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LRRB
LOCAL ROAD RESEARCH BOARD

TECHNICAL SUMMARY

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TOTAL PROJECT COST:
$431,205
LRRB Project Cost:
$75,000
MnDOT Contribution:
$131,205

PARTICIPATING AGENCIES:
MD, MN, OH, TX, WI, FHWA

Block cracking indicates that the asphalt binder has oxidized, making the pavement brittle.

MINNESOTA DEPARTMENT OF TRANSPORTATION

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Early Preventive Maintenance Extends Asphalt Pavement Life

What Was the Need?

As asphalt pavements age, the asphalt cement that binds the aggregate oxidizes, making the pavements more brittle and susceptible to cracking and other deterioration. To help mitigate this process, MnDOT periodically conducts preventive maintenance using surface treatments.

These treatments, such as fog seals and chip seals, cover the existing pavement surface with an asphalt emulsion sometimes accompanied by an additional layer of gravel or crushed aggregate. When timed correctly, successive preservation treatments can extend the time needed before more expensive rehabilitation and reconstruction, resulting in a reduced life-cycle cost for the pavement.

By optimizing the timing of preventive maintenance, MnDOT can extend the service lives of its asphalt pavements and delay the need for more costly rehabilitation, reducing pavement life-cycle costs.

However, it is unclear how to best time such treatments to maximize pavement life while minimizing life-cycle costs. Research was needed to investigate the fundamental mechanisms of pavement aging by relating it to the material properties of asphalt pavements. To conduct this research, MnDOT led pooled fund study TPF-5(153) in cooperation with the Federal Highway Administration, Minnesota Local Road Research Board and four other states.

What Was Our Goal?

The goal of this project was to help determine the proper timing of preventive maintenance by identifying how environmental aging affects asphalt material properties in the pavement and how the application of pavement preservation treatments influences the aging process.

What Did We Do?

Researchers conducted field tests on two roadway test sections. The first section was located on the Low Volume Road of the MnROAD pavement research facility. This 2.5-mile loop consists of 500-foot pavement test sections constructed with various materials and designs, and subjected to repeated truck loading. Researchers evaluated test cell 24, an asphalt pavement built in 2008 and divided into five 100-foot subsections. One subsection received a fog seal, in which an asphalt emulsion is applied to the surface of the pavement immediately after construction. Three other subsections were sealed each year thereafter, with the final seal in 2012, and one subsection was left unsealed.

In 2010, researchers took core samples from each of these subsections as well as several other test cells and used various laboratory tests to evaluate them for stiffness, low-temperature durability, creep and susceptibility to cracking. They also evaluated pavement aging by testing samples for asphalt binder properties.

Researchers conducted similar tests on core samples from a 10-year-old pavement on Trunk Highway 56 in southern Minnesota. Seals were similarly applied to consecutive subsections over a four-year period, with one subsection left unsealed as a control.

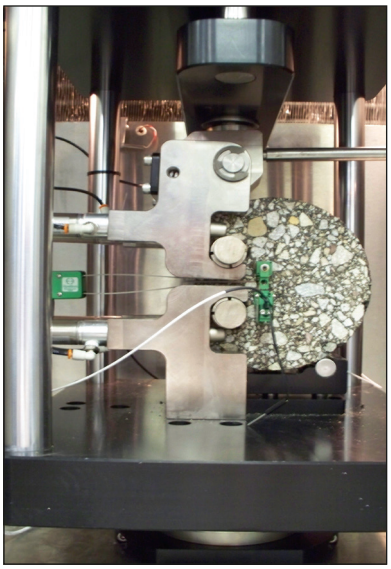
continued

"As with changing the oil in a car, the earlier the preventive maintenance of asphalt pavements, the longer they will last without needing more serious repair."

—Tom Wood,
Research Project Engineer, MnDOT Office of Materials and Road Research

"The key to preventive maintenance is timing it to occur before there is pavement distress."

—Mike Anderson,
Research and Laboratory Services Director, Asphalt Institute



Researchers evaluated core samples from test sites for their resistance to cracking using the disk-shaped compact tension test in which a specimen is loaded to failure.

What Did We Learn?

Results showed that for core samples from both test sections, the aging and stiffness of the asphalt pavement were significantly greater near the surface than farther down in the pavement structure.

Researchers had hypothesized that the time between the initial construction and treatment application would be an important factor in the measured properties related to aging, with sections sealed sooner having the least aging, but with sealing becoming less effective at preventing aging when applied later in the life of the pavement. The TH 56 test section confirmed the hypothesis, with testing indicating that the subsections with chip seals applied more than two years after construction had essentially the same susceptibility to cracking as the unsealed control subsection. The findings from TH 56 imply that to mitigate damage from environmental aging, sealing should occur within the first two years of the pavement's life. After that, while some benefits may still be obtained from treatment, it appears that the damage from environmental aging may have already substantially occurred.

However, results from the MnROAD test section did not confirm this hypothesis; aging was similar for all subsections. This may be because the TH 56 test section was 12 years old at the time core samples were taken and had experienced measurable distress, while the MnROAD section was only five years old and had experienced no distress, making it difficult to see the effect of sealing.

What's Next?

MnDOT is reviewing its asphalt preventive maintenance guidelines and considering whether to reduce the timing for preventive maintenance to as little as one to two years after initial paving. It is also considering replicating this study on a newly constructed pavement. Researchers recommend keeping MnROAD subsections in place and continuing testing every two to three years to see if initial findings change after 10 years in service instead of five. Researchers also recommend applying a new round of treatments to these subsections beginning after they have been in service for seven years to determine if that practice has added benefits.

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This Technical Summary pertains to the LRRB-produced Report 2014-45, "Optimal Timing of Preventive Maintenance for Addressing Environmental Aging in Hot-Mix Asphalt Pavements," published December 2014. The full report can be accessed at http://www.lrrb.org/PDF/201445.pdf. *Further details about this effort can be found at* http://pooledfund.org/Details/Study/380.

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