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MNDOT FURTHERS PAVEMENT MICRO SURFACING RESEARCH

Agency's District 3 tries new highly polymer modified asphalt emulsion in demonstration on section of Trunk Highway 23 near St. Cloud

By Paul Fournier

Minnesota's Department of Transportation continues its practical research of pavement preservation techniques with the recent demonstration of micro surfacing containing emulsified highly polymer modified asphalt (HiMA) on a section of Trunk Highway 23.

ASTECH Corporation of St. Joseph, Minn., applied the micro surfacing on a one-mile section of the two-lane highway near the city of St. Cloud, the county seat of Stearns County and the largest population center in the state's central region. Bisected by the Mississippi River, St. Cloud is a regional transportation hub in Minnesota, with major roadways including Interstate Highway 94, U.S. Highway 10, and Minnesota State Highways (Trunk Highways) 15 and 23 passing through the municipality.

Located about 65 miles northwest of Minneapolis-St. Paul, the city of St. Cloud lies within MnDOT's District 3, which has the largest population base outside of the Twin Cities metropolitan area. District 3 encompasses all or part of 14 counties, and its personnel plan, design, construct and maintain roughly 1,650 centerline miles (nearly 4000 lane miles) of Interstate, U.S. and trunk highways.

Sophisticated Pavement Research

The June 2012 TH23 application was the first time MnDOT used HiMA emulsion in the micro surfacing process, although the agency did approve the installation of hot mix asphalt modified with HiMA on a section of TH100 west of Minneapolis last year, as part of its continuing search for advanced products capable of retarding pavement reflection cracks.

Minnesota's trunk highway system of 11,000 miles ranks it the fifth largest in the nation, and its DOT is considered to be in the forefront of highway maintenance, research and construction practices. In connection with this, the agency owns and operates MnROAD, a sophisticated pavement test track built to study various research materials and pavements. MnROAD works in conjunction with MnDOT's Materials Lab located in Maplewood, Minn. (See sidebar on last page.)

Jerry Geib, MnDOT research operations engineer, suggested the use of HiMA in the 2011 TH100 mill-and-fill hot mix asphalt operation. That application went without incident, with the paving crew noting there was no difference between handling HiMA mix and MnDOT's usual 12.5mm Superpave mix. The asphalt binder used in this mix was dosed at 7.5-percent SBS polymer.



ASTECH Corporation applies micro surfacing containing emulsified highly polymer modified asphalt to a section of Trunk Highway 23 for Minnesota DOT.



MNDOT FURTHERS PAVEMENT MICRO SURFACING RESEARCH

*Owner: Minnesota Department of Transportation
Contractor: ASTECH Corporation
Emulsified HiMA Supplier: Flint Hills Resources*

Geib also urged the testing of emulsified HiMA for the 2012 TH23 micro surfacing demonstration to see if it would improve the retardation of pavement reflection cracks. The base asphalt was dosed at 6.0-percent SBS polymer prior to emulsification.

A History of Micro Surfacing

MnDOT has used micro surfacing since 1999, much of it in and around metro areas as a pavement preservation method for high-volume roadways. Designed to protect structurally sound roads, micro surfacing is a cold-mix material, manufactured on site in a continuous mix paver that blends mineral aggregate, Portland cement or other type of mineral filler, water, and a polymer-modified asphalt emulsion. The polymer modified emulsion binds the asphalt, mineral aggregate and fines together.

Micro surfacing can be spread in variable thicknesses, depending on its purpose. It may be used as a leveling or scratch course prior to surface treatments, to fill pavement wheel ruts, or as a thin pavement wearing course. It's a "quick-traffic" process. General traffic is usually placed on micro surfacing any-

where from 15 to 30 minutes after application. No rolling is required.

The Minnesota agency traditionally calls for emulsion containing latex-polymer modified asphalt for its micro surfacing, approving both natural latex rubber and synthetic latex rubber for the process. The latex proportion of the emulsion is generally 3 percent or slightly higher, while the emulsion content of the micro surfacing mixture is normally between 12- and 13 percent by weight.

An Issue of Cracking

One of the issues the agency has had with micro surfacing is reflective cracking. The treatment is a thin material – usually between ¼-inch and ⅜-inch – and over time cracks in the underlying pavement reflect up to the surface.

MnDOT's Geib and Tom Wood, research projects supervisor for the agency's Materials Division, wanted to see if using emulsified HiMA could retard the appearance of cracks, providing more service life for the treatment.

Wood consulted Chris Lubbers, technical sales manager for Kraton Performance Polymers, which manufactures the polymer used in HiMA, and it was determined that emulsified HiMA could be incorporated in micro surfacing for a section of TH23.

“We had a micro surfacing project scheduled for TH23 and it was easy to do a change order,” Wood said.

According to Wood, the section of TH23 chosen for the test experiences an average daily traffic count of more than 5000. It was originally a Portland cement concrete slab, was paved in 1998 with 6 inches of bituminous concrete, and was chip sealed in 2004 – the last time this section underwent surface treatment.

Easier, Cost-Efficient Emulsification

Liquid HiMA binder for emulsion applications contains 6.0-percent SBS polymer – about twice as much used in conventional polymer-modified binders. While polymer modification improves asphalt binder performance, there is a limit to the dose that can be applied. 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.

Houston-based Kraton solved this dilemma by developing and manufacturing a new type of SBS – Kraton D0243 – which improves asphalt performance beyond that for conventional SBS dosage, but does not increase binder viscosity even in polymer concentrations exceeding 6.0-percent. In addition, emulsification of HiMA containing this advanced SBS product is easier and less costly than manufacturing emulsion using asphalt pre-blended with a more conventional SBS polymer. The reason: A heavier-duty mill for shearing asphalt and significantly higher temperatures are required to emulsify asphalt pre-blended with conventional SBS polymer than required for emulsifying HiMA binder.

HiMA emulsion for the demonstration was provided by

Flint Hills Resources, a refining and chemical company based in Wichita, Kan. Flint Hills blended D0243 polymer with base asphalt at its Savage Mountain, Minn., plant. Subsequently the company shipped the SBS polymer-modified asphalt to its plant in Algona, Iowa, for emulsification, then trucked the finished product to ASTECH Corporation for the micro surfacing application. The finished emulsion grade was a CSS1-h.

MnROAD Track Also Micro Surfaced

DOT’s Materials Lab decided to apply emulsified HiMA micro surfacing to not only TH23, but a section of the MnROAD test track as well. The MnROAD section, Cell #1, involved 550 feet of 2-lane road.

Cell #1 received a scratch (leveling) course of HiMA micro surfacing on Wednesday evening June 27 and received the final micro surfacing the next morning. Wood pointed out that micro surfacing was of variable thickness due to distresses in the pavement, and that a total of approximately 30 pounds per square yard of micro surfacing containing 16 percent HiMA emulsion was applied.

On the same day, June 28, the contractor proceeded to TH23 and applied a leveling course of HiMA micro surfacing. Wood said this course dealt with slight wheel rutting (less than ½ inch) and was applied at the rate of 14- to 16 pounds per square yard. The following morning, Friday, June 29, ASTECH crews applied the final HiMA micro surfacing at about 15 pounds per square yard. The target total application rate was 30 pounds per square yard, with a HiMA emulsion concentration of 13 percent.

A control section of non-HiMA micro surfacing was applied to an adjacent lane of TH23 for comparison with the HiMA micro surfacing. The control micro surfacing, also provided by Flint Hills Resources, incorporated 13 percent CSS1-h emulsion modified with synthetic rubber latex to meet MnDOT’s specifications.



A ‘nurse’ truck takes on a load of emulsified HiMA binder with a grade of CSS1-h supplied by Flint Hills Resources.

Left: A Bergkamp continuous mix paver first applies a leveling course, then follows with a final coat, for a total application of 30 pounds per square yard.



A Volvo L70D fills hopper of a Terex Powerscreen Chieftain 600 which processes aggregate used to make micro surfacing mix.

Quick Traffic Returns

ASTECH employed a Bergkamp continuous mix paver for micro surfacing. Feeder or ‘nurse’ trucks on the job stocked with necessary raw materials – emulsified HiMA binder, water and aggregate – continuously supplied the Bergkamp micro surfacing machine to make sure it maintained a steady pace. Portland cement was stored in bags on the Bergkamp machine. As water in the emulsion evaporated, the micro surfacing on the road changed color from a brownish red to black. No rolling was necessary.

There was no discernible difference between the application of micro surfacing containing emulsified HiMA and that containing the usual polymer modified emulsion used in the control section. The waiting time between the application of micro surfacing and the placing of rolling traffic on the material was different, according to Kraton’s Lubbers.

“Both were well within the 60-minute maximum specified by MnDOT. The actual return to traffic time was about 10 minutes for the control section and 20 minutes for the HiMA section,” Lubbers noted.

Keeping a Close Eye for Cracks

Traffic was placed on the TH23 sections the same day the micro surfacing was placed, while traffic was diverted from westbound I-94 to MnROAD’s Cell #1 on July 1.

Wood said that the heavy July 4 holiday traffic had no observable effects on any of the micro surfacing on either Cell #1 or TH23

The Materials Lab will continue to monitor the effects of traffic and weather on the newly micro surfaced road sections with a close eye out for signs of reflective cracking. 🚧



An International nurse truck leads micro surfacing train on TH23, a road that experiences an average daily traffic count of more than 5000.



MnDOT personnel monitor micro surfacing project: left to right: Paul Nolan, Rick Beckes, Patty Wallin Johnson and Tom Wood.

MnROAD Test Track Finds Ways To Make Roads Better

Located near Albertville, Minn., MnROAD is a cold region testing facility and laboratory operated by the Minnesota Department of Transportation (MnDOT).

Working with MnDOT Materials Lab, MnROAD operates and maintains two unique road segments located next to Interstate 94. These road segments are divided into over 50 test cells, each representing various combinations of road-building materials and designs. According to MnROAD, the segments are designed to find ways to make roads last longer, perform better, be built faster, cost less to build and maintain, and have minimal impact on the environment.

One segment is a 3.5-mile mainline interstate roadway carrying “live” one-way traffic averaging 28,000 vehicles a day diverted periodically from the parallel westbound I-94 between Albertville and Monticello, Minn. Normally there is a monthly switch of traffic from March to November, with the switch off one week or less.

The other segment is a 2.5-mile, closed-loop, low-volume roadway carrying a controlled 5-axle tractor-semi-trailer to simulate conditions of rural roads.

MnROAD has installed over 9500 sensors in and under the track pavement which measure and forward to a computerized data collection system such variables as temperature, moisture, strain, deflection and frost depth, among others.



For more information about MnROAD, visit www.dot.state.mn.us/mnroad

MnROAD Research Center operates and maintains two road segments divided into more than 50 test cells for studies of various road building materials.



Recently micro surfaced segment of MnROAD’s 3.5-mile mainline test section that periodically carries average daily traffic of 28,000 vehicles from I-94.