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OFFICE OF TRANSPORTATION SYSTEM MANAGEMENT

TECHNICAL SUMMARY

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PROJECT COST:

\$130,373



On coarse asphalt surfaces, one winter is enough to wear away even well-painted centerlines.

Pavement Markings: Epoxy Paints and Thick Coats Perform Best on Challenging Asphalt Surfaces

What Was the Need?

In a 2009 Transportation Research Board Annual Meeting paper, researchers ascribed over 25,000 fatalities per year to lane departure, about 60 percent of the country's highway fatalities. Authors noted that "adding edge lines to rural two-lane highways can reduce crashes and fatalities." A range of limited studies, they argued, demonstrated a significant safety benefit from edge lines and centerlines at night, in other low-visibility conditions and on all terrains. However, such pavement markings are often challenging to effectively install, particularly on coarsely surfaced asphalt pavements.

In Minnesota, most highway asphalt pavements have coarse surfaces with gaps between aggregate pieces. Seal coats, the resurfacing option most widely used by MnDOT, involve a thin layer of asphalt-water emulsion followed by a cover layer of aggregate that provides excellent traction to drivers, even in wet conditions. Seal coats are used on all two-lane rural highways. Microsurfacing, typically reserved for large, multilane, higher speed roadways, involves a mixture of polymer-modified asphalt and high-quality fine aggregate blended into a single layer. This treatment option yields a smoother and quieter ride, but offers a little less traction.

Both of these surface types offer a similar challenge for pavement marking performance: surface gaps into which fresh paint sinks. In less than one year, road use and snowplowing can scrape paint off the higher aggregate surfaces, leaving behind sunk-in paint that drivers see as faded lines.

What Was Our Goal?

Investigators conducted a field trial of various combinations of pavement marking materials and installation practices on these challenging asphalt surfaces. The trial evaluated pavement marking approaches in terms of product, thickness, bead package and the use of a primer coat. The goal was to identify what striping approaches hold up best on chip seals and microspheres.

What Did We Do?

Working closely with MnDOT's Technical Advisory Panel, researchers identified two test decks for evaluation, coordinating initial and follow-up evaluations with pavement painting crews. The 3-mile site on U.S. Highway 52 featured a divided four-lane highway of microsurfaced asphalt pavement marked with white edge lines and a skipping white centerline, and a wide right shoulder. The 3-mile site on U.S. Highway 61 (U.S. 61) featured seal coating on a two-lane highway marked with white edge lines and a skipping yellow centerline, and a wide right shoulder.

Line marking variants included thin layers (12 mil wet) of latex and epoxy paints. High-build markings entailed thick coatings of latex at 25 mil and 35 mil thicknesses. Sites

On microsurfaced asphalt highways, epoxy centerlines and edge lines perform well, as do thickly layered latex markings. Material problems prevented analysis of seal-coated highways, but city roads in Eden Prairie, Minnesota, suggest that latex striping followed a year later with epoxy restriping works well on seal-coated surfaces.

“The most challenging surface is the seal coat surface, and we lost that in the study. But with microsurfacing we found that primers can help in some instances, and VISILOK does speed up curing time.”

—Michelle Moser,
Pavement Marking and
Traffic Device Engineer,
MnDOT Office of Traffic,
Safety and Technology

“Standard latex just didn’t hold up. We see promise in the use of the thicker high-build materials on the microsurface roadway. The epoxy materials performed well even after two winters.”

—Neal Hawkins,
Director, Center for
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and Education, Iowa State
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Painting long-lasting edge lines and centerlines on challenging, porous asphalt surfaces requires thickly painted stripes or the use of epoxy paint.

were evaluated for striping uniformity and retroreflectivity in October 2013, July 2014 and May 2015.

In spring 2014 researchers learned that the seal-coated pavement surface itself on U.S. 61 had failed due to problems with materials, effectively eliminating this road from the research study. In August 2015, to provide limited data on marking seal coat surfaces, investigators evaluated seven seal coat sites in Eden Prairie, Minnesota, that offered variations in line types and traffic levels.

What Did We Learn?

Results provide a basis for considering striping practices in terms of performance and cost. Generally, high-build layers with latex primers and VISILOK curing additive performed similarly to epoxy-painted markings.

Conclusions for pavement markings placed on Minnesota microsurfaced roadways include:

- Thin latex markings, with and without primer coatings, performed poorly and had to be repainted in 2014, less than one year after installation.
- Epoxy paints in 12 mil layers performed well after two winters, regardless of the use of primer coats.
- Increased paint thickness seems to yield improved performance, particularly in 12 mil versus 25 mil latex striping. At 25 mil thickness, primer improves performance. At thicknesses greater than 25 mil, enough marking material covers surface voids to perform well without primer.
- Given that the thicker high-build markings take longer to cure, VISILOK (drying agent) was used and found to reduce curing time by half (similar to normal application thicknesses).

Eden Prairie seal coat sites showed:

- The practice of striping with latex over seal coats after installation, and following with epoxy the year after, performs well for two and even three years, depending on traffic and winter maintenance needs.
- Increasing traffic levels erode performance in terms of retroreflectivity, but epoxy striping applied a year after installation can perform well for two to three more years.

What’s Next?

A full investigation of pavement marking practices over seal coat surfaces on highway pavements would still be useful to MnDOT because seal coating is the agency’s more widely used surface treatment.

This Technical Summary pertains to Report 2016-08, “Evaluation of Pavement Markings on Challenging Surfaces,” published March 2016. The full report can be accessed at mndot.gov/research/TS/2016/201608.pdf.