Fixed Automated Spray Technology (FAST)

OM 4

Photo: Courtesy of WTI

Description: Fixed Automated Spray Technology (FAST) systems are an anti-icing treatment method to prevent the formation and bonding of frost, ice and snow to the roadway. FAST systems are typically deployed on bridges, which are often the first locations to become slick or icy during a storm. They are also good candidates for remote, difficult to reach locations. When these systems are automated, they make use of road weather information systems (RWIS) (see #STW1) to identify the preferred activation time. They can also be manually activated (i.e. by control from a traffic management center (see #TM9)), using a camera to view the conditions.

Rural Transportation Critical Needs

- ☐ Crash Countermeasures
- ☐ Emergency Services
- ☑ Operations & Maintenance
- ☐ Rural Transit & Mobility
- ☐ Surface Transportation & Weather
- ☐ Tourism & Travel Information
- ☐ Traffic Management

Issues Addressed

- ☐ Resource mapping & monitoring
- ☐ Central data storage
- ☑ Icing of roads
- ☐ Avalanches
- ☐ Maintaining cameras
- ☐ Commercial vehicles
- ☐ Prioritizing snow removal

Strategies Achieved

- ☐ Road User
- ☑ Road
- ☐ Vehicle
- ☐ Safety Culture
- ☑ Engineering
- ☐ Emergency Response
- ☐ Enforcement
- ☐ Education

Applicability	Partnerships	Key Components
•FAST systems might be more easily deployed in rural environments where the roadway designs are less complex. For example, there may not be on and off-ramps in the vicinity of the bridge an agency desires to treat, which could reduce the treatment area. (Note: See *Evaluation of North Dakota's Fixed Automated Spray Technology Systems* for a discussion of a rural and urban installation and the differences in complexity.) These systems offer significant safety benefits as they help to ensure that the roadway, typically a bridge, remains passable. Furthermore, they provide cost and safety benefits by not having to send maintenance personnel to locations of concern in potentially icy conditions.	•Applications benefit from collaboration among numerous agencies, which may include: •Departments of transportation (local, state, federal)	•Pavement sensors •Weather sensors •Pump house containing pumps •Storage tanks •Power/communication equipment •Computer controller •Spray nozzles •Plumbing (electrical/anti-icing chemical) connecting the pump house to the spray nozzles •Anti-icing chemicals (e.g. magnesium chloride, sodium chloride, calcium chloride, calcium magnesium acetate, and potassium acetate)

Examples of Implementation

- **Buxton Bridge, North Dakota**

A FAST system was installed in 2002 on Interstate 29, Buxton Bridge near Buxton, North Dakota. A system was slotted for this location based on a consistently high crash rate, and its ranking in the top five on a high crash location list for interstates in North Dakota. The system uses potassium acetate for the anti-icing chemical. The system was found to use approximately 5.5 gallons per spray, with a total use of approximately 1,155 gallons of anti-icing chemical for the winter 2007 season.

- **I-90, Washington State**

This FAST installation was found to be associated with a 2.36 benefit/cost ratio and a 60 percent reduction in snow and ice-related crashes.

- **I-215, Utah**

The FAST system was installed in 2003. There are eighteen valves. Potassium acetate is sprayed onto the bridge via deck-mounted spray discs.

- **I-80; Clearfield County, Pennsylvania**

The FAST system was installed on I-80 over Anderson Creek in Clearfield County, Pennsylvania in 2002. The average number of crashes decreased from 2.63 crashes annually to 0.63 crashes annually.

Implementation Considerations (General)

- Maintenance crews should be involved in design and installation of any FAST systems[1].
- Systems need to be installed properly to function to their full capabilities[1].
- Vendor assistance during the first season is very important.
- The systems require regular maintenance (e.g., the tanks should be cleaned and the lines flushed with a water/bleach mixture and replaced with the anti-icing agent) [1, 2].
- Remote access of the FAST systems is considered invaluable by current users[2].
- A dual closed-loop system can help identify and bypass malfunctioning spray nozzles[2].
- A fiberglass walkway in the pump house (metal would corrode), stainless steel piping, and composite valve control boxes (painted metal would corrode) is recommended[2].
- A low liquid warning light should be installed on the outside of the pump house[2].
- Both active and passive sensors are recommended and should not be installed on the same lanes as the spray pucks[2].
- Plumbing in deck is preferred to plumbing anchored to the deck[2].
- Install a valve to ensure air does not enter the system, causing failure, and filters should be used to help to protect the equipment[2].

Implementation Considerations (Pro)

- Return on investment in a FAST system can be as short as a year[1].
- Reduction in winter-related crashes[1].
- Savings on material use (i.e. sand) and labor (i.e. less overtime)[1].
- Reduction of negative environmental impacts (Note: This depends significantly on the anti-icing agent used and the method of application)[1].
- Improves roadway safety:
  - Two percent reduction in annual crashes on multilane rural highways (in Colorado)[1],
  - Crash reduction ranging from 31 to 57 percent on rural interstates (in Colorado)[1],
  - Fifty-four percent reduction in property damage only crashes (sixty-two percent when incorporating average annual daily traffic (AADT) (in North Dakota)[2],
  - Seventy percent reduction in injury crashes (seventy-five percent when incorporating AADT) (in North Dakota)[2],
  - Safety benefit of $196,428 per winter season (as reported in Colorado)[1], and
  - Systems reported as 95% reliable (in North Dakota)[2].

Implementation Considerations (Con)

- Need significant maintenance[1].
- May not be as effective in treating heavy snow[2].
- Not recommended to be used with wind speeds greater than 15 mph[2].
- Low temperature thresholds were identified as 15 degree Fahrenheit (in North Dakota); however, this depends significantly on the type of liquid product that is being used[2].
- Price increases with an anti-icing chemical of choice can be problematic[2].
- These systems may not be applicable for bridges less than 40 feet[1].

Opportunities for Future Expansion

- With vehicle-to-vehicle (V2V), the in-roadway sensors will be able to communicate with the driver and/or vehicle, notifying them of icy conditions on the roadway, even potentially recommending a different route or recommending that drivers delay their trip.

Useful Tip

For a low-cost installation, prioritize locations based not only on need, but also on locations of existing RWIS and cameras.

Additional Resources

- *Evaluation of North Dakota's Fixed Automated Spray Technology Systems,* found here: http://library.nd.gov/statedocs/UGPTI/DP21920091214.pdf
- *Benefit-Cost Analysis of CDOT Fixed Automated Spray Technology (FAST) Systems*, found here: https://www.codot.gov/programs/research/pdfs/2014/benefit-cost-analysis-of-cdot-fixed-automated-spray-technology-fast-systems/view
- *A Synthesis to Improve the Design and Construction of Colorado's Bridge Anti-Icing Systems*, found here: http://hermes.cde.state.co.us/drupal/islandora/object/co%3A5256/datastream/OBJ/view
- *Bridge Prioritization for Installation of Automatic Anti-icing Systems in Nebraska*, found here: https://www.researchgate.net/publication/228807370_Bridge_Prioritization_for_Installation_of_Automatic_Anti-icing_Systems_in_Nebraska
- *Vehicle-Based Technologies for Winter Maintenance: The State of the Practice*, found here: https://sicop.transportation.org/wp-content/uploads/sites/36/2017/07/NCHRP-20-7200_Vehicle-Based_Winter_Technologies_2006.pdf

Cost Range

(Cost/financial information, where noted, is based on 2016 dollars (unless otherwise specified). Cost/financial information is estimated, and will vary based on size and scope of project, number of units, etc. In general, capital costs include initial purchase costs of hardware, software, and other required equipment. Maintenance and operations costs include staff time to operate, monitor and maintain systems; data collection; system upgrades; evaluation; etc.)

Capital Costs: The total capital cost for this tool is higher (above $250,000). Utah installed a FAST system on I-215 for $326,000. The FAST system on the Buxton Bridge (North Dakota) was installed at a cost of $224,839, not including the cost of the environmental sensor station[2]. The reported cost-benefit ratio of the system was 4.3, assuming a 20-year design life. The span of the treatment area was 370 feet; it was treated using 20 spray nozzles for both directions.

Operations Costs: The operations and maintenance costs for this tool are anticipated to be low ($0 to $50,000). Costs for this tool will include labor, anti-icing chemicals and their shipping (the chosen chemical has significant impact on costs), utilities, communications, scheduled and periodic cleaning of valves, routine maintenance, repairs/replacement and system modifications. The cost of the anti-icing chemical (potassium acetate) used at the Buxton Bridge (North Dakota) was reported to be $8.20/gallon in 2008, even though in prior years it was reported to be as low as $2.80/gallon (these prices were not adjusted because it is unclear how inflation or other factors impact these costs). In North Dakota, average utility costs, mostly the power required by the systems, were $1,300 per year. Filling, removing, and cleaning the storage tank at the pump house was estimated to cost less than $1,120. Finally, it is anticipated that every seven years, pumps and other equipment will need to be replaced at a cost of approximately $5,600 (averaged over 7 years to estimated annual cost). The chemical costs were estimated as $10,600 annually. All of these costs add up to approximately $13,820 annually[2].

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