Florida Department of Transportation Research

Evaluation of FC-5 with PG 76-22 HP to Reduce Raveling

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Current Situation

Road resurfacing involves removing the road's worn and possibly damaged top layer and replacing it with fresh asphalt. This top layer is the friction course, and its composition has important effects on roadway performance. An open-graded friction course (OGFC) improves traction because it has been formulated and placed with a certain amount of voids that improve drainage. For this reasons and others, OGFC is used by many states. However, the structure of OGFC also has an important shortcoming: shorter service life. With this come the additional costs of more frequent maintenance.

With Florida's frequent rain, the superior drainage of open-graded friction courses is valuable, especially if their durability can be improved.

Research Objectives

Researchers at the Texas A&M Transportation Institute evaluated asphalt formulations that include heavily polymer-modified binders that can improve the service life of open-graded friction courses.

Project Activities

The researchers compared the durability of OGFC mixtures made with two versions of PG 76-22 binder: a polymer-modified binder currently in common use which contains 2% to 3% polymer and a heavily polymer-modified (HP) binder containing 7% to 8% polymer. Each binder was mixed with either limestone or granite aggregate, creating four basic mixtures. Each of the basic mixtures was tested unaged or after one of four aging protocols: rolling thin-film oven treatment, which simulates the preparation of hot-mix asphalt during paving operations, and pressure aging vessel treatment for 20, 40, or 80 hours. Changes in the properties of the mixtures due to these treatments were determined using a variety of tests, including Superpave performance grading, Fourier transform infrared spectroscopy, and others. In general, HP mixtures containing granite aggregate showed the highest potential durability.

Numerical modeling of the mixtures complemented the experimental testing. Finite-element models were used to examine the response of the asphalt mixtures to short-term and long-term service. Results of the experimental tests of the mixtures guided the modeling. Particular attention was paid to mechanisms within the mixtures that might contribute to raveling, such as stone-to-stone contact or matrix-to-matrix contact. The modeling indicated that the conventional binder mixtures were less prone to raveling in the short-term, but the HP binder mixtures were almost twice as resistant to raveling in the more realistic, long-term condition.

A life-cycle cost analysis that takes into account all aspects of installation, maintenance, and service life determined that the advantages of HP binders indicated by experimental results and numerical modeling would translate into cost savings. The granite-HP mixture clearly showed the most savings, followed closely by the limestone-HP and granite-conventional binder mixtures. The limestone-conventional binder mixture was last by a significant margin.

Project Benefits

The project indicates that resurfacing roads with heavily polymer-modified binders in OGFC asphalt mixes would reduce maintenance and replacement, yielding substantial savings.

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