It's in There

Epoxy overlay system for bridges utilizes unique aggregate that stores anti-icing chemicals.

By Russ Alger and Joel Kunnari

At the request of the Indiana Department of Transportation (INDOT), Rieth-Riley Construction Company and the Keweenaw Research Center (KRC) of Michigan Tech University conducted an overlay research test on a bridge in South Bend, IN, in 2005. The material to be tested was a patented thin epoxy overlay system that uses aggregate which stores anti-icing chemicals and then releases them as conditions develop for the formation of frost or ice.

The Ironwood Bridge was selected as the test site since it has an extensive history of weather-related crashes in both east and west directions. The goal of the project was to evaluate if the overlay could reduce weather-related traffic accidents. The finished project overlay is 30 ft by 393 ft and was installed in three, 10-ft by 393-ft strips in a single coat application. Installation began on May 16, 2005 and was completed on May 21, 2005.

Ironwood Bridge is located on Eastbound US 20 and is an overpass deck over Ironwood Road/Drive. The bridge is a continuous composite welded plate girder with a portland cement concrete deck. The roadway and approaches in both directions are likewise portland cement concrete. The bridge has three spans of 97 ft, 194 ft, and 97 ft. The roadway includes a 45-ft, 5-in. opening in each direction that includes two travel lanes at 12 ft each, an inside shoulder at 11 ft, 5 1/2 in., and an outside shoulder at 10 ft. Traffic is separated by concrete barriers 2 ft, 9 in. high. Precast concrete noise barrier walls about 30 ft tall are situated adjacent to the shoulders of both rights-of-way and extend along all four ramps.

The surface overlay system consisted of an epoxy...

US 20 is a four-lane divided, limited access freeway with a 65-mph speed limit. It is a bypass around the cities of South Bend, Mishawaka, and Elkhart. ADT is approximately 28,800 vehicles per day (1996 count) with about ten percent commercial vehicles. The location is in the heart of Indiana's snowbelt with lake effect snowfall averaging about 83 in. per season. The primary snow season extends from late October through March and the frost season from mid-October through April. There are typically 50 days per season that the local maintenance unit will treat the section with deicing chemicals.

Installation

INDOT decided to place SafeLane™ Surface Overlay (Cargill, Inc., www.cargillsafelane.com) on the eastbound bridge deck lanes and leave the westbound lanes untreated, or in their natural tined state. The overlay installation was completed in May 2005. Overall, the pilot installation went well. This overlay was installed using the single pass method by which the entire amount of epoxy and stone is applied in one layer, one batch at a time. There were some imperfections in the finished surface caused by the installation procedure that was used at the time. These imperfections were small elevation differences (seams or ripples) that were transverse to traffic flow and located at the start and end of each epoxy batch. These resulted in a less than perfect ride quality that was considered at the time rough but acceptable due to the experimental nature of the job. After the epoxy cured and the surface was swept of loose aggregate, a rotary diamond grinder was used to minimize the effect of the ripples upon ride quality. The new installation procedure is a two-pass method, which eliminates these effects.

...that was squeeged into place...

A portion of pavement was shot-blasted using coarse shot and another portion was blasted with fine shot. This technique changed the surface texture of the overlay on these strips, but observations during winter snow events show that there is no difference in the performance of the overlay when comparing these two topical treatments to plain grinding.

Results, Costs, and Benefits

KRC personnel made four site visits to the bridge during the contract period. These trips consisted of inspections of the surface, meetings with INDOT personnel to discuss data acquisition on the site, and attempts to monitor a precipitation event. Since the 2005-2006 winter in South Bend resulted in only a handful of short storms, none of the trips overlapped storm events. Friction measurements were performed by INDOT on the overlay and the uncoated westbound bridge over Ironwood Road in July 2005. The friction was much higher on the coated deck than the uncoated parallel bridge deck. Additional friction tests were completed in spring 2006.

The total cost for the installation in South Bend was $128,805. This cost was derived by using an installation and materials cost of $9 per sq ft of overlay on a total project size of 11,790 sq ft or $106,110 for the installation portion of the project. The remaining $22,695 covered follow up site visits and report writing costs.

The benefits of this system have been seen in a number of ways including:

- No accidents occurring on the test section at the same time accidents were occurring on the control section.
- Less frequency of chemical treatment.
- Easy removal of heavy accumulation without bonding or crusting.
- Increased all-weather friction.
- Effective in year-round weather condition—minimizes back-splash and hydroplaning.

Conclusions

Since the placement of the overlay on the eastbound deck lanes there have been no weather-related crashes, while the uncoated westbound lanes experienced three crashes during the winter of 2005-2006. Detailed records maintained by INDOT clearly note that crashes occurring on the tined (westbound) deck directly correlated with snow and ice accumulation while the SafeLane (eastbound) deck remained free of snow and ice.

Department maintenance personnel have also noted that on the SafeLane section heavy accumulating snow could be easily removed by plowing, alleviat-

...and then covered with stone...

...after which excess aggregate was removed by sweeping.

ing reconsolidation and dangerous hard pack conditions. Furthermore, department field records suggest that significant savings in labor and de-icing material might be realized since the SafeLane surface stores and automatically releases de-icing chemical, needing less re-application.

Friction measurements made on the treated surface almost one year after installation show that they are almost two times the levels that were measured on the adjacent westbound tined pavement. This benefit alone will improve safety year round in all weather conditions.

Overlay Update

The South Bend installation was the first commercial SafeLane overlay installation and was considered experimental in all areas—materials, methods, and post-installation maintenance and performance. Since the installation in South Bend in May 2005, the technology has continued to evolve. This has led to improvements in the finished overlay, installation methods, and materials.

AGGREGATE. The aggregate used in the overlay system has been improved to meet quality and durability properties while still having the ability to maintain the long term residual chemical effect required.

INSTALLATION. The South Bend Overlay was installed using a single-pass method. During that installation and other subsequent jobs it was found that it is extremely difficult to keep a uniform and consistent finished surface using this method. The unevenness of the overlay that is present in the South Bend overlay, for instance, was solely a result of the one pass installation method used at the time. The specific reason for the unevenness was due to the starting and stopping of the epoxy/aggregate spreader in between spreading batches and the fact that the thickness of the epoxy at the squeegee interface could not be easily controlled while the machine was not in motion. This as well as other problems that occurred on subsequent jobs led to the two pass method, which is the widely accepted method for installing other polymer type overlays. Initially it was believed that the two pass method would cause the aggregate on the surface of the road to be coated with epoxy, nullifying the anti-icing capabilities of the stone with liquid chemicals. However, the method has since proven that it does not seal the aggregate on the surface and leads to a surface that reflects the original contour of the road surface.

Overlay Benefits

The benefits of the SafeLane Overlay technology have been observed at the various evaluation sites over the past couple of years.

- There were no weather-related accidents reported at any of the nine test sections in place during the 2005-2006 winter season. In some cases accidents, occurred on adjacent control sections not treated with the overlay.

During the winter of 2006-2007, dramatic accident reduction was again reported among the 26 road and bridge test sites for which performance data was available.

- Less ice and snow means traffic continues to flow normally over treated sections during treacherous weather conditions.
- The overlay minimizes the penetration of damaging chlorides into a structure and subsequent corrosion of steel reinforcement. The epoxy binder also prevents water from penetrating and minimizes pavement degradation due to freeze thaw cycles. Ultimately these two benefits are expected to lead to longer life cycles of both pavements and infrastructure.
- INDOT reported up to 50 percent less chemical pre-treatment in their first winter.
- Easy removal of heavy snow accumulation without bonding or crusting.
- Increased friction in all weather events. The overlay also works to improve friction in rain events.
- Minimize back-splash and hydroplaning.

INDOT undertook the first major installation of SafeLane overlay and is now one of many across the country in different environments. To date, these overlays have been installed at 32 road and bridge sites in 15 states with that number expected to grow by at least 50 percent this summer. GE

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