U.S. Department of Transportation
Federal Highway Administration

TOPS
Targeted Overlay Pavement Solutions

CASE STUDY

November 2021

HIGHLY MODIFIED ASPHALT
FLORIDA DEPARTMENT OF TRANSPORTATION

This is one of five case studies highlighting FHWA's Every Day Counts initiative known as Targeted Overlay Pavement Solutions (TOPS). The purpose of TOPS is to integrate innovative overlay procedures into practices to improve performance, lessen traffic impacts, and reduce the cost of pavement ownership.

Highly modified asphalt (HiMA) mixtures contain asphalt binder that is typically modified with 7 to 8 percent polymer, most commonly styrene-butadiene-styrene (SBS). This amount of polymer is more than twice what is used in conventional polymer modified binders—approximately 3 percent by weight of the binder. According to Florida Department of Transportation (FDOT) research (Habbouche et al. 2019)[1], the binder-polymer structure of conventional modified binders consists of asphalt binder with a dispersed swollen polymer phase that improves binder properties. By increasing the polymer content, the researchers found that the structure changes to a swollen polymer with a dispersed asphalt phase. This makes the resulting binder behave more like rubber and enhances cracking resistance and rutting performance.

FDOT initially adopted the use of HiMA binder as a mechanism to address severe rutting observed in high-stress locations subject to heavy axle loads and slow-moving traffic, such as truck weigh stations, agricultural inspection stations, and high-volume intersections and interchanges. FDOT's idea of using a high-polymer content binder to improve rutting resistance was prompted by results obtained from experimental test sections constructed at the National Center for Asphalt Technology Test Track in Auburn, Alabama.

Research

FDOT confirmed through its Accelerated Pavement Testing program that HiMA mixtures reduce rutting and improve cracking performance (Greene et al. 2014)[2]. The agency constructed its first implementation projects in 2015, and based on what FDOT considered successful outcomes, modified State specifications in July 2017 to replace PG 82-22 binder with high-polymer modified binder. Since then, FDOT has placed more than 500,000 tons of HiMA mixtures on at least 40 projects across Florida. In addition, FDOT has implemented HiMA for other purposes, such as mitigating reflective cracking from construction joints in overlaid portland cement concrete pavements and reducing raveling in open-graded friction courses. According to FDOT research, HiMA mixtures increase structural contribution, potentially allowing for a reduction in pavement thickness without sacrificing performance.

FDOT has monitored and evaluated HiMA overlay performance on U.S. 90 North in Midway since construction in 2015. Source: Gary Fitts.

[1]Habbouche, J., Hajj, E., & Sebaaly, P. (2019). *Structural Coefficient for High-Polymer Modified Asphalt Mixes*. Report Number WRSC-UNR-FDOT-BE321-DEL6, https://rosap.ntl.bts.gov/view/dot/54621.

[2]*Greene, J., Chun, S., and Choubane, B. (2014). Evaluation and Implementation of a Heavy Polymer Modified Asphalt Binder through Accelerated Pavement Testing.* Report Number FL/DOT/SMO/14-564.

Construction Considerations

Based on FDOT's experience, producing and handling HiMA binders involves the following special considerations:

- Controlling the storage temperature and limiting the storage period to ensure the binder is not overheated. If overheated, the polymer will continue to crosslink, thereby affecting binder handling capabilities.
- Avoiding exposing the modified binder to high temperatures for an extended period, as this will result in mixture workability issues.
- Planning and communicating to ensure the material is handled properly.

HiMA Potential Benefits

- Reduces rutting
- Delays fatigue cracking
- Mitigates crack reflection
- Improves durability of open-graded mixtures

FDOT found the production and construction of HiMA mixtures is similar to conventional polymer-modified mixtures, and the same best practices generally apply. According to FDOT State Bituminous Materials Engineer Howie Moseley, Florida contractors can consistently achieve the desired level of compaction when using HiMA binders. FDOT's experience suggests that by controlling temperature and minimizing hand work, the laydown and compaction of HiMA mixtures can be completed without any major issues. On average, contractors exceed FDOT targets for in-place density on most HiMA projects and achieve an International Roughness Index from 33 to 47 inches per mile at acceptance.

> *"FDOT has been using HiMA binder for over six years. It has been a valuable tool for mitigating isolated areas of severe rutting and cracking in our dense graded mixtures and premature raveling in our open graded friction courses. We are very satisfied with its performance."*
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> ***—FDOT State Bituminous Materials Engineer Howie Moseley***

Cost

According to Moseley, on average, the material cost differences when using HiMA mixtures range from an additional $20 to $25 per ton for dense-graded mixtures and $15 to $20 per ton for open-graded mixtures when compared to mixtures using a PG 76-22 binder. FDOT performed a preliminary analysis and concluded that HiMA projects need to last 10 months longer than conventional polymer-modified asphalt projects to pay for the increased cost. FDOT research and preliminary data suggest the expected gain in pavement life will exceed what is needed to offset the additional cost of HiMA.

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