

VERMONT AGENCY OF TRANSPORTATION

Materials & Research Section
Research Report



CARGILL SAFELANE® HDX OVERLAY

Report 2014 – 04

April 2014

**Cargill SafeLane® HDX Overlay
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Reporting on Work Plan 2006-R-04

STATE OF VERMONT
AGENCY OF TRANSPORTATION

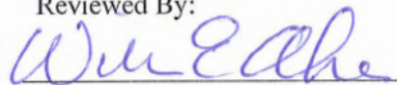
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16. Abstract <p>The vast topography paired with the unpredictability of climatic conditions statewide, result in many high traffic incident locations on Vermont highways. Such locations may also be difficult to maintain during winter conditions, which only compounds the unsafe travelling conditions for motorists.</p> <p>One specific site located along Vermont Route 9 in Searsburg, Vermont has recently begun exhibiting increased safety and maintenance problems in the westbound lanes during inclement weather. The Vermont Agency of Transportation (VTrans) chose to apply an anti-icing overlay produced by Cargill, known as Cargill SafeLane® HDX Overlay. The treatment was installed by District 1 maintenance forces in the summer of 2007. Research personnel were onsite to document the two-day installation. During the second day installation, it was noted that water seepage on the steep grade was evident in the travel lane. This later arose as a delamination problem over the length of the overlay system.</p> <p>Though delamination issues were noted at preexisting cracks, over the course of the evaluation, the treatment provided traction for vehicles especially multi-axle trucks. Considering this factor alone, the treatment was deemed successful. Due to this success, it was placed in two other locations in the northwest region of Vermont. The first application was on a bridge deck where frequent and sudden braking had caused many rear end collisions. The second application was on a downhill lane of a city road, noted to be a high crash location as vehicles were having a difficult time stopping at the traffic signal at the bottom of the hill. Both provided significantly different situations, with a similarly resulting maintenance and safety problems as experienced in the Searsburg location.</p>					
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ABSTRACT

The vast topography paired with the unpredictability of climatic conditions statewide, result in many high traffic incident locations on Vermont highways. Such locations may also be difficult to maintain during winter conditions, which only compounds the unsafe travelling conditions for motorists.

One specific site located along Vermont Route 9 in Searsburg, Vermont has recently begun exhibiting increased safety and maintenance problems in the westbound lanes during inclement weather. The Vermont Agency of Transportation (VTTrans) chose to apply an anti-icing overlay produced by Cargill, known as Cargill SafeLane[®] HDX Overlay. The treatment was installed by District 1 maintenance forces in the summer of 2007. Research personnel were onsite to document the two-day installation. During the second day installation, it was noted that water seepage on the steep grade was evident in the travel lane. This later arose as a delamination problem over the length of the overlay system.

Though delamination issues were noted at preexisting cracks, over the course of the evaluation, the treatment provided traction for vehicles especially multi-axle trucks. Considering this factor alone, the treatment was deemed successful. Due to this success, it was placed in two other locations in the northwest region of Vermont. The first application was on a bridge deck where frequent and sudden braking had caused many rear end collisions. The second application was on a downhill lane of a city road, noted to be a high crash location as vehicles were having a difficult time stopping at the traffic signal at the bottom of the hill. Both provided significantly different situations, with a similarly resulting maintenance and safety problems as experienced in the Searsburg location.

INTRODUCTION

The weather in the state of Vermont is highly variable with a large range of daily and annual temperatures. Wintertime temperatures fluctuate within a day by an average temperature range of approximately 20°F. In addition to fluctuating ambient temperatures, Vermont receives an average annual snowfall amount of about 100 inches. These weather conditions paired with the unique statewide topography impacts the safety of the transportation system. In order to address this safety hazard, the Vermont Agency of Transportation applies road salt, salt brine, and sand to combat the formation and build-up of ice and snow or to increase friction. While these have proven to be effective treatments, they often require constant attention, especially in high vehicle incident locations.

The purpose of this study was to evaluate an experimental roadway treatment manufactured by Cargill known as SafeLane[®] HDX Overlay. The product is an anti-icing pavement overlay system. This system, comprised of polymer epoxy and aggregate, is intended to eliminate ice and frost formation on the riding surface. When applied to the surface of a bridge deck, it is also quoted to provide a barrier to water and chloride intrusion into the concrete deck. (1)

Several locations were reviewed including roadway and bridge deck locations across Vermont. VTrans along with product representatives decided to place the overlay at along VT Route 9 in the town of Searsburg, VT. This location was chosen because of the historically poor traction conditions on the incline in both the travel and passing lanes, especially for multi-axle trucks. During any given accumulation of snow, Agency maintenance forces in District 1 noted numerous incidents involving vehicles not being able to climb the 13.5% grade slope. The selected stretch of highway exhibited difficult travel conditions over approximately 400 feet of roadway and carried significant related costs and maintenance concerns. Cargill placed the SafeLane[®] HDX Overlay in both passing and travel lanes in 2007. Since applied, the treatment has been used at two other locations in Vermont. The installations at all locations were observed by Research personnel. The periodic evaluations of these locations are summarized in this report.

PROJECT LOCATION AND SUMMARY

The experimental feature was applied to the existing roadway surface within the westbound lanes of VT route 9 in the Town of Searsburg at approximately MM 2.660. The section of roadway is very steep and travels uphill at a 13.5% grade at a distance of 373' and a width of 22.5' for a total of 8392.5 ft². The section is part of a segment with an estimated Annual Average Daily Traffic (AADT) of 4300. Of the vehicles, a 50.04 percent are traveling in

the WB lane and 12 % of those vehicles are medium to heavy trucks shown in Figures 1 and 2 below.

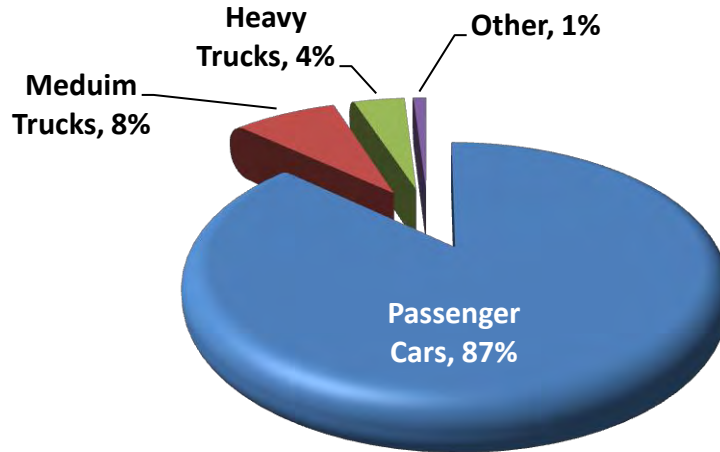


Figure 1 Percent of vehicle types traveling in the west bound lane.

The existing pavement was completed by State Maintenance Activity SMA0111 in 2001. The repair included a thin 1" overlay from mm 1.81 to mm 3.34 in Searsburg. Due to the type of project and the nature of the thin treatment, no plans were drawn up. This rehabilitation was needed due to poor performance of project F 010-1(32) constructed in 1994 from MM 8.686 in Woodford to MM 3.531 in Searsburg. This project contained an 8" reclaimed stabilized base with a 1¾" type II bituminous concrete pavement with a ¾" nominal aggregate size and a 1½" type III bituminous concrete pavement wearing coarse with a ½" nominal aggregate size. Since the work in 2001, the road has been crack sealed in 2003.

The location was inspected by Cargill and VTrans representatives prior to applying the SafeLane® HDX Overlay to ensure that the location was ideal for the treatment. This location has a high rate of wintertime accidents and incidents as reported by District Personnel and local police enforcement. According to the Shaftsbury Police, six crashes and eight motor vehicle complaints have been reported over the winter from November 2006 to February 2007. The Shaftsbury Police noted that most of the issues emanate from heavy trucks becoming stuck at the base of the steep incline, which, in turn, causes additional traffic problems. 7 crashes and 22 complaints have been reported in 2005 and 2006. Out of the 22 complaints, 20 were reported

from November of 2005 through February of 2006. Additionally, District personnel provided additional commentary concerning numerous crash events during a single snowstorm event and the need for constant reapplication of deicing chemicals. It is common for local and state officials to close off this roadway section for periods while addressing vehicular incidents.

MATERIAL DESCRIPTION

According to the manufacturer, SafeLane[®] HDX Overlay was developed at Michigan Technological University and is licensed and marketed by Cargill based in Wayzata, Minnesota. It is a patented two component pavement overlay system that reduces ice or frost formation on its surface while protecting infrastructure from corrosion and chloride intrusion. (1) The two part system is composed of a limestone aggregate and modified Type III, two-part polymer epoxy system meeting the requirements of ASTM-C-881, Grade 1, Classes B & C. (1) The SMARTBOND[™] epoxy system is manufactured by Unitex and is quoted to have excellent, high early bond strength. (2) In accordance with the manufacturer's instructions, the overlay is to be a minimum of 3/8" thick with an in place weight of approximately 4 pounds per square foot. Proper installation should result in a minimum adhesive strength of 250 pounds per square inch 24 hours following application. (1)

INSTALLATION

Construction of the Cargill Safelane Overlay began on July 10, 2007. In accordance with the Experimental Features Work Plan, WP-2006-R-4, the experimental SafeLane[®] HDX Overlay was placed in the westbound lanes on VT Route 9 for a distance of 273 feet. Each lane was prepared and treated individually starting with the passing lane. All labor was provided by District 1 Maintenance forces. The installation was supervised by a Cargill representative.

Preparation included sandblasting the pavement with a medium sand to remove oils and pavement markings to provide proper adhesion between the epoxy and the roadway surface shown in Figure 2 below. Prior to this, high-pressure water blasting and high-pressure water blasting with sand proved to be ineffective. The use of powered air blowers to remove the sand was insufficient due to the capacity, so it was swept off using a sweeper.

On the following day, the remaining particles were blown off with an air compressor shown in Figure 3 below. Upon completion of the cleaning process, duct tape was used to delineate the area of application.

The mixing of the two-part epoxy was the next step in the process. The two parts of the epoxy were individually poured into 5-gallon buckets as shown in Figure 4 below. The two parts

were then poured into a larger container in a 1 to 1 volumetric ratio and mixed using a large paddle mixer for approximately 3 minutes shown in Figure 5. Due to unfamiliarity with the product, the representative from the manufacturer had the workers start with a small load size of about 3.7 gallons.



Figure 2 Sand Blasting



Figure 3 Air Compressor



Figure 4 Part A and Part B



Figure 5 Mixing the Epoxy

Once properly mixed, the epoxy was immediately poured onto the road surface beginning at the top of the test section where it was spread uniformly with grooved V-notched squeegees shown in Figure 6. The aggregate was then spread over the epoxy layer using shovels shown in Figure 7. An approximate length of 1 foot of epoxy was left uncovered at the end of each pour so the pour that directly followed could form a smooth joint. The duct tape was removed before the epoxy completely cured at about 15 to 20 minutes after application.



Figure 6 Spreading Epoxy



Figure 7 Spreading limestone

After the workers were familiar with the process, batches of 4.7 and 9.4 gallons of epoxy were used in the application, which sped up the process. After completion of the first course, an hour was allotted for the epoxy to cure to ensure proper compatibility for the second course. The pour of the first layer started at 9:11 AM and the section was finished at 10:57 AM. It is important to note that epoxy-curing times are dependent on the average temperature of the pavement and ambient temperatures.

In preparation for the second lift, the area was swept twice with the mechanical sweeper, blown with leaf blowers and the air compressor to rid of any excess aggregate. It was once again delineated with duct tape. The section edges were taped again over the edge of the first lift to create a space to form a level joint between the adjacent lanes. This was important to provide for a smoother transition upon entering the overlay from the non-treated roadway for all roadway users. To ensure the overlay area was uniform in thickness, larger epoxy mixtures were used to ensure that the entire surface was coated with the two-part mixture. The batches applied were between 9.7 and 18.4 gallons. The epoxy was spread using flat-bladed squeegees as shown in figure 8. Once consistency was evident, the aggregate was spread over the epoxy. After the crew completed the second layer and allowed it to cure, it was once again swept and blown with an air compressor to rid the surface of any excess aggregate. On the final day of installation, the same process was used for the travel lane except that duct tape was only used to delineate the upper and lower widths of the section, not along its length on either side. The completed surface is shown in Figure 9. The completed surface texture is shown in Figure 10, and the texture after a year of service is shown in Figure 10.



Figure 8 Placement of the second lift.



Figure 9 Completed overlay

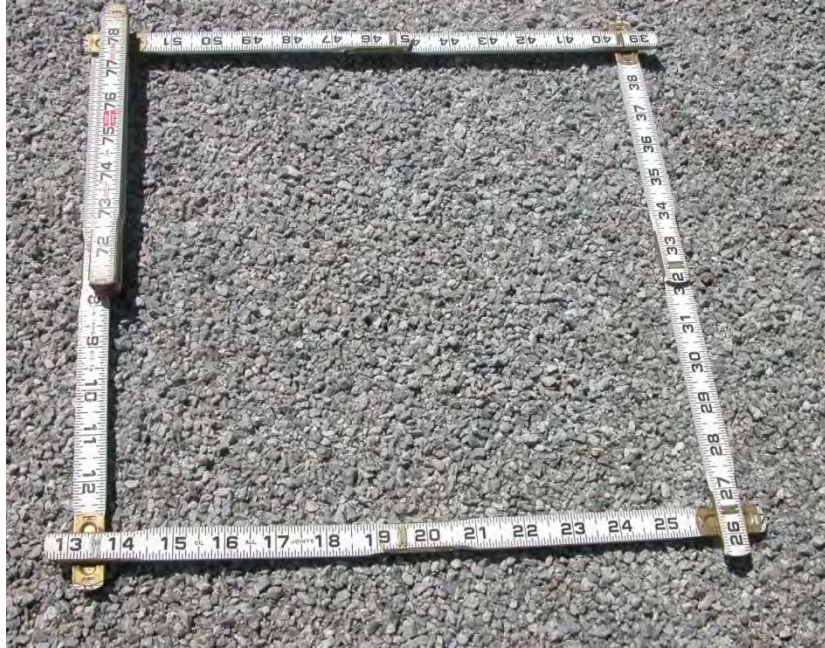


Figure 10 Surface Texture of the SafeLane® HDX Overlay



Figure 11 The texture of the SafeLane overlay after a year of service.

An overview of the project was provided by the Cargill Representative providing valuable information such as application rates, material usage and cure times. The average overall application rate for the project was 0.102 gallons per square foot. The first lift averaged an application rate of about 0.026 g/sf and the second lift averaged an application rate of 0.077 g/sf. These were the average of both lanes. All of these values met the specifications provided by the manufacturer. For the first lift on the westbound passing lane, 119.6 gallons of epoxy and roughly 3.4 bags at 2,500 lbs each were used. Information on the amount of material used was only provided for the first lift of the passing lane. Cure times averaged roughly 10+ minutes throughout the duration of the project.

The weather on the first day of installation was cloudy and humid with temperatures ranging from 70°F to 80°F. During late hours of the project, a rainstorm passed over the section of roadway. This created seepage along the centerline joint leaving water markings in the driving lane. The final day of the project was sunny and humid with an average temperature at about 65°F to 70°F. On the final day, the sun heated the pavement to almost 100°F, decreasing cure times.

PERFORMANCE AND OBSERVATIONS

Cracking, rutting and IRI, or the International Roughness Index values of the original roadway was used to correlate data for examination. A 100' test section was established within the area of application before installation to document average cracking and to collect rut depths using a handheld rut gauge. The test site was chosen to represent the most typical area and was located 124' downhill from the beginning of the overlay. Most of the distress was located in the right wheel path of the travel lane. VTrans' Pavement Management Unit collected rut depths and IRI measurements along the 300 ft section using a road profiler on a biennial basis. All pavement distress data is summarized below.

2007/2008 Winter Season

In the first winter of the application of the overlay, the maintenance district applied a liquid de-icer, calcium chloride (CaCl₂) to the surface following each storm for preparation for the next storm. The plowing and salting activities by the district remained under normal operating procedures. While snow had accumulated on the anti-icing overlay in the westbound lanes, greater amounts of snow accumulated on the untreated eastbound lane. The district reported that the overlay provided an increased traction during the winter season. All documented incidents where heavy trucks were not able to climb the grade were reported to have occurred at the base of the incline prior to where the anti-icing overlay treatment was applied.

Trucks that managed to reach the overlay treatment were able to reach the top of the grade. In the same season, no reported highway incidents or crashes were reported.

Cracking

There are several causations for cracking in flexible pavements, including inadequate structural support such as the loss of base, subbase or subgrade support, an increase in loading, inadequate design, poor construction, atypical environmental conditions or poor choice of materials. For this analysis, longitudinal and transverse cracking was examined. Longitudinal cracks run parallel to the laydown direction and are usually a type of fatigue or load associated failure. Transverse cracks run perpendicular to the pavement’s centerline and are usually a type of critical-temperature failure or thermal fatigue that may be induced by multiple freeze-thaw cycles.

Table 1 Cracking Summary.

Year	Transverse	Fatigue	Longitudinal	Reflective	Total	Pop-outs
Pre-application - 2007	31	113	261	0	292	N/A
2008	24	111	543	0	567	14
2009	24	152	556	0	580	28

Prior to the application most cracking was located in the right wheel path (RWP) of the travel lane presumably due to a slight turn effecting weight distribution of traveling vehicles resulting in load failures in the pavement. Transverse cracking was the only type of cracks noticed in the passing lane although there were abrasions evident possibly from heavy trucks using chains on their tires in winter months. All cracks along the section were previously filled with a crack fill material, which according to the manufacturer would not adhere to the epoxy. District personnel chose to leave the crack fill in place prior to applying the overlay. After installation, cracking was evident within the 100 ft test section.

None of the cracks appeared to reflective cracks. Reflective cracks are those in the newly applied surface layer that permeate from preexisting cracks in the underlying layers. Most of the cracking was longitudinal in nature. The overlay is not a structural overlay and was not expected to prevent new cracking, however if underlying cracks are propagating through the overlay it may cause the overlay to break apart and deteriorate at an increased timeframe than expected.

Rutting

Rutting is generally caused by permanent deformation within any of the pavement’s layers or subgrade and is usually caused by consolidation or lateral movement of the materials

due to traffic loading. Throughout the duration of the investigation rut depths were quantified using two methods summarized below.

Rut Gauge Method

A rut gauge was utilized to quantify the overall depth of rut within the 100’ test section. Depth measurements were collected at 50’ foot intervals from the beginning to the end of the test section. The method requires extending a string across the width of the road and measuring the vertical distance between the string and the deepest depression within all wheel paths identified along the length of the string. All measurements were recorded on standard field forms to a 1/8th of an inch accuracy. It is important to note that this procedure is highly subjective due to the nature of the data collection procedure. Table 2 displays the rut data that was collected prior to application and the two following years. Data show significant deformation within the RWP of the travel lane, further supporting presumptions made in the cracking section of this report.

Truck Profiler Method

Because the truck profiler is calibrated and is an objective data-collection device, which integrates measurement over distance, the data collected for both rutting and IRI should be regarded as more representative than the handheld rut gauge method. The average rut depths recorded with the profiler are summarized in Table 3. Although considered more accurate, the trends are the same. The right wheel path both before and after the overlay was installed was experiencing much more deficiencies than the rest of the area.

Table 2 Average Rut Depths – Measured using the rut gauge (inches.)

Location	Passing Lane		Travel Lane	
	LWP	RWP	LWP	RWP
Pre-application - 2007				
0 + 00	0.000	0.000	0.125	0.625
0 + 50	0.000	0.000	0.125	0.750
0 + 100	0.000	0.000	0.125	0.500
Average	0.000	0.000	0.125	0.625
2008				
0 + 00	0.000	0.000	0.000	0.000
0 + 50	0.000	0.000	0.000	0.000
0 + 100	0.000	0.000	0.625	0.250
Average	0.000	0.000	0.208	0.083
2009				
0 + 00	0.000	0.000	0.125	0.250
0 + 50	0.000	0.000	0.250	0.250
0 + 100	0.625	0.000	0.250	0.000
Average	0.208	0.000	0.208	0.167

Table 3 Average Rut Depths – Measured using the truck profiler (inches.)

Year	Passing Lane		Travel Lane	
	LWP	RWP	LWP	RWP
Pre-application - 2007	0.02	0.024	0.087	0.362
2009	0.047	0.020	0.091	0.413

IRI

International Roughness Index (IRI,) is utilized to characterize the longitudinal profile within the wheel paths and constitutes a standardized measurement of smoothness. According to Better Roads Magazine, “Pavement’s IRI in inches per miles, measure the cumulative movement of the suspension of the quarter-car system divided by the traveled distance. This simulates ride smoothness at 50 miles per hour.” (3) IRI values are directly correlated to pavement distresses. The Federal Highway Administration (FHWA) has published a conditional rating scale of a roadway segment based upon IRI results shown in Table 4. It should be noted that the scale is based on average IRI values collected over a much larger span of road. The values still provide a rating that can be applied to the treated section. (4)

Table 5 depicts the average roughness as described by the IRI values for both the passing and travel lanes of the treated 300 ft section of overlay area in the westbound direction. The eastbound travel lane was included as well. The eastbound lane was used as to gather baseline numbers for the IRI values collected. Prior to placing the overlay the RWP in both directions fell within the mediocre range on the FHWA scale and the LWP was considered to be fair across the board. Due to several “pop-out” delaminations described in the next section, the IRI values in 2009, two years after application were much higher than pre-application. The IRI in the RWP where a good portion of the pop-outs were documented was 390 on average.

Table 4 FHWA IRI Pavement Condition Scale.

Condition Categories	Interstate	Other
Very Good	<60	<60
Good	60-94	60-94
Fair	95-119	95-170
Mediocre	120-170	171-220
Poor	>170	>220

Additional Observations

On the second day of the installation, water seepage along the centerline joint was noted in the travel lane and was attributed to the heavy rainstorms the night before. Table 6 summarizes the water seepage locations. The water seeped through the first lift of the overlay as can be seen in Figures 10 and 11 below.

Table 5 Average IRI values collected with the truck profiler.

Year	WB Passing Lane		WB Travel Lane		EBTravel Lane	
	LWP	RWP	LWP	RWP	LWP	RWP
Pre-application - 2007	151	171	163	209	131	219
2009	200	168	191	390	151	169

Approximately four months following installation, these areas began exhibiting distress in the form of “pop-outs” where presumably the hydrostatic pressure of the groundwater within the steep incline caused the portions of the treated area to essentially lift from the layers below resulting in “pop-out” or pothole areas. In most cases, these uplifted areas were not merely the overlay but portions of the underlying pavement as well. These areas are summarized in Table 7. Some of the pop-out or pothole areas are near the water seepage locations noted during the application. Figure 12 shows one of the potholes. As such, many pop-outs were failures of the underlying pavement and not the overly itself.

Table 6 Water seepage locations.

Location	Distance from top of hill (ft)	Location	Distance from top of hill (ft)
1	29	6	118.5
2	39.4	7	138.6
3	74.2	8	145.8
4	102.5	9	148.8
5	110.5		



Figure 12: Water leaking from the centerline joint

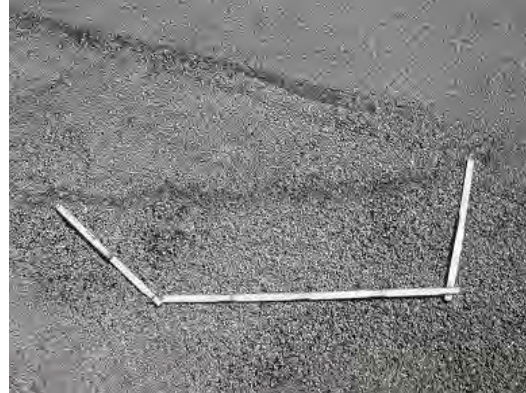


Figure 13: Water seeping through 1st lift of overlay



Figure 14 An example of a pothole. The underlying pavement was lifted out with the overlay.

Table 7: “Pop-out” or pothole locations.

#	Distance from top of hill (feet)	Length (feet)	Width (inches)
1	26'	3	14
2	102'	4	12
3	109'	3	10
4	118'	5 to 6	13
5	147'	1	12
6	153'	4	12
7	191'	2	15
8	194'	2.5	12
9	200'	6	17
10	208'	37	Varies
11	248'	2	8
12	255'	3	14
13	260'	3.5	15
14	267'	8	15

ADDITIONAL INSTALLATION SITES

SafeLane[®] HDX Overlay was installed in two additional locations in Vermont:

- North Prospect Street in Burlington, Vermont
- Bridge #7 in Jericho, Vermont.

Both applications were placed the first week of August 2008. Cargill technical representatives were onsite for both applications. Pre-existing site conditions and general observations are summarized below.

North Prospect Street in Burlington, Vermont

This location was a joint project with VTrans Highway Safety and Design Section and the City of Burlington. VTrans provided the city with \$31,500 through the Strategic Highway Improvement Program (SHIP) to place the overlay on the downhill lane of North Prospect Street in Burlington. The total project cost was \$32,613.10. Because the city was only allowed \$31,500 from VTrans, the city incurred the additional cost of the project. This site was selected to improve traction and reduce the number of crashes at the bottom of the hill where North Prospect Street intersects with US Route 7. Parent Construction was the contractor chosen to

apply the overlay. The first day involved milling the existing pavement to ensure the overlay would be flush with the surrounding pavement after completion. In the night after the milling process, a passing truck leaked oil onto the milled surface. As a result, the surface required shot blasting to ensure that the surface was clean in preparation of applying the overlay. Though the surface was properly prepared for the application of the material, the supplemental blasting left a ripple pattern on the surface of the overlay. Although the finish was not smooth and flat, the overlay was noted as being in good condition after placement. The site was visited periodically over the next 4 years. A considerable amount of cracking was noted in the last visit in March of 2012. No crashes or incidents have been reported between placement and the summer of 2012.



Figure 15 Overlay after application in 2008



Figure 16 Application in 2013

Bridge #7 in Jericho, Vermont

This project included placing the overlay on Bridge #7 along VT Route 15 in Jericho, VT and was initiated by District 5 Maintenance through a Maintenance Rental Agreement (MRA). The total cost was \$40,200. The site was selected because of the large number of fender bender crashes and “close-call” incidents occurring at the site. Vehicles travelling westbound have limited sight distance as they negotiate a 90° curve and travel down a slight decline as they approach the bridge. From this direction, there is gas station located directly after the bridge. Vehicles have to brake or stop suddenly on the bridge deck due to stopped vehicles ahead that are waiting to turn in or out of the store driveway. This has been the case for multi-axle vehicles especially in inclement weather conditions.

The application was also completed by Parent Construction. As with the North Prospect Street site, this site was visited periodically by Research personnel. Figure 17 shows the completed application in 2008. In August 2010, two years after installation Research personnel

noted that the wheelpaths of the overlay were slippery. The surface was damp due to precipitation during morning hours. Upon furtherer examination, it was noted that within the wheelpaths, little aggregate remained on the surface of the experimental overlay. Instead, as shown in Figure 18, exposed epoxy was present in the majority of the surface of the overlay.



Figure 17 Application after installation in 2008

Cargill representatives were contacted and an onsite meeting to collect material and determine possible causes was conducted in September 2010. Attending were representatives from District 5, Cargill, and Materials and Research personnel. Ten cores of the overlay material were extracted to examine the current condition of the overlay and probable causes. Cargill personnel examined the cores at their central laboratory. They believed the loss of aggregate was due to studded tires. An earlier hypothesis was that the epoxy set up too quickly which did not allow enough time for the aggregate to bond properly to the epoxy. The analysis rebutted the earlier hypothesis. See Figure 19.



Figure 18 The darken wheel paths show where the aggregate has been stripped, exposing the underlying epoxy (2010).



Figure 19 Core of the overlay.

Because of the premature failure in the wheelpaths, Cargill agreed to repair the overlay with a harder aggregate, which was projected to resist the wear of studded tire use more effectively. Due to time and weather constraints, the repair did not take place until August 2nd and 3rd, 2011. Research, District 5, Cargill, and Parent Construction representatives were onsite.

To prepare the surface the wheelpaths were milled to remove any remaining epoxy or aggregate from the original overlay. One lift of the epoxy and aggregate was then placed. Once cured, traffic was switched to the other side and the wheelpaths in the other lane were completed. As of the summer of 2012 the overlay appeared to be in good condition with no reports of crashes or incidents at the location.

COST ANALYSIS

This research initiative was a joint effort between the VTrans Operations Division, the product manufacturer, Cargill™, and VTrans Research. The cost of the overlay was \$7 per square foot. Cargill donated 5000 ft² and VTrans paid \$23,100 for the remaining 3300 ft² of material including the epoxy and aggregate. The Operations Division supplied traffic control and all labor and equipment required to apply the treatment. VTrans Research incurred all costs of evaluating the treatment.



Figure 20 Repairing the wheel paths.

SUMMARY AND RECOMMENDATIONS

In an effort to reduce vehicular accidents due to ice and snow formation in susceptible highway locations, Research personnel assessed an anti-icing surface overlay. The Cargill

SafeLane[®] HDX Overlay was expected to last up to 15 years if the existing roadway held up well. Due to pre-existing site conditions that were not evident until half way through the application, the Searsburg location was only in service for two years. Though there was evident deterioration in the area of the overlay, the treatment was aiding vehicles in climbing and reaching the top of the steep hill. Significant maintenance issues began to arise from having to fill a growing number of “pop-out” or potholed areas as shown in Figure 21. The District decided that the treatment would be replaced as part of a maintenance paving project that was constructed in the summer of 2009.

Crash data from 2000 and throughout the study period on to the present day was collected from the Traffic Research Section and local police records. Crash data indicated that where the overlay has been utilized, there has been no crashes and very few complaints about vehicles not being able to travel. Since the treatment was taken out in Searsburg, the District forces have noticed a considerable difference in travelers, mostly with multi-axle vehicles, not being able to reach the top of the incline.



Figure 21 Pothole repair less than a year after application.

The use of Cargill SafeLane[®] HDX Overlay has shown promise in reducing highway incidents; therefore, warranting continued research in how to benefit from the anti-icing properties of the overlay. The repair work in Jericho has shown that using a more durable aggregate can counter the aggressive wear from studded tires. Remaining problems that need resolution are with its initial application such as environmental conditions, quality of the roadway bed and the durability and competency of the underlying pavement. Due to these

unresolved problems, it is recommended that the institutionalized use of the SafeLane® HDX Overlay be halted for highway use.

Cargill has introduced another material that acts as an additive to a typical asphalt mix. This additive offers the same anti-icing properties as the SafeLane Overlay does only it becomes embedded within the asphalt layer rather than a thin overlay. It is recommended that the Agency continue research with anti-icing surfaces with this additive as well as furthering the research on the proper application of anti-icing overlays.

The treatment has been found to be effective in improving safety and mobility in all test locations. Aggregate durability has not met expectations and warrants further improvements before widespread application of the technology.

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STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS AND RESEARCH SECTION
CATEGORY II WORK PLAN FOR
Cargill Safelane Overlay
Work Plan No. WP- 2006-R-4

OBJECTIVE OF STUDY:

Like other New England States, the weather in Vermont is highly variable with a large range of diurnal and annual temperatures. Wintertime temperatures fluctuate daily with an average temperature range of approximately 20°F. In addition to fluctuating ambient temperatures, Vermont receives an average annual snowfall amount of about 100 inches. These weather conditions pose an ongoing threat to local residents and tourists that may be unaware of the associated roadway hazards. In order to address this safety hazard, the Vermont Agency of Transportation applies road salt and sand to combat the formation and build up of ice and snow or to increase friction. While this is an extremely effective treatment, it often requires constant attention, especially in high vehicle incident locations.

The purpose of this study is to apply an experimental roadway treatment manufactured by Cargill known as Safelane, an anti-icing pavement overlay system. This system, comprised of polymer epoxy and aggregate, is intended to eliminate ice and frost formation on the riding surface. As an aside, when applied to the surface of a bridge deck, it also provides a barrier to water and chloride intrusion into the concrete deck. Crash data prior to and following installation will be used to evaluate the effectiveness of the treatment with regards to wintertime weather conditions. As a final aside, the system will be evaluated for observed skid resistance which should ultimately be related to the potential of vehicular incidents due to roadway conditions.

LOCATION:

The experimental feature is to be applied to the existing roadway surface within the west bound lanes of VT Route 9 in the Town of Searsburg at approximately MM 2.660. The roadway

alignment is curved and steep at a grade of 13.5% only further compounding the problems associated with the build up of ice and snow. The estimated longitudinal length of the application is approximately 370' with a roadway width of 22.5' for a total area of approximately 8300 ft². The exact location will be delineated by Research and Development personnel.

This location was selected for this project due to a high rate of wintertime accidents reported by District Personnel and local police enforcement. According to David Notte, from the Shaftsbury Police Station, 7 crashes and 22 complaints have been reported over the past year. Out of the 22 complaints, 20 were reported from November of 2005 through February of 2006. Additionally, District personnel provided additional commentary with regards to numerous crash events during a single snowstorm event and the need for constant reapplication of deicing chemicals. It is common for the need to temporarily close off this roadway section while addressing vehicular accidents.

MATERIAL:

Safelane was developed at Michigan Technological University and is licensed and marketed by Cargill based in Wayzata, Minnesota. Cargill Safelane is a patented pavement overlay composed of a Type III pavement of polymer epoxy and limestone aggregate. In accordance with the manufacturers instructions, the overlay is to be a minimum of 3/8" thick with an in place weight of approximately 4 pounds per square foot. Proper installation should result in a minimum adhesive strength of 250 pounds per square inch 24 hours following application.

COST:

This research initiative is to be a joint effort between the VTrans Operations Division and manufacturer, Cargill. Cargill is to furnish all associated product relating to the patented system and will include, but may not be limited to, the epoxy and limestone aggregate. The Operations Division is supply traffic control and all efforts for proper surface preparation. District personnel will also be responsible for the installation of the experimental feature and all associated labor costs.

SURVEILLANCE AND TESTING:

In an effort to reduce vehicular accidents due to ice and snow formation in susceptible highway locations, Research personnel will assess the roadway surface overlay in the following manner:

1. Research personnel will monitor and observe all installation activities. This may include any preparation activities as well as application efforts. The time for installation and return of traffic is to be recorded.

2. An annual collection of IRI (international roughness index) is to be collected through the Pavement Management Section. The collection of crash data prior to and following installation.
3. All crash data from 2000 to the present day and throughout the study period is to be collected from the Traffic Research Section and local police records.
4. Site inspections are to be carried out during black ice and snow events to examine the characteristics of the anti-icing component of the system. The observer should use all proper safety precautions and make observations from a designated vehicle or behind guardrail.
5. Although a reduction in salting efforts may not be noted due to the smaller size of the test application, feedback from District personnel is to be gathered with regards to the ease of difficulty of performing wintertime maintenance activities.
6. Visual inspections of the roadway surface, prior to and following application, are to be conducted annually to examine any potential product delamination or evidence of additional bridge deck corrosion following application.
7. Two 1' by 1' squares are to be delineated on the surface of the experimental substrate through the use of traffic paint following installation. One is to be identified within a wheel path and one is not to be located in a wheel path. Photographs are to be taken on an annual basis and compared to previous years to determine any loss of aggregate due to vehicle tires or wintertime maintenance activities.
8. Photographs are to be collected on an annual basis and any other pertinent information is to be recorded.
9. If feasible, a skid resistance test is to be performed at several intervals during the experiment.

DURATION OF THE STUDY:

The duration of this study will be no more than three years or until final conclusions can be drawn from the observations and results from data collection.

REPORTS:

An initial report will be prepared to include the installation of the materials and preliminary observations, with a subsequent/final report at the conclusion of the study. Interim reports will be prepared and submitted as needed. These reports will be authored by Research staff.

Agency of Transportation Reviewed By:

Materials and Research Section

William Ahearn P.E.

Materials and Research Engineer

Date: