Florida Department of Transportation Research

Development of a Test Method that Will Allow Evaluation and Quantification of the Effects of Healing on Asphalt Mixture

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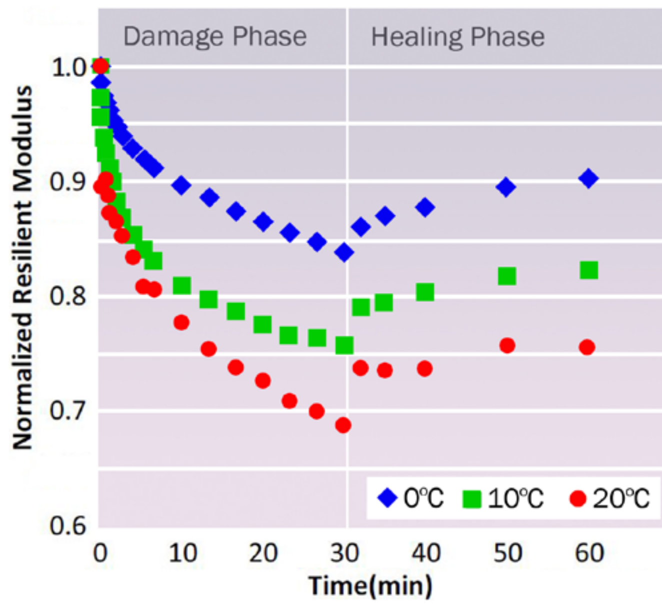
Top-down cracking in flexible pavement is one of the most common and crucial modes of pavement distress in Florida, reducing both service quality and life of flexible pavement. The process begins with micro-cracks (micro-damage), which grow and merge to form macro-cracks. Loading and temperature cycles permit some micro-crack healing and may strongly influence the service life of pavement. However, adequate methods to quantify healing do not exist. Central to this problem is the lack of an appropriate testing and interpretation system to measure damage recovery, or healing, rates of asphalt mixtures.

This project continues a program by University of Florida researchers to develop better quantitative characterizations of asphalt and pavements with the overall goal of improving mechanistic-empirical design. In this study, the objective was to develop a testing and data interpretation system to measure healing rates of asphalt mixtures. Requirements for the system were suitability for testing of laboratory-compacted specimens and field cores and reliance on the Superpave Indirect Tension Test (IDT). The system adopted concepts of asphalt fracture mechanics from previous FDOT research.

The researchers developed and validated a two-phase healing test to evaluate healing characteristics and measure healing potential of asphalt mixtures. The first phase of the test (damaging the asphalt mixture) consisted of cyclical loading, followed by a second phase (healing the asphalt mixture) during which reduced, non-damaging load was applied. IDT testing was used throughout the project. Resilient modulus was used as a convenient way to measure effective stiffness of asphalt mixtures and as an indicator of damage and damage recovery.

By varying the load amplitude and rest period during the damage tests on asphalt samples, appropriate load levels and rest periods were determined and validated. Rest period duration had a significant effect on healing. Appropriate load levels for use during the damage phase depended on brittleness of the asphalt mixture, and a relationship between brittleness and loading level was established and validated for all mixtures tested. Brittle mixtures were more sensitive to changes in loading level.



This graph shows the decrease and recovery of resilient modulus as a measure of asphalt mix micro-damage and healing at three temperatures.

Rate of healing was measured for all mixtures and, in general, was in good agreement with expected intuitive trends. Rate of healing was found to decrease with time. A healing rate parameter was defined using a logarithmic relation to allow for comparison between mixtures. Results showed that healing rates were generally faster for mixtures at higher temperatures and with less oxidative aging or SBS-polymer modification.

A more precise understanding of asphalt damage and healing can lead to the design of more resilient, less damage-prone pavements and significant savings in maintenance costs.

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For more information, visit http://www.dot.state.fl.us/research-center