Automated Anti-Icing Bridge Systems

Black ice is a phenomenon whereby condensed moisture settles on a road or bridge surface. At temperatures below 0°C (32°F), this creates a thin but dangerous layer of "shiny" ice. Freezing of pavement moisture is more prevalent on bridges because cold air passes above and below the bridge decks, increasing efficiency of heat loss and thus propensity for freezing.

Black ice on bridge decks is not very visible to the naked eye. This causes unsuspecting motorists to lose traction, sometimes with deadly consequences.

Automated Fixed Location Anti-icing/De-icing System

The automated fixed location anti-icing spray system is a revolutionary winter technology that largely takes the guesswork out of forecasting the probability of ice formation on bridge decks. It takes preemptive action to forestall ice formation without human intervention. A typical system consists of in-deck pavement sensors, spray disks, anti-icing liquid container, atmospheric meteorological sensors, controller, and valve units. These devices are installed on the bridge. When the atmospheric sensors in conjunction with the pavement sensors detect the formation of ice or frost on the bridge deck, the spray disks are activated to release measured amounts of the anti-icing chemical onto the deck. The chemical prevents the formation of ice or frost. The chemical is a freeze point depressant and works by lowering the freeze point temperature of the moisture on the deck surface, thereby preventing freezing.

The in-deck sensor uses a thermo-electric element to freeze road moisture captured in the sensor’s cup to determine the freezing point. During freezing conditions, when the temperature falls to within 2°C of the road fluid's freeze point, the system automatically deploys and sprays de-icing fluid on the deck to prevent the formation of ice or frost.

PennDOT Pilot Systems

PennDOT maintenance forces installed three (3) Automated Fixed Location Anti-icing/De-icing Systems on bridges in Warren, Westmoreland and Allegheny Counties. As an emerging technology, the aim of the pilot installations was to determine whether the systems would be beneficial to the Commonwealth. The systems were monitored and evaluated over the winter season both functionally and operationally. Evaluation results determined whether more systems would be deployed in their current forms or with
Preliminary evaluation results indicated that the systems performed well functionally. They deployed as programmed in the system logic, spraying an anti-icing chemical onto the bridge decks when conditions indicated imminent ice or frost formation.

District 1-0 and the Conewago Township police reported that 25 crashes were recorded on the Warren County Bridge in the two years before installation of the system. Since installation, no crashes have occurred. The system is fulfilling its most essential function – reducing crashes on bridge decks during adverse winter conditions.

The anti-icing system is performing well and a customer survey conducted by District 1-0 indicated that motorists overwhelmingly believe that these systems should be deployed on other bridges. However, not all bridges are suited for the systems, by virtue of their design, age, location, and other factors. Furthermore, due to the cost of the systems ($150,000 per bridge, on average), the Commonwealth must prioritize installation, starting with the bridges that will benefit the most. The Department has developed a set of guidelines to aid in selection of bridges for anti-icing systems.

### Important Considerations for Selection of Bridges for Installation of Anti-icing Systems

- Bridges with a history of crashes attributable to snow, icing, and frosting
- Bridges on a grade of 2.5% or more
- Bridges located in an area susceptible to black ice and frost
- Bridges with speed limits greater than 45 MPH
- Bridges with super-elevated decks greater than 5%
- Bridges with high average daily traffic (ADT) volume
- Bridges structurally sound enough to accommodate anti-icing systems

Bridges with one or more of these attributes should be considered for installation of anti-icing systems. There are no definitive criteria. Indeed, other factors such as distance from the nearest maintenance stockpile and adequate right-of-way to install the necessary hardware may come into play.

The anti-icing system was brought to Pennsylvania through a Transportation Pooled Fund Research Project. In this multi-state initiative, PennDOT partnered with 11 states plus Canada and Sweden to cost share in the development of the anti-icing system.

For further information, refer to the Bureau of Maintenance and Operation's Guidelines for Selection of Bridges for Installation of Automated Anti-Icing Bridge Systems, or contact:

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