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MNDOT TRIAL SEEKS TO REDUCE PAVEMENT CRACKS

Minnesota targets reflective cracking with test of polymer modified asphalt pavement on section of busy trunk highway

by Paul Fournier

A Wirtgen W2200 cold mill conveys pavement millings into a Mack truck prior to placement of highly polymer modified asphalt on Minnesota TH100.

The Minnesota Department of Transportation (MnDOT) has taken aim at cracked pavements with a new highly modified asphalt mix.

MnDOT sanctioned the installation of hot mix asphalt modified with a high concentration of a new type of polymer on a section of Trunk Highway 100 west of Minneapolis, to see if the advanced product could reduce a certain type of pavement cracking.

"The 12.5 millimeter Superpave mix we've been using for our mill-and-fill operations has done a good job of reducing thermal cracking, but we need a way to reduce reflection cracks," said Jerry Geib, MnDOT research operations engineer.

As a member of the Federal Highway Administration's Pavement Preservation Expert Task Group and Midwestern Pavement Preservation Partnership (MPPP), Geib learned about a series of planned field demonstrations of thin-lift asphalt overlay incorporating highly polymer-modified liquid asphalt binder (HiMA). The demonstrations were to be held by the Northeast Pavement Preservation Partnership (NEPPP), which, like MPPP, is a regional partnership dedicated to advancing pavement preservation practices through education, research and outreach.

The PMTOL Difference

The Northeast group recently developed new regional specifications, "Superpave 9.5mm Highly Polymer-Modified Thin Overlay Specifications" (PMTOL), that govern the design, production, installation and performance of the advanced hot mix overlay.

Designed as a pavement preservation strategy to extend the service life of structurally sound pavements, PMTOL employs liquid HiMA binder containing 7.5-percent SBS (styrene-butadiene-styrene) polymer – more than twice as much used in conventional polymer-modified binders.

While it's generally accepted throughout the industry that modification of liquid asphalt binders with polymers improves resistance to cracking, rutting and raveling of asphalt mixes, there is a practical limit to polymer concentration. Usually, as polymer concentration exceeds three percent, the binder viscosity increases such that the mix becomes more difficult to produce in the plant and less workable for the paving crew.

However, polymer used in HiMA binder is Kraton™ D0243, a new SBS product developed and manufactured by Houston-based Kraton Performance Polymers, Inc., which does not increase binder viscosity even in polymer concentrations exceeding 7.5-percent.

PMTOL also allows the use of up to 25 percent recycled asphalt product (RAP) in the mixture.

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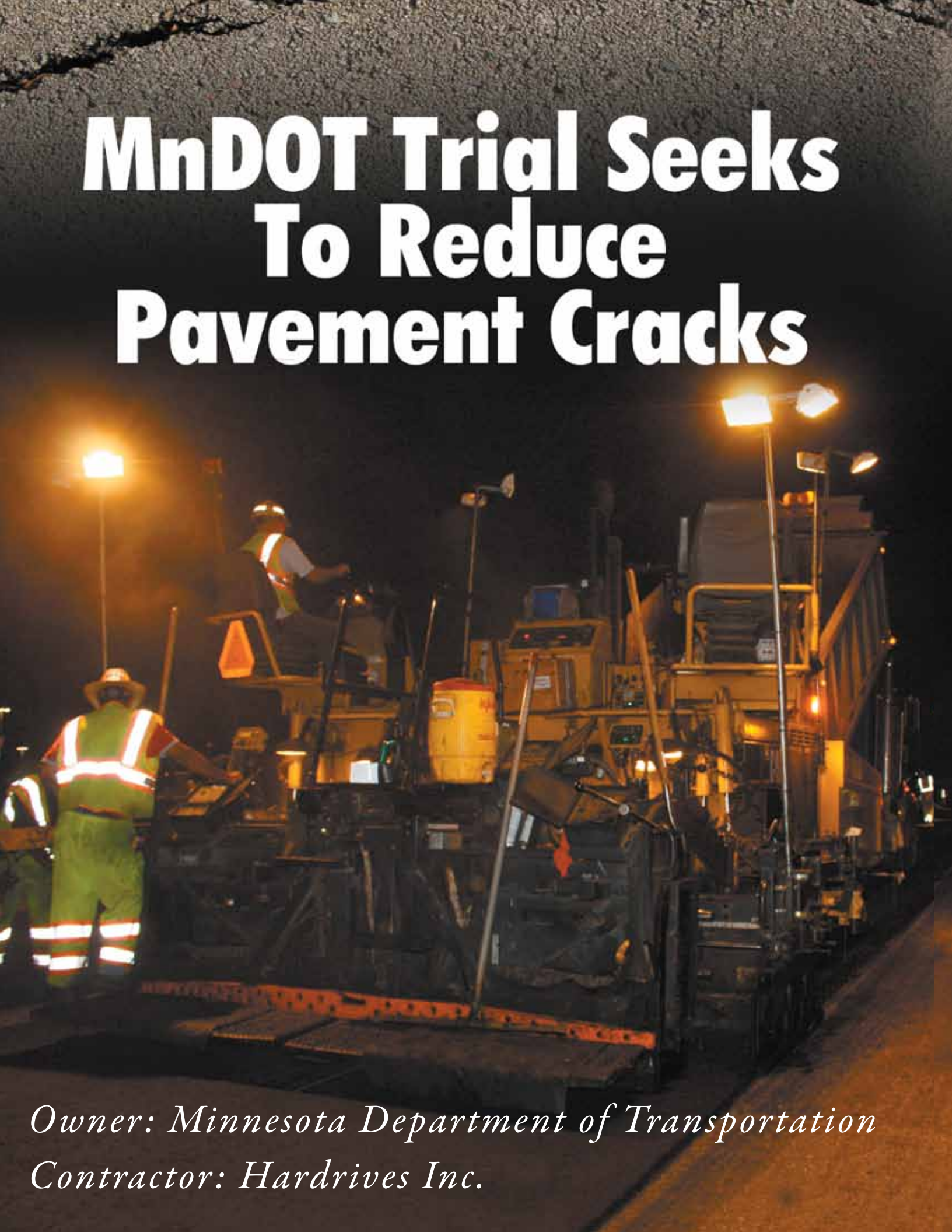


Owner: Minnesota Department of Transportation

Contractor: Hardrives Inc.

Commercial Asphalt produces 12.5mm Superpave hot mix in its Gencor drum mix plant, combining virgin aggregate, RAP and HiMA.

Left: Hardrives Inc. uses a Cat AP-1055D Paver for night-time installation of HiMA overlay on 1-¾-mile test section of TH100.

Switching Binders

MnDOT's Geib believed the new product used in the demonstrations might have beneficial applications in Minnesota. He spoke with personnel of the agency's Metro Maintenance Operations Engineering Services to see if they'd be interested in trying the new highly modified asphalt binder in one of their mill-and-fill operations. They agreed to do so on a trial section on TH100, substituting HiMA binder for their regular binder, a Performance Grade 64-28.

A major arterial experiencing an average annual daily traffic of 64,000 vehicles, TH100 has 2 lanes in each of the north and south barrels. The section chosen for the trial was approximately 1-¾ miles in the right lane of northbound TH100. About ¼ of the section would involve a 1-½-inch mill-and-fill while the remainder of the section would consist of 2-inch mill-and-fill – the usual thickness for the procedure.

The hot mix used in both portions of the test section would incorporate the highly modified binder and 25-percent RAP. Approximately 1,370 tons of asphalt mix would be required.

The Proper Blend

The HiMA binder for the hot mix was produced by Midwest Industrial Asphalt of Onalaska, Wis., a major supplier of conventional and polymer modified bitumen products. In addition, MTE Services, a sister company, has a modern, highly-specialized product lab and research facility staffed by professional chemists and engineers to provide technical support.

MTE supported Midwest Asphalt's operation to produce the proper blending of D0243 polymer with the selected liquid asphalt binder, with support from Bob Kluttz, chief asphalt chemist of Kraton Performance Polymers, Houston.

Kluttz said Midwest Asphalt and MTE are very technically astute companies. "They did a fantastic job in producing HiMA for the TH100 demonstration," he said. Kluttz explained that MTE started working with a PG 52-34 liquid asphalt binder, blending it with Kraton D0243 SBS polymer. The weight of the polymer amounts to 7.5-percent of the total weight of the HiMA binder. The finished product tested as a PG 76-34, a grade verified by MnDOT's own lab.

Issue-Free Mix Production

The modified binder was shipped to Commercial Asphalt Co., a division of Tiller Corp. of Maple Grove, Minn., for production of hot mix.

"We received about 12,750 gallons, or some 54 tons, of the liquid binder, which tested as a PG 76-34," said Rob Kuehborn, Director of Materials and Quality at Tiller Corporation.

Commercial Asphalt produced the hot mix in its 700-ton-per-hour Gencor drum mix plant. Kuehborn said that when the Gencor plant was erected in 2001-2002, it was the largest drum mix plant in production. The facility has 14 aggregate cold feed bins; 3 RAP feed bins; 7 mix-storage silos; and 4 large-capacity stainless steel tanks for storing liquid asphalt binder.

"On average, the plant produces between 500- and 600-tons per hour of hot mix asphalt, although with dry weather conditions we can make up to 760 tons of mix per hour," he said. "In 2003, 2004, and 2005, when the economy was better, the plant was producing 700- to 800,000 tons of mix a year," he continued. "And the plant can store 1,900 tons of hot mix in our silos," he concluded.

Commercial started manufacturing the mix at about 315 degrees Fahrenheit but the temperature was lowered to about 295 degrees Fahrenheit and kept there for the remainder of mix production. Virgin aggregate, HiMA and RAP were combined to produce the 12.5mm Superpave mix ordinarily used by MnDOT for their mill-and-fill work. The aggregate gradation for this mix begins with 100 percent passing ¾-inch sieve size and 90- to 95- percent passing ½ inch. In contrast, the "Superpave 9.5mm PMTOL mix uses a smaller aggregate, with 100-percent passing ½-inch and 90- to 100-percent passing a ⅜-inch sieve.

The total liquid binder content amounted to approximately 5.4 percent, which was a blend of 4.3 percent HiMA and 1.1 percent asphalt binder contributed by the RAP.

Mix production at Commercial Asphalt's plant went smoothly. "The use of HiMA didn't change any of our volumetrics," Kuehborn said. "We didn't notice any significant difference in production from that of the Superpave 12.5mm mix ordinarily used in MnDOT mill-and-fill operations," he continued.

Tiller Corporation was pleased with the characteristics of the HiMA binder. "In our experience, liquid asphalt binder that is highly polymer-modified can be sticky and have flow problems and a noxious odor. This material did not have these issues," he said.

Installing the Mix

Hardrives Inc. of Rogers, Minn., performed milling and paving, which were scheduled at night because of heavy daytime traffic on TH100. Milling started at approximately 7 p.m. after work crews had established safety zones with barrels and traffic cones. Next the road was swept and vacuumed. With sufficient distance established behind the milling operation, paving began at approximately 8:30 p.m. Milling and sweeping crews stayed in front of the paving operation throughout the night.

A Peterbilt deposits millings from TH100 mill-and-fill operation into RAP pile at Commercial Asphalt plant site.

MnDOT Trial Results to be Posted on AASHTO TSP•2 Website

Dr. Walaa Mogawer, P.E., professor and director of the Highway Sustainability Research Center housed by the University of Massachusetts/Dartmouth, is testing hot mix samples from MnDOT's TH100 HiMA trial.

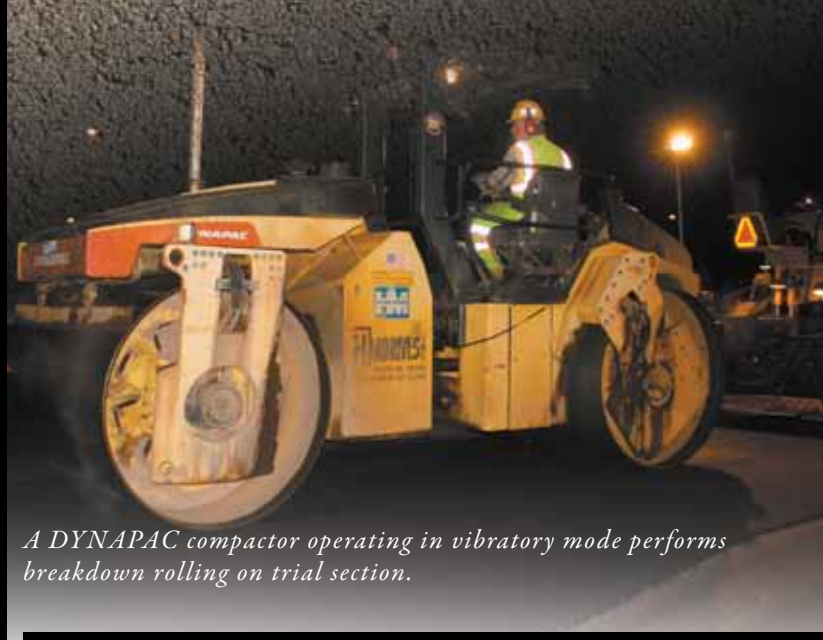
Professor Mogawer and 11 participating transportation agencies of the Northeast Pavement Preservation Partnership developed the new regional specifications, PMTOL, used for the NEPPP field demonstrations. Professor Mogawer also developed testing protocols for the specifications.

The Highway Sustainability Research Center is currently under contract to Kraton Performance Polymers, Inc. to coordinate the NEPPP project with participating transportation agencies. Kraton is underwriting the project by donating Professor Mogawer's lab services as well as supplying the additional polymer needed for demonstrations.

As part of his contractual functions, professor Mogawer is testing samples of raw materials to be used in NEPPP field demonstrations of the mix, and also testing samples of the installed mix. In addition, he will provide similar services for the MnDOT TH100 HiMA trial. Professor Mogawer's test results will be posted on the website of the Transportation System Preservation Technical Services Program (TSP•2).

Sponsored by the American Association of State Highway Transportation Officials, the AASHTO TSP•2 website is administered by the National Center for Pavement Preservation (NCPP), which is located at Michigan State University. NCCP is also hosting the NEPPP field demonstrations.

NEPPP and Midwestern Pavement Preservation Partnership, together with two other regional groups, the Southeast Pavement Preservation Partnership and the Rocky Mountain West Partnership, are signatory to the national program.



A DYNAPAC compactor operating in vibratory mode performs breakdown rolling on trial section.

Jerry Geib, MnDOT research operations engineer and Bob Kluttz, chief asphalt chemist of Kraton Performance Polymers, observe plant production of HiMA hot mix.

Paul Nolan, MnDOT operations engineering services, and Trudy Elsner, MnDOT senior engineer, work on specifications preparations for trial section.

The mix was installed on the road at about 290 degrees Fahrenheit. Approximately 880 tons of mix was installed between 8:30 p.m. and midnight on Friday. Crews halted operations at this time due to an impending rainstorm. Milling and paving of the remaining 490 tons resumed Saturday afternoon. The contractor received credit for each truck-full of millings brought to Commercial Asphalt's facility and each truck returned to the jobsite with a load of hot plant mix. There was no "dead heading."

For the TH100 trial, Hardrives employed a Wirtgen W200 Cold Planer to mill off existing pavement, a CAT AP-1055D Paver to install the HiMA overlay, and two rollers operating in vibratory mode – a DYNAPAC Steel Drum Breakdown Roller and a HAMM HD + 140 Steel Drum Finish Roller. A BROCE RJ350 Broom did the sweeping.

According to Geib, the paving crew said there was no difference between handling HiMA mix and MNDOT's usual 12.5mm Superpave mix.

The Ultimate Test

To determine the effectiveness of the highly polymer modified asphalt binder, Geib said, MnDOT will inspect the full length of the TH100 mill-and-fill project in mid-November to see if any reflective cracking has started.

"After we've had some minus-20-degree days later into our winter, we'll go out and see if any reflective cracks have developed in the test section and in the regular hot mix portion of the job.

"We'll also conduct tests of samples from both in our own lab, and also send samples to Professor Walaa Mogawer at the UMass lab for his analyses (Ed.: see accompanying sidebar).

"The results of these tests might be helpful in developing performance specifications for the highly polymer modified asphalt mix," he concluded.