SafeLane Surface Overlay Improves Winter Road Safety

Michigan Technological University

When an experimental strip of SafeLane surface overlay was laid down on the icing-prone Wolf River Bridge at Crandon in northeastern Wisconsin in 2003, officials hoped to cut down on the four to five weather-related motor vehicle accidents the structure saw each winter.

It reduced them by cutting them to zero for all of the next five years.

A SafeLane system installed in 2005 on a problematic ramp for the Blatnik Bridge at Superior, Wis., yielded the same, zero accident results. An analysis of other test sites in several states during the 2005- 2006 winter season — all normally hazardous — reinforced those results: no ice-and-snow-related accidents.

At the same time, similar untreated stretches of roads and bridges near each were a mess.

“Rather than putting down chemicals to melt snow and ice once they’ve accumulated, SafeLane embeds anti-icing chemicals in the roadway ahead of time,” says Russ Alger, the technology’s inventor and director of the Institute of Snow Research at Michigan Technological University in Houghton, Mich.

“Melting agents are stored for release when they’re needed — when a storm comes. They help prevent ice from forming from the time the storm begins. This improves safety tremendously.

“Beyond this,” Alger notes, “the epoxy overlay ‘armors’ the roadway and extends its useful life. And, the system reduces the amount of chemicals needed to keep it ice-free, so it’s a big advance environmentally.”

> *However, SafeLane overlay is more expensive than regular paving, so it is used mostly to target specific trouble spots like bridges, access ramps and intersections rather than to cover full-length roadways.*

Patented by Michigan Tech in 2001 and licensed to the Deicing Technology Division of Cargill Inc. in 2004, the SafeLane product has now been installed at more than 85 highway and 15 sidewalk and airport sites in states from Maine to Texas to California.

To De-ice or to Anti-ice?

Creation of the SafeLane surface overlay represented a combination of several technologies. One is the epoxy coating on the surface of the roadway, most commonly a two-part glue designed to expand and contract like the underlying roadway itself.

The epoxy hardens the surface, but, more importantly, it provides the base for an overlay of small, aggregated quarter inch pebbles — somewhat like the texture of rough sandpaper — that can soak up and hold anti-icing agents like a hard sponge. Applied ahead of time, these chemicals remain dormant until the moisture of snow or sleet releases them and their anti-icing action.

“There are a couple of different ways to maintain a highway in winter,” Alger says. “One is the traditional de-icing approach — plowing the roadway and applying chemicals to melt the ice that has been formed. The other is anti-icing — using chemicals to keep snow and ice from accumulating at all.”

Alger continues, “There are different ways of anti-icing. You can focus on the pavement or on the chemicals. Or, you can do what the SafeLane system does and combine the two — creating a pavement that releases the salt brines that prevent ice from forming in the first place.”

When researchers began looking at antiicing in the mid-1990s, it was a new idea. Working with liquid sodium chloride on different pavements, Alger realized the samples were behaving differently.

“I found the difference was in the pavements themselves,” he says. “At the same time, in a separate project I was looking at epoxy overlays to armor pavement. The two of them crashed together, and I saw some possibilities.”

To test his ideas, Alger explored a broad range of pavement materials, aggregates and chemicals in his 10’x15’ cold lab, subjecting six-inch- and eight-inch-square blocks to temperatures as low as -400 F. Between tests, they would be washed and subjected to cold temperatures multiple times to assess the chemical’s lifespan.

While several types of chemicals are utilized as melting agents, the most common is sodium chloride — the equivalent of table salt. Solid salt granules work best for de-icing, but Alger found that sodium chloride in a liquid brine is more effective for SafeLane application.

“The aggregate has to hold onto the antiicer and release it in reaction to moisture,” Alger notes. “It has to be durable and able to hold the chemical well. Those two characteristics don’t necessarily go hand in hand. Very porous isn’t really good for an aggregate material — the anti-icer stays in the pores. We want it to stay at the surface, where the ice forms."

Limestones and dolomites proved to be excellent for this. Not so porous, they keep the anti-icer at the surface — it dries out and crystallizes in tiny surface pores. Also, Alger believes that a chemical reaction bonds them to the stone.

Field Testing and Licensing

By the time Alger contacted Michigan Tech's Technology and Economic Development office, he had taken his findings beyond the simple idea stage.

"Russ worked on it in earnest before he disclosed it to us in 2001," notes Technology Director Jim Baker. "We filed for a patent that year and began a search for a corporate partner. We undertook tests with the Wisconsin Department of Transportation.

"I met some folks from Cargill at an AUTM conference. They responded quickly. We now have a series of patents that the university owns and have exclusively licensed to Cargill. The initial research was supported by university discretionary funds, with Cargill supporting some of the later work."

A study of 26 sites during the 2006-2007 winter repeated earlier observations of excellent results — but added a caveat: At a few test sites it appeared that wet, heavy snowfall diluted the chemicals to the point that the test segments performed no better than control stretches.

Overall, the analysis revealed, SafeLane surface overlay worked well: It kept treated segments free of ice and snow and it dramatically improved safety. It cited one interchange in Superior, Wis., that had seen 87 accidents before installation and just one afterward.

The 2006-2007 study's finding that dilution over time can diminish effectiveness wasn't a surprise.

"Chemical duration is a function of the frequency and vehemence of a site's weather," Baker notes. "Areas with heavy precipitation likely need more frequent application. Even so, SafeLane overlay sites tend to need less treatment than other roads. A bridge that used to get anti-icer two times a week may now need it only once a month."

Corporate Licensing

Since those 26 sites of 2006-2007, the number of SafeLane surface overlay installations has increased exponentially, says Sean Riley, marketing manager for Cargill's Deicing Technology Division. Today, he notes, there are SafeLane product sites in more U.S. states than not, and installations have begun in Canada.

"From our point of view it has several benefits," Riley says. "Most importantly for our mission, it's a great anti-icing product. But it also helps preserve the pavement. And, since customers can use less chemical, it's more environmentally sound."

Cargill focuses on selling the two-part system — epoxy and aggregate — but installation, although specialized, relies on subcontractors (Alger, for one, has founded a company that does this). Cargill sells the chemicals as well, but not as part of the SafeLane system. It's up to the customers to buy and apply it.

Alger and Cargill have developed a second version of the SafeLane technology — a product that uses eighth-inch stones in a single layer, versus the highway's double layer of quarter-inch stones, for use on sidewalks, bike paths and airport taxiways and service roads.

“The fact that it’s a single layer lowers the cost substantially,” Alger notes. “And the smaller aggregate means it’s a little easier for somebody with a snow shovel to clean up.

“Most importantly,” he adds “the evidence is clear is that SafeLane technology improves highway safety significantly for drivers forced to deal with winter-time ice and snow. And it does it in a way that’s better for the environment.”

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