except for the softest binder type (PG 52-28). The researchers believed the mixture tests did not adequately differentiate the binder types to the degree of the binder tests because the binders were only a small portion of the overall mixture and their effects were diluted at the mixture level. To evaluate binder cracking performance at intermediate temperatures, the researchers recommended the BFE test FED property, determined in accordance with the AASHTO TP_127 standard. As an alternative, the LAS test is acceptable when performed in accordance with TP 101-14.

Project Benefits

Better testing protocols for the approval of asphalt binders can lead to more durable pavements that provide safer driving surfaces and require less maintenance.

For more information, please see www.fdot.gov/research/.