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EVALUATION OF THE SUPERPAVE MIXTURES WITH AND WITHOUT POLYMER MODIFICATION BY MEANS OF ACCELERATED PAVEMENT TESTING

PROBLEM STATEMENT

The Florida Department of Transportation (FDOT) started to use Superpave mixtures on its highway pavements in 1996. Modified binders have been used in some of the Superpave mixtures in an effort to increase the cracking and rutting resistance of these mixtures. Due to their short history, it is still too early to assess the long-term performance of these Superpave mixtures and the benefits from the use of the modified binders. There is a need to evaluate the long-term performance of these mixtures and the benefits obtained from the use of modified binders, so that the Superpave technology and the selection of modified binders to be used could be effectively applied.

The FDOT Materials Office has recently acquired a Heavy Vehicle Simulator (HVS) and constructed an Accelerated Pavement Testing (APT) facility that uses it. The HVS can simulate twenty years of interstate traffic on a test pavement within a short period of time.

OBJECTIVES

A research study was undertaken to evaluate the long-term performance of Superpave mixtures and modified Superpave mixtures using the APT facility. The main objectives of this study are as follows:

(1) To evaluate the operational performance of the Heavy Vehicle Simulator and to determine its most effective test configurations for use in evaluating the rutting performance of pavement materials and/or designs under typical Florida traffic and climate conditions.

(2) To evaluate the rutting performance of a typical Superpave mixture used in Florida and that of the same Superpave mixture modified with a SBS polymer.

(3) To evaluate the relationship between mixture properties and the rutting performance.

(4) To evaluate the difference in rutting performance of a pavement using two lifts of modified mixture versus a pavement using one lift of modified mixture on top of one lift of unmodified mixture.

FINDINGS AND CONCLUSIONS

Five trial runs with the HVS were made using a super single tire with a load of 9,000 lbs (40 kN), tire pressure of 115 psi (792 kPa) and a wheel traveling speed of 8 mph (12.9 km/hr). These five trial runs used different combinations of wheel traveling direction (uni-directional or bi-directional), total wheel wander and wander increments.

Uni-directional loading was a more efficient mode for evaluating rutting performance using the HVS. Compared to the bi-directional loading mode, the uni-directional mode produced substantially higher rut depths for the same number of wheel passes and also for the same testing time duration. When the bi-directional loading with no wander was used, imprints of the tire treads were observed on the wheel track. The use of a loading mode with wander smoothened out the imprints of the tire treads considerably. The uni-directional loading mode with 4-inch (10.2-cm) wander using 1-inch (2.54-cm) increments was selected to be used in the main field testing program for evaluation of rutting performance based on consideration of testing efficiency and realistic rutting results.

Results from the HVS tests showed that the pavement sections with two lifts of SBS-modified mixture clearly outperformed those with two lifts of unmodified mixture, which had two to two-and-a-half times the rut rate. The pavement sections with a lift of SBS-modified mixture over a lift of unmodified mixture practically had about the same performance as the sections with two lifts of SBS-modified mixture at ambient temperature, and had only about 20% higher rutting than those with two lifts of modified mixture when tested at 50° C. The test section with two lifts of SBS-modified mixture that was tested at 65° C still outperformed the test sections with two lifts of unmodified mixture that were tested at 50° C.

The mixtures with a higher rut depth in the APA also rutted more in the HVS tests. The mixtures with a GSI of more than 1.0 as measured by the GTM rutted more than one with a GSI close to 1.0. Rutting of the unmodified mixture was observed to be due to a combination of densification and shoving, while that of the SBS-modified mixture was due primarily to densification.

BENEFITS

The results of this project provide information on the benefits and performance of polymer-modified asphalt binders. Such information is critical to support informed highway planning, policy, and decision-making, both at the local and at the State levels.

Specific benefits of the SBS-modified mixture include improved workability and significantly increased rut resistance. During the construction of the test tracks, the cost of the modified asphalt was approximately 25% greater than that of unmodified asphalt. However, the price gap has already diminished and may close further as industry becomes more familiar with the product. Furthermore, the long-term savings resulting from less frequent resurfacing projects will far outweigh initial increases in mix costs.

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