As the manufacturer of I-35W system stands up to accusations linked to collapse, Mn/DOT increases anti-icing usage

Combine 140,000 vehicles crossing the I-35W bridge in Minneapolis every day with almost 5 ft of average annual snowfall, and the likelihood of spinouts, rear-end collisions and fender benders increases exponentially. For years, public transportation managers have battled snow, freezing rain and ice with an ever-increasing array of tools, techniques and technologies.

In 1999, the Minnesota Department of Transportation (Mn/DOT) took a step forward in addressing winter weather-related accidents by installing an anti-icing system on the eight-lane, 1,950-ft-long bridge. Boschung America LLC, New Castle, Pa., an American subsidiary of a Swiss company, was hired to design, install and manage the system. Final cost of the contract was $618,450.

Justin Bruce, vice president of Boschung America, said, “The systems were first installed in 1999. The I-35W was the fourth in the Midwest; three others were installed in Pennsylvania the same year. Worldwide, the Boschung systems have been in use since the 1970s, and the first system installed in Switzerland is still operating.”

Commenting on the Minneapolis installation, Bruce said, “Minnesota is ahead of the curve in terms of using anti-icing systems and understanding of the value they create.”

A reducing role
The multidisciplinary Boschung anti-icing system combined road
weather information system (RWIS) weather stations with a series of 38 valves and 68 flush-mounted disk spray nozzles. The nozzles were installed along the centerline of lanes in both directions at 55-ft intervals.

When weather conditions deteriorated, a computerized control system activated one of 13 spray programs. Once engaged, the valves opened and the nozzles sprayed potassium acetate onto the bridge deck and road surfaces. A pump house tank located next to the bridge contained a 3,100-gal potassium acetate storage tank, pumps, valves and a computerized control system. Designed to operate independently based on established weather and atmospheric data, the anti-icing system could be activated at the pump house manually or with remote-control electronics.

An operational test of the anti-icing system was conducted in December 1999 through March 31, 2001. Test objectives included confirming the system’s functionality, cost-effectiveness and contribution to reducing accidents on the bridge during inclement weather conditions.

Mn/DOT’s I-35W & Mississippi River Bridge Anti-icing Project Operational Evaluation Report, published in July 2001, called the test a success. The report stated, “Overall, it was concluded that the anti-icing system worked extremely well and was able to increase safety and reduce crash-related congestion as advertised. This system sets an anti-icing precedent nationwide, being the first of its kind successfully installed and operated on a 1,950-ft bridge structure in a metropolitan area.”

During the test period, the anti-icing system was activated 129 times when the temperature fell below 15°F. At that point, chemicals like sodium chloride traditionally applied by Mn/DOT vehicles become ineffective. The potassium acetate used in the Boschung system prevented ice from forming in temperatures as cold as -15°F. When activated, 34 gal of potassium acetate from Cryotech Deicing Technology, Fort Madison, Iowa, were sprayed across the road surface. The spray nozzles delivered approximately 12 gal per lane.

Bruce pointed out that while potassium chloride is more expensive than a salt or salt brine alternative, it is a more effective deicing agent.

The potassium acetate is becoming viewed as the chemical of choice. It is a lot more expensive than salt brine (approximately $3.25 per gal vs. salt brine’s 25 cents per gal), but you can use a lot less—one-fifth as much potassium acetate will provide comparable results. The traffic moves the chemical but it doesn’t dilute as quickly as salt brine.

In the crash analysis section of the test, Mn/DOT compared accident reports over two winter seasons. Results from the 2000-01 Minneapolis winter were compared with similar winter weather and snowfall conditions in the 1996-97 winter. The analysis noted a 68% reduction in crashes.

A benefit-cost analysis in the evaluation reported that the anti-icing system was cost-effective for the I-35W bridge location resulting in a B/C ratio of 3.4. The analysis considered costs including construction/installation, replacement parts, routine maintenance, utilities and chemical purchasing/delivery.

Breaking the snap reaction
Based on those positive findings, Mn/DOT has expanded the use of anti-icing systems in other parts of the state. Duane Hill, P.E., Mn/DOT assistant district engineer, operations, said, “The benefit [of anti-icing systems] is they reduce accidents and
reduce the number of times our dispatchers are required to send trucks to address an icy road. Some of the systems have just about eliminated accidents at the locations where they have been installed, which is a huge benefit to the public.”

The systems remained in place and operating until the Aug. 1, 2007, collapse of the I-35W bridge brought National Transportation Safety Board scrutiny to all the bridge’s structural components. Although Mn/DOT bridge inspection reports noted some corrosion on a galvanized metal grate associated with anti-icing chemicals, the system has not been cited in post-collapse conjecture concerning the cause of the collapse.

Bruce commented, “There has been some snap reaction. Inherently, people want to find a reason why this happened. They want to point to one single thing and say this is the reason and this is what we are doing so that it never happens again.

“Mn/DOT was ahead of the curve when they said they wanted to put an anti-icing system on the bridge and don’t want to put salt on it. There was some salt used on the bridge deck but not nearly as much as was used before the system was put in. They were using potassium acetate and that’s less corrosive than tap water. In my opinion, Mn/DOT actually extended the life of the bridge by not using the amount of salt they had been using prior to the system. Structurally, our system had no effect on the bridge whatsoever.”

Boschung provides maintenance programs and a one-year warranty with two- to three-year options available. Hill pointed out that ongoing maintenance is crucial to keeping the system operating at full efficiency. “We found the chemicals can corrode the valves and you have to have a preventive maintenance plan to go through and upgrade or replace on a regular basis.”

The deicing chemicals play a fundamental role in creating corrosive conditions.

Bruce explained, “The mechanical side [of the system] definitely needs attention. The valves are constantly immersed in fluid. That’s where corrosion will be found.”

Boschung has conducted internal studies to compare the effects of salt brine vs. potassium acetate. Bruce reported, “After one winter season we compared valves. The potassium acetate valves look like water flowing through them. Salt brine [valves] look like they have been in the ocean and beat up all winter. It’s amazing the corrosion that happens with the salt brine.”

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He added, “We don’t designate what to use from a chemical standpoint. Our system will work with any anti-icing-approved chemical. There is a notion within some DOTs that says we want to use the salt brine because it’s cheap. But we don’t think it’s nearly as effective or good for the environment.”

Year-round, systems at Boschung’s headquarters monitor every installed station and perform diagnostic tests and alarms. In order to operate at peak efficiency in January, Boschung conducts preventive maintenance operations during summer months. Bruce described the process: “If you let a hydraulic system sit all summer without it running you will have problems. The pumps dry up, O-rings dry up and things get brittle. Our systems go into a summer program mode. Once a week the system will spray water from a separate water tank in the pump house. Technicians switch back to chemicals in the fall.”

Expanding conditions
Anti-icing systems are in opera-
tion in Nebraska, Colorado, Alaska, Minnesota and Pennsylvania and across Canada. Bruce said, “Today, states are much more proactive and advanced in how they approach the use of anti-icing and technology systems within their roadways. The use of these technologies is becoming better understood. The old way of putting a salt brine mixture on the road is just not as good as what is available for them.”

Since the first installations in 1999, the anti-icing systems have continued to evolve. Bruce described the advancements: “The functionality of the anti-icing system hasn’t changed. What has changed is the installation methods have continued to improve to make it less and less noticeable to the driving public. Sensors are more accurate and wear longer on the roadway.”

Users are asking the systems to deliver more information faster and for that information to be easier to access. Boschung is introducing a web-based product that will allow the transportation authority to see their complete system.

“They want the conditions on the surface in real time and they want to be able to get it wherever they are,” Bruce said. “The tool allows the user to be able to view a map of their roadway and obtain information about RWIS stations, anti-icing systems and conditions on the roadway in real time.”

Over time, expanded use of anti-icing systems may reduce the public’s dread of winter driving conditions and provide transportation authorities with a cost-effective tool to battle Father Winter’s blasts. Bruce said, “There is always room for advancement. Now the advancement is not coming from the hydraulic delivery systems but from the information systems.”

Drierzak is a freelance writer based in Richfield, Minn.

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