After floods, Vermont fixes, maintains roads – and tries new pavements

As state’s road maintenance normalizes, VT Agency of Transportation tests new thin asphalt overlay for more durability and lower life-cycle costs

By Paul Fournier

Approximately one month after Hurricane Irene had dumped up to 12 inches of rain in parts of Vermont on August 28, 2011, causing the state’s worst flooding in 80 years, state and municipal construction crews assisted by the Vermont National Guard had rebuilt and reopened many of the sections of some 300 roads that had been closed due to storm damage.

In most areas of the state, regular pavement maintenance was back on target. This included a stretch of US Route 7 in Danby that was slated for an asphalt overlay by contractor Pike Industries.

Fortunately, the portion of US Route 7 that had been selected for the overlay had not been affected by the August deluge.

“This area is about 25 miles south of where most flood damage occurred, although we did lose a bridge on Route 7 up in Clarendon,” said Mike Fowler, Vermont Agency of Transportation (VTrans) Pavement Management Engineer.

Pike had a $1.8-million contract with VTrans to install a “Paver-Placed Type C Surface Treatment” on 11.6 miles of the highway, which in the Danby area is an undivided two-lane road. However, the Type C treatment was not applied to the entire 11.6 miles of the contract.

Not Your Usual Overlay

Fowler explained that a two-mile portion of the contract specified the installation of thin hot asphalt overlay containing highly polymer modified asphalt (HiMA) binder. VTrans had volunteered to install the HiMA-modified mix as part of a series of field demonstration tests under a program initiated by the Northeast Pavement Preservation Partnership (NEPPP), a regional group that promotes advanced pavement practices through education, research and outreach.

“We decided to test the highly polymer modified mix because we’re constantly looking for better, high-performance pavement materials that will provide longer service life at lower life-cycle costs,” he said. “For example, if we can get the same durability and same installation cost per square yard from one-inch-thick HiMA-modified overlays that we’re getting from conventional 1-1/2-inch overlays, then we’re using less material and saving money over the life of the pavement,” Fowler said. “And if it’s a mill-and-fill operation, then we don’t have to mill off as much existing pavement, which gives us further savings.”
The Danby demonstration project was hosted by the National Center for Pavement Preservation (NCPP) housed at Michigan State University, which is under contract to develop and administer the Transportation System Preservation Technical Services Program (TSP•2). This is a national program funded by the American Association of State Highway and Transportation Officials (AASHTO) that provides current information on pavement and bridge preservation measures.

Developed as an extension to NCPP’s existing website, the TSP•2 website provides transportation agencies with news and technical information on preservation issues. While access to the TSP•2 website is open to the public, it is supported by contributions from AASHTO member agencies.

Benefits of Regional Groups

Fowler pointed out that he had learned of the HiMA field demonstrations project through VTrans’ role as one of 14 state transportation agencies belonging to NEPPP.

“We’ve been members of NEPPP for about five years. In that time, the organization has grown and matured significantly, with large meeting turnouts these days that provide outstanding networking opportunities for us. We benefit from the experiences of not only other agencies but from paving contractors and suppliers who attend the meetings as well.

“This gives us a chance to talk with the folks on the ground. We learn a lot from people actually doing the field work,” he said.

States beyond the NEPPP territory learned of the field demos through memberships in sister regional groups. Two of these, MnDOT, a member of the Midwestern Pavement Preservation Partnership (MPPP), and Oregon DOT, a member of the Rocky Mountain West Pavement Preservation Partnership (RMWPPP), decided to incorporate HiMA in sections of their regular maintenance overlay contracts. These agencies are employing their own asphalt mix designs, not the PMTOL specs, but are substituting HiMA binder for their usual binder.

Collective Effort Yields Regional Specs

Eleven member agencies of NEPPP worked together to develop the regional specifications, with coordination managed by Professor Walaa Mogawer of the Highway Sustainability Research Center (HSRC) housed by the University of Massachusetts/Dartmouth. (See sidebar accompanying this article.)

Entitled “Superpave 9.5mm Highly Polymer-Modified Thin Overlay Specifications” (PMTOL), NEPPP’s new regional specifications guide design, production, installation and performance of the advanced hot mix asphalt overlay.

The PMTOL specs were not developed as a “one-size-fits-all” design for all agencies. The testing protocols are so numerous and stringent that not all agencies would use all of the protocols for their regular asphalt overlays.

“This collective effort produced specifications that are generic in nature,” explained Fowler. “That is, they provide many more testing protocols than most agencies need, so each agency can select protocols meeting their own particular criteria for asphalt overlays. Vermont might use certain protocols, while Rhode Island, with its milder climate, might use different ones,” he said.
A Ford-mounted ROSCO distributor sprays asphalt emulsion tack coat on US Route 7 prior to application of HiMA thin overlay.

Observing paving project are VTrans personnel Mike Fowler, left, pavement management engineer, and Josh Hulett, project resident engineer.

It took the 11 agencies and professor Mogawer just 3 months in the summer of 2010 to draw up the specifications. In October 2010 several of the agencies expressed interest in having field demonstrations of the HiMA-modified PMTOL thin lift overlay in their states. Two of them, Vermont and New Hampshire, held demonstrations in 2011. The demonstrations were conducted on two-mile sections of regular pavement maintenance contracts.

Twice As Much Polymer

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 traditionally used in conventional polymer-modified binders.

While it's generally accepted throughout the industry that polymer modification of liquid asphalt binders boosts durability of hot mix by improving its resistance to cracking, rutting and raveling, there is a practical limit to polymer dosage. Usually, as polymer content is increased to more than three percent, binder viscosity increases. This makes it more difficult to produce asphalt mix in the plant and diminishes workability 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 dosages exceeding 7.5 percent.

NuStar Asphalt blended the D0243 polymer with a performance-graded asphalt binder at its New Jersey specialty asphalt product plant to produce the HiMA binder for the Danby demonstration. Frank Fee has been the principal NuStar Asphalt manager for the AASHTO TSP•2 HiMA production in the Northeast. NuStar also produced the HiMA binder for a New Hampshire DOT demonstration held recently in Rochester, N.H.

With RAP and Without

The PMTOL specifications allow up to 25 percent recycled asphalt pavement (RAP) to be used in the hot mix. For the two-mile Danby demonstration the contractor installed one-inch of PMTOL mix containing all virgin aggregate on the first mile, and on the second mile installed one inch of PMTOL mix incorporating about 25 percent RAP.

The remaining 9.6 miles underwent Type C Surface Treatment, an overlay of thin open-graded hot asphalt mix that is placed by paver over fresh-sprayed asphalt emulsion. This treatment is characterized by a maximum stone size of ½-inch and a neat (unmodified by polymers) liquid asphalt binder content of 4.9 percent.

The PMTOL mix required a crushed 9.5-mm stone (½-inch), which was supplied by precast concrete manufacturer J.P. Carrara & Sons Inc. of Rutland, Vt. Natural sand from Pike’s own Danby plant was used in the mixes.

Pike manufactured the Type C and demonstration mixes at its North Clarendon asphalt batch plant, a 1983, 3.5-ton facility retrofitted over the years for meeting environmental regulations.
But long before the field demonstration took place, according to Brian Hricay, Pike’s regional quality control manager, Pike technical personnel tested pertinent pavement materials in the company’s laboratories in the Barre, Vt., office and Belmont, N.H., headquarters.

A Mack dump truck receives a batch of HiMA mix at Pike’s Cedarapids plant in North Clarendon, Vt.

Pike Labs Work With Researcher

Hricay said Pike’s laboratory technicians determined physical and chemical characteristics of various aggregate, using sophisticated tests for soundness, TSR tensile strength, specific gravity of coarse and fine aggregate, and LA abrasion index, among other procedures. They also tested the RAP, heating samples to fail temperature, conducting sieve analyses and grading the material. The lab also used solvent to extract asphalt binder from RAP to determine the amount of binder it would contribute to the PMTOL mix. Although up to 25 percent RAP is allowed, the recycled binder cannot contribute more than one percent — roughly 15 percent — of the 6.5 percent of binder required for the PMTOL design.

Furthermore, using samples of HiMA binder provided by Professor Mogawer, Pike technicians created experimental blends of various aggregate and RAP to produce the desirable PMTOL mix. They even ran several test batches through the asphalt plant to arrive at the appropriate blend.

Key technical personnel for the testing procedures were Asphalt Binder Engineer Peter Moore, Quality Control Technician Grant Swenson and QC Manager Dave Duncan. This group worked with Professor Mogawer of UMass/Dartmouth to verify that both of Pike’s HiMA mixes — the all-virgin aggregate and the 25-percent RAP blend — would satisfy PMTOL specification protocols.

The Demonstration

During the actual paving demonstration at the Danby test site, VTrans technicians took samples of the PMTOL mixes and had them taken by courier to Professor Mogawer’s lab for analyses.

Pike’s haul trucks delivered Type C mix to a Gorman Bros. special paver at the Danby jobsite. The Albany, N.Y., subcontractor used one of its Novachip pavers to lay down the mix. This self-priming paver sprayed asphalt emulsion on the road surface immediately before it laid down the Type C overlay.

For the two-mile demonstration section, Pike used its own pavers, a Terex Cedarapids and a Cat AP-1055D, to install the PMTOL mix. US Route 7 at this location is 44-ft. wide, with 2 12-ft. travel lanes and 2 10-ft. shoulders. Crews used the Terex Cedarapids paver for the shoulders and the Cat for the travel lanes. The pavers operated in tandem, with the Terex Cedarapids always in the lead for a better joint between the two.

Three rollers provided compaction — a Cat CB534D Breakdown Roller, Cat CB434 Intermediate Roller and a HYPAC roller. All rollers operated in non-vibratory mode.

Results from NEPPP field demonstrations, as well as those from the aforementioned Minnesota and Oregon DOTs use of highly polymer modified asphalt mixes, will be analyzed and verified at professor Mogawer’s Highway Sustainability Research Center lab and subsequently posted on the AASHTO TSP*2 website.