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Bituminous Pavement Resurfacing at Snowmobile Crossings

MDOT Studies Asphalt Pavement Coatings

Snowmobiles are a common sight during the winter months throughout Michigan. This snowmobile activity, from both Michigan residents and out-of-state visitors, brings a windfall of recreational spending to the state. Many people in Michigan's rural communities rely heavily on these snowmobilers during the winter months. However, as beneficial as the economic impact is, these high-powered recreational vehicles are starting to draw more negative attention recently. Motorists, road commissions, and Michigan Department of Transportation (MDOT) personnel have been noticing the increased damage to asphalt pavements at snowmobile crossings throughout the state. In an effort to develop a cost-effective solution, technical personnel in the Construction and Technology (C&T) Division of MDOT began investigating the effectiveness of eight commercially-available polymer materials for use as armor coatings on asphalt surfaces at snowmobile crossings. The advantages of these coatings are that they are easy to apply with limited manpower, they set up rapidly, they require short lane closures, and they are relatively inexpensive.

The Problem

It is apparent that asphalt pavements deteriorate quicker in areas where snowmobiles frequently travel, such as crossings, along shoulders, etc. What isn't apparent is whether or not this accelerated deterioration is from typical snowmobile traffic or the use of traction-control devices. These traction-control devices, such as carbide tipped studs on the tracks, and wear bars on the skis, were initially developed for racing applications. Although studies have shown that these traction-control devices do indeed help with acceleration, braking, and cornering on ice, their effectiveness on snow-covered trails is questionable. However, many snowmobile op-

erators are now installing these aftermarket traction-control devices in an effort to increase the performance and handling of their machines. It is estimated that between 60 and 70 percent of the snowmobiles currently being operated have traction-control devices installed.

Regardless of the owner's reasoning for installing the devices, there appears to be a direct correlation between the increased use of traction-control devices and the accelerated wear of asphalt pavements at snowmobile crossings. In fact, these traction control devices appear to be milling away the bituminous surface of the roads at snowmobile trail crossings. (Miller, pg. 1)

If this were an isolated incident, there wouldn't be such a concern. However, in many areas of the state, such as the northern lower and throughout the Upper Peninsula, the relatively high number of crossings, combined with the steady flow of snowmobile traffic, has made the deterioration that much more conspicuous. It is in these areas of the state where a compromise is most needed between accommodating the snowmobilers and maintaining safe road conditions for motorists.

The MDOT Study

During the summer and fall of 1997, various polymer coatings were applied at select snowmobile crossings. A test section located on M-55 near Wellston, MI was the first area to receive the experimental treatments. This location was chosen because of the high amount of snowmobile traffic in the area, and because that section of M-55 had been resurfaced two years prior and was in good condition. Four individual crossings were chosen near Wellston. Each crossing was divided into two test sections, each being a 3.7 m lane and a 0.9 m shoulder wide by 7.3 lineal m in length. (Miller, pg. 1) Eight material manufacturers were chosen to apply their

respective products to a crossing location specified by MDOT personnel. Each manufacturer was required to have a representative present during the installation to ensure that their product was applied according to their specifications. Each test section was thoroughly sandblasted and blown clean with oil-free compressed air. Duct tape was used to establish boundaries for the products.



Figure 1: Typical crossing after installation of test coatings

Methods used during the installation of the coating materials varied from spray-on to broom and seed to trowel applied. In addition, several different aggregate types were used as part of the coating systems. These ranged from silica sand to aluminum oxide to chipped flint, depending on the manufacturer's recommendations. The sprayed-on materials were applied in as many coats as the manufacturer's representative felt necessary. The most common method of application involved applying two coats of material.

After a 24 hour curing period, the first six coating products began to crack around the perimeter. This cracking is most likely due to either stresses resulting from thermal incompatibilities between the coating and the bituminous concrete, or to tensile stresses from shrinkage of the coating materials during curing. The problem was alleviated by sawing 25 mm deep by 3 mm wide channels around the perimeter of the coated sections. These saw cuts were blown out and sealed with silicone sealant to prevent the possible infiltration of incompressibles.

In addition to the test section in Wellston, crossings were coated near Grayling, MI and in the Keweenaw Peninsula near Mohawk, MI, in July and September of 1997, respectively. The crossings near Grayling were located on M-72 and M-93. The product that was used on both of these crossings was the same two-coat prod-

uct as was used at one of crossings in the Wellston area. The product was applied using the same processes mentioned earlier, including saw cutting and sealing the perimeter of the coated area to control cracking.

Each crossing near Mohawk was divided into two separate test areas, in similar fashion as the test crossings in Wellston. This was done because four products were used on these two crossings. The purpose of this test was to again apply some of the same materials that were used in Wellston, but this time they were applied as one-coat systems. The objective was to compare the one-coat versus the two-coat system to see if a correlation could be made between the cost of the two methods, their effective performance, and their anticipated service life. (Miller, pg. 5)

In September 1997, tests to determine the friction resistance of each material were conducted on each coating in the Wellston area. Furthermore, each material was evaluated shortly after installation, with subsequent inspections in December, the following spring, and again in the fall. This inspection schedule will continue for a period of five years. Friction testing will also be conducted once per year during this five year period.

Snowmobile Counters

In order to quantify the performance of the various coatings at all of the test locations, MDOT personnel had to develop and install snowmobile traffic counters at selected crossings near the Wellston area and at the Mohawk crossings. The counters consisted of infrared sensors located next to the trail near the crossings.

MDOT Conclusions

Based on the first two years of service, several conclusions have been made regarding the installation and performance of the various surface coatings.

Going into this project, a three-year life expectancy for these coatings was anticipated. After reviewing the performance of the coatings, it is now likely that a five to eight year life span can be expected in areas such as Wellston that get light midweek sled traffic and heavy weekend traffic. In areas such as the Keweenaw Peninsula, which get very high sled numbers throughout the week, it is anticipated that a three to five year life of the crossing coatings is expected. These assumptions are based on two-coat systems.

The one-coat systems at the crossings in the Keweenaw Peninsula are showing a significant amount of wear. Comparatively, the two coat systems in Wellston are showing little to no deterioration. It is believed that the wear in the Keweenaw is due to a combination of snowplow damage and the considerable snowmobile traffic.

In addition, the southernmost Mohawk crossing is located at a junction where the road surface changes from concrete to asphalt, and there is a considerable dip in road from an old railroad crossing that had been previously removed. This dip appears to be contributing greatly to the snowplow damage and resultant wear to the coatings.

During the installation of the test materials, a number of important observations were made that will help ensure a better performing coating system in the future. As mentioned earlier, it is vital that relief cuts are sawed at the leading and trailing edges of the coating, and that these cuts must be cleaned and sealed with a silicone sealant to prevent intrusion of incompressible materials (please refer to Figure 2). Furthermore, the liquid binder must be allowed to run off of the edge of the pavement onto the gravel surface to protect the exposed edge of the pavement.

Other issues that will have to be addressed include pavement condition prior to coating, qualification of new coating materials, and edge treatments for the coated areas to minimize plow damage. As experienced at the southern crossing at the Mohawk test location, it is important that the pavement is in relatively good condition prior to installing the coating system, with no appreciable humps, dips, or other variations in the surface.

The KRC Study

In addition to the field study mentioned earlier, MDOT also funded a study conducted by the Keweenaw Research Center (KRC) at Michigan Technological University. The KRC studied the suitability of using the epoxy-like coatings as a protective measure against the wear created by traction control devices. This was accomplished by studying four of the commercially available, polymer coatings that were being studied by MDOT in numerous controlled laboratory and field tests. The KRC studied numerous characteristics of the materials, including bond strength, flexibility, material strength in tension and compression tests, shear strength, wear resistance, expansion and shrinkage, and setup time. The results from these tests are a good indication of the materials' overall performance. In addition to the testing mentioned above, the KRC also studied how well the various coatings bond to different materials, how fast these coatings set up without jeopardizing performance, and how they are affected by various traction-control devices. By reviewing the results of all these criteria, the best combination of performance, longevity, cost, and reduced lane closure time can be determined.

Field Testing

Due to the relatively close proximity of the KRC to the Mohawk test locations, these crossings were regularly monitored throughout the course of the last two winters. In addition to monitoring these crossings, several different controlled field tests were performed on samples us-



Figure 2: Leading edge of crossing near Wellston damaged by combination of snow plow traffic and lack of relief cut

ing studded snowmobiles at the KRC. The first test involved coating a 4 ft. x 8 ft. sheet of plywood with epoxy and the same aggregate as was used at Mohawk. This test was designed to assess the wear of both studs and wear bars under controlled conditions. 200 passes were made over this sample in intervals of 50. Wear was monitored after each 50 passes. The snowmobile was kept at a constant speed of 32 km per hour for this test. After 200 passes, it became apparent that only slight scratching and some small stud marks were visible in the coating surface. This indicates that the aggregate surface topping is quite durable. (Alger, pg. 13)

After the constant speed tests were performed, a test of damage caused by "spinning" the track on the coating sample was performed. The first attempt to perform this test resulted in an interesting finding. The aggregate-covered epoxy is rough and strong enough to make it difficult to spin a track on it. The studs grab the surface tight enough to limit slip considerably. Since previous studies have shown that spinning tracks cause the majority of the damage to the road surface, this is an important finding. Further testing of spin was conducted by holding the snowmobile in place and spinning the track. Wear in this case was minimal and was considerably less than similar tests have shown on non-coated pavements. (Alger, pg. 13)

The KRC also performed another test using a 4 ft. x 8 ft. sheet of plywood. In this test, the four different coatings were applied in four rows consisting of three square test sections (please refer to Figure 3). The thickness of the epoxy was approximately 3.2 mm. The test snowmobile was run over these test sections and the wear to each was monitored. The four samples along the right-hand side of the plywood in Figure 3 were coated with aggregate, while the samples along the center and left-hand sides consisted of the epoxy coating only. The samples on the right and left edges lined up with the carbide runners on the skis, while the samples along the center aligned with the snowmobile track which contained the carbide studs. This configuration allowed the KRC to directly compare the performance of the four samples with and without aggregate. The four samples that contained aggregate performed the best, showing minute scratches after passage, but for all practical purposes, showing no wear.

Laboratory Testing

In addition to the field testing, the KRC also performed numerous laboratory tests to help identify various material properties that can show indications of overall material performance. These properties included bond strength, flexibility, material strength in tension and compression tests, shear strength, wear resistance, slip-resistance (with aggregate), expansion and shrinkage, and setup time.

Future

Although MDOT is still investigating the best course of action regarding snowmobile crossings, the use of polymer materials as armor coatings appears promising. MDOT will continue to monitor the test sections for the next three years. Based on the performance of the various materials, MDOT personnel anticipate developing a Qualified Products List in the near future.

For additional information regarding this study, including specifics about the actual polymer materials used in the study, contact Tom Miller, MDOT C&T Division at (517) 322-1070, or via email at millerth@mdot.state.mi.us. For specifics regarding the study conducted by the KRC, contact Russ Alger, KRC, Michigan Technological University at (906) 487-2498, or via email at rgalger@mtu.edu.

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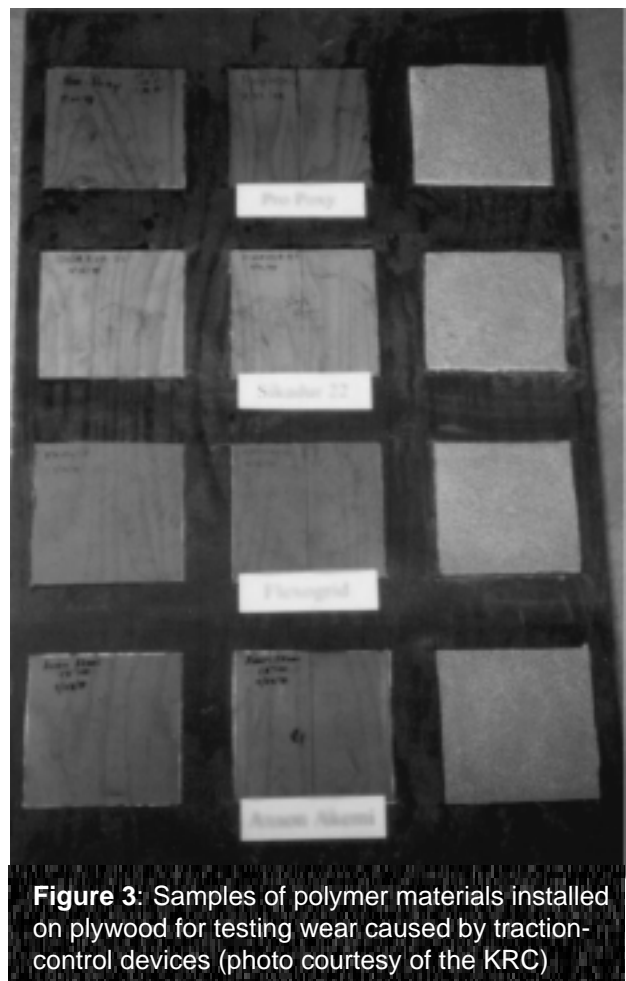


Figure 3: Samples of polymer materials installed on plywood for testing wear caused by traction-control devices (photo courtesy of the KRC)

Reference Material

Bituminous Pavement Resurfacing at Snowmobile Crossings - First Year Review
Report Number: R-1359
Thomas Miller
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March 1998.

Research of Elastomeric Concretes For Surface Patching of Pavements At Snowmobile Trail Road Crossings
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