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LRRB
LOCAL ROAD RESEARCH BOARD

TECHNICAL SUMMARY

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TOTAL PROJECT COST:
$93,969

LRRB COST:
$26,735

Road crews applied various pavement sealants, including Biorestor (shown here), to evaluate their ability to preserve pavements.

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Preliminary Tests Raise Questions About Biosealant Effectiveness

Researchers conducted preliminary tests of biosealants and traditional asphalt-based sealants as pavement preservation treatments. Results were inconclusive, however. While the sealants had mild impacts on laboratory-prepared specimens, they were undetectable on samples collected from the field.

What Was the Need?

As Minnesota's roadway infrastructure ages, preservation efforts are playing a growing role in keeping pavements in satisfactory condition given severe constraints on transportation budgets.

Asphalt pavements typically become more brittle as they age. Pavement sealants are widely used to extend the life of roads by softening the asphalt to reduce this brittleness. However, oversoftening pavement can harm performance, so the goal of sealant application is to keep the pavement's properties at or near design specifications. There are also environmental concerns associated with some sealants.

The Local Road Research Board (LRRB) is investigating relatively new "biosealants"—sealants that aren't asphalt-based, including those that are created from agricultural products. According to manufacturers, These sealant products will perform well at reduced cost and with less environmental impact than traditional sealants, and they will dry clear so that pavement markings remain visible after the products are applied. The manufacturer claims have not been independently verified, however. Before biosealants can be widely implemented, there is a need to determine whether they perform adequately.

What Was Our Goal?

This project sought to evaluate the effectiveness of new biosealant products as pavement preservation agents.

What Did We Do?

Researchers tested four sealants in this project. Two of these products, Biorestor and Re-Play, are agriculturally derived and considered biosealants. The remaining two products, CSS-1h and Jointbond, are traditional asphalt-based sealants. Researchers analyzed binder and mix samples using several routine tests of strength and flow properties:

- A bending beam rheometer test, conducted according to the American Association of State Highway and Transportation Officials (AASHTO) T 313-06 (2006) test method, evaluated the creep of the asphalt binder at low temperatures.
- A modified bending beam rheometer test evaluated the creep and strength properties of the asphalt mix.
- A dynamic shear rheometer test, conducted according to the AASHTO T 315 test method, evaluated the flow properties of the asphalt binder at intermediate and high temperatures.

Asphalt mix samples were taken from County State Aid Highway 75 in Wright County, Minnesota. A few days after each sealant was applied, researchers removed three cores from sections of the road treated with a sealant as well as an untreated control section. Eight months later, they took a fourth core from each section.

continued

"What we're hoping to do with any kind of maintenance treatment is to preserve the top of the asphalt mix so it doesn't become too soft or too brittle."

—Ed Johnson,
Research Project Engineer, MnDOT Office of Materials and Road Research

"These new biosealants have not been tested, so there was a strong need to evaluate how they'll impact road durability. However, no clear recommendation can be drawn from this preliminary research."

—Mihai Marasteanu,
Professor, University of Minnesota Department of Civil, Environmental, and Geo-Engineering

Researchers used pipettes to apply a precise amount of sealants to laboratory-created binder samples. These samples showed mild softening effects, but these impacts were not observed in samples collected from the field, so the sealants' effectiveness is unclear.

Researchers were uncertain what kind of laboratory-created binder and mixture specimens would replicate field conditions, so they used different methods to prepare specimens for testing in the laboratory. The amount of sealant added was based on MnDOT's application rates and manufacturer descriptions of their products' penetration depth. They found that using a pipette to apply precise amounts of sealant to the binder and mixture specimens was the best application method.

What Did We Learn?

Laboratory tests of sealant impacts on asphalt binder and mixture specimens produced varied results. For example, the direct mixing procedure of sealant and hot binder led to significant changes in the performance grade of the original binder, strongly suggesting that it does not accurately simulate the effects of sealants under field conditions. The pipette method produced mild softening effects more consistent with observed field applications, suggesting that it may represent how sealants actually affect asphalt pavements.

However, tests of mixture field samples showed few statistically significant impacts on stiffness or strength compared to laboratory-prepared specimens. These results prompted researchers to conduct Fourier transform infrared spectroscopy analysis (which uses a sample's light absorption properties to detect the presence of specific compounds) on RePlay and Biorestor samples nine months after application. The spectroscopic analysis found no traces of the sealants on the field-treated samples while their presence was detected in the laboratory-prepared specimens.

What's Next?

Results of this project suggest that more research is needed. Additional materials and application rates must be investigated before manufacturers' claims about product benefits can be verified. This project was a small-scale, preliminary study, and while the results could accurately reflect the performance of tested materials, they may also have been affected by insufficient or inconsistent application rates. Also, field samples were tested nine months after product application, and some of the sealant may have been absorbed by the aggregates or evaporated. In contrast, laboratory samples were tested only one month after product application in very stable environmental conditions. The field evaluation of these products is anticipated to continue until 2018. Results of that extended evaluation may suggest additional research possibilities.

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