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Ready, steady, Spread

Research verifies benefits of properly calibrated ground-speed controllers

Just enough. That's how much salt highway agencies aim to put on snowy and icy roads to make them safer for traffic.

Salt and other deicing agents provide undeniable safety benefits by melting snow and ice or preventing their accumulation, and using salt for winter maintenance remains a time-tested practice across the U.S.

Yet deicing and anti-icing come with a cost. Salt accelerates the corrosion of the steel in highway structures and vehicles, and the overuse of some agents can cause harm to the environment. There also is a heavy financial cost: Road salt can be a sizable line item in a state's winter maintenance budget, running into the tens of millions for a harsh winter season.

And the price of salt has been on a dizzying rise. The price per ton of salt, averaged among 10 states, has more than doubled in the last decade, up from $30.25 in the winter of 1999-2000 to $70.90 in the winter of 2008-09.

Together, these costs point to the need to use the right amount of salt at the right time. Having a spreader system that accurately and consistently distributes the intended amount of material is absolutely critical.

An obvious improvement?

Spreading deicing agents for winter road maintenance used to be an imprecise process. Years ago, the burden of controlling salt output fell to the truck operator. Whenever the truck accelerated or decelerated, the operator had to adjust the controls to change the speed of the belts or augers in the salt-delivery system. With part of the operator's attention already given over to navigating streets in poor weather, the frequent adjustment of the delivery settings was a difficult task, and the results were often imprecise. Typically, operators would err on the side of caution, laying more salt than conditions demanded.

In the 1990s a technology emerged that offered a better answer: ground-speed controllers for salt spreaders. These devices included hardware to constantly monitor a truck's ground speed and automatically adjust the speed of the spreading systems: the belts, augers or some combination of the two, depending on the design.

State DOTs quickly bought into ground-speed controllers.

"We saw right away that these would be an improvement over manual controllers in Iowa," said Iowa DOT Winter Operations Administrator Dennis Burkheimer.

Today, ground-speed controllers are the technology of choice of highway agencies across the country.

Despite this perceived improvement, two significant questions remained unanswered: Do ground-speed-controlled salt spreaders really outperform manual ones, and are these controllers operating according to specifications?

"Even as we transitioned our fleet to ground-speed controllers," said Burkheimer, "we never knew for certain the scope of the benefit we were getting."

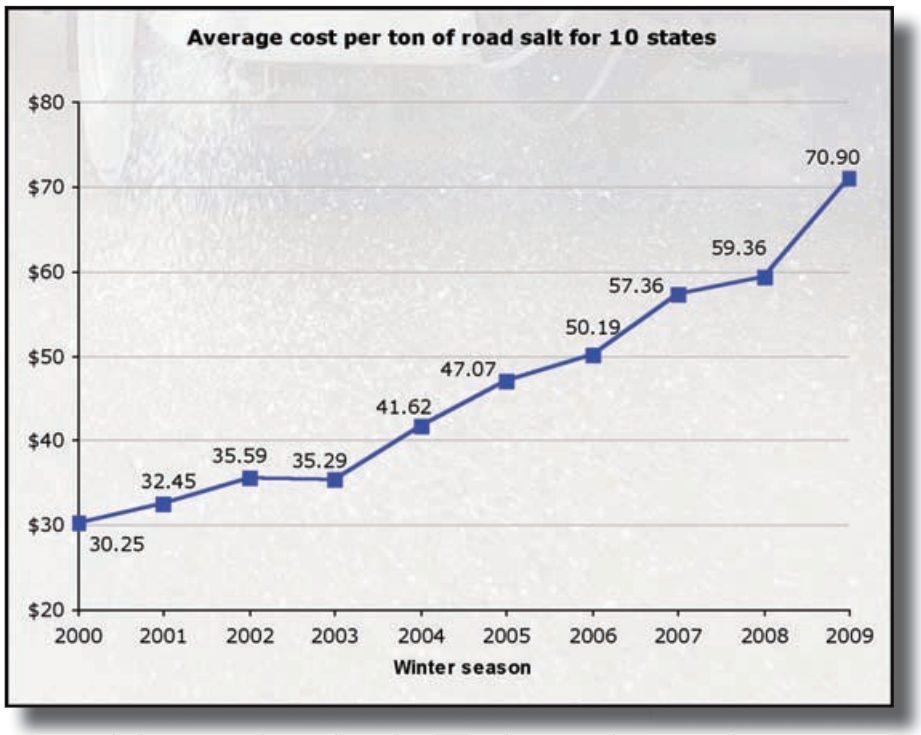
Ground-speed pursuit

To help quantify the value of ground-speed controllers, Clear Roads, a consortium of state DOTs focused on testing winter-maintenance materials, equipment and methods, sponsored a research project to test manual and ground-speed-controlled salt-spreader systems. The test protocols included yard testing and simulated field testing, as well as a survey of practices of DOTs across the nation.

Principal investigator Bob Blackburn of Blackburn and Associates led the independent research project, which was not designed to compare individual system manufacturers or to make product recommendations. Instead, the research sought to differentiate between three types of technologies: manual controllers, closed-loop ground-speed controllers (which monitor truck speed and spreader discharge speed and continually adjust the spreader accordingly) and open-loop ground-speed controllers (which do not have the speed-adjusting feedback feature seen in closed-loop controllers). Most of the systems under consideration control the distribution of solid materials (salt and sand) and liquids (prewetting brine or similar liquids sprayed onto the salt to accelerate the melting process and to help it cling to the road).

Blackburn noted that field testing during winter weather can be a tricky business.

"Each winter and each storm is different, so it can be especially hard to make good, scientific comparisons," he said. "Add to that the hurry-up nature of launching a fleet of snowplows and deicing trucks as a storm arrives, and it becomes clear that data collection is the last thing on everyone's mind when a winter-maintenance department is on alert."



Instead the researchers elected to carefully measure salt discharge in a controlled environment. They compared the system-indicated discharge values with the actual measured amounts and then analyzed how well the different technologies performed. In the process of conducting the research, the investigators received unprecedented exposure to the many issues surrounding spreader-system calibration, including how and when spreaders need to be calibrated in order to perform to specifications.

The test results pointed to ground-speed controllers as clearly superior to manual controllers. An analysis showed that compared with a manual controller, a closed-loop ground-speed controller operating at an application rate of 400 lb of salt per mile could yield a material savings as high as 47%.

"This validated Iowa DOT's assumptions and helped us justify our existing practices and policies," said Burkheimer, whose agency is a Clear Roads member.

As expected, researchers also found greater material savings for roadway tests that included stop-and-go conditions—when operators need to frequently adjust spreader settings—than for freeway tests at a more constant speed. Another key finding was that closed-loop systems outperformed open-loop systems, with the highly integrated closed-loop systems delivering material at a much more accurate rate.

With many states now solely purchasing ground-speed-controlled systems—most commonly the closed-

Price of salt not a worry in 2009-10

The salt crisis apparently has been tossed over the shoulders of public works directors everywhere.

With prices returning to normal levels heading into the buying season, concern has been simply discarded.

According to Dick Hanneman, president of the Salt Institute, the break in snow during the opening months of 2009 helped restore order in the industry.

"The market blipped because there was this real concern, which is a political concern, because no mayor wants to run out of salt," said Hanneman. "Because they were out of salt [in 2008] and because the winter before had been severe, so they had two severe winters in a row, they wanted to make sure this time around."

The cost of salt elevated to as much as $150 a ton during the peak of the panic in 2008. Currently, Hanneman believes it could be selling as low as $55 a ton. Some agencies, taking advantage of early delivery and multiyear contracts, paid more in the area of $40 a ton last year.

Some thought if they would submit their bids earlier heading into the 2009 season they could fight off any price hike. Hanneman, however, believes the early birds might end up paying even more because if demand is down the price will follow.

"Prices really were all over the lot last year. It was never more chaotic since I have been around," added Hanneman.

loop variety—this research comes at the right time. For example, the Wisconsin DOT, a Clear Roads member agency, will move entirely to ground-speed-controlled spreaders by 2010. "With the Nov. 1, 2010, deadline approaching for all trucks used on state winter-maintenance patrol sections to be equipped with ground-speed controllers, the Clear Roads research provides supporting data on why Wisconsin is making this move," said WisDOT Winter Maintenance Engineer Mike Sproul.

Wisconsin doesn't own its winter-maintenance trucks or salt-spreading equipment (the state is unique in this way, contracting all winter maintenance to county authorities), so sharing the message on the proof of ground-speed controllers' benefits will be particularly important.

Make it right

The value of the Clear Roads research extends beyond the demonstration of the advantages of ground-speed controllers. Having gained a wealth of experience by putting the hardware through its paces, the Clear Roads program went a step further and put this knowledge to work by developing a useful, hands-on calibration tool for winter-maintenance practitioners. Clear Roads' "Calibration Guide for Ground-Speed-Controlled and Manually Controlled Material Spreaders" is available for free online along with the research report at www.clearroads.org/research-projects/05-02calibration.html. The guide provides practical step-by-step calibration processes and checklists, and addresses system and hardware maintenance issues raised in the research.

For example, the guide points out that to get the intended amount of snow-and-ice material onto the ground, calibrating once a year is not enough. It recommends calibrating (or recalibrating) spreader and controller systems in any of the following situations:

- When the spreader/controller unit is first put into service; it is important to remember that this hardware does not arrive calibrated;
- Annually, before snow-and-ice control operations begin;
- After major maintenance of the spreader truck is performed and after truck hydraulic fluid and filters are replaced;
- After the controller unit is repaired or when the speed (truck or belt/auger) sensors are replaced; and
- After new snow-and-ice-control material is delivered to the maintenance garage, since the physical properties of these materials can vary.

The guide's detailed information on calibration, verification and acceptance make it a valuable companion to the calibration information supplied by manufacturers.

One agency that is making the most of the guide is the Minnesota DOT, a Clear Roads member. Linda Taylor, former statewide maintenance research and training engineer and current director of research services, describes how the research and the calibration guide dovetail with Mn/DOT's best practices for environmental stewardship.

"We are always looking for ways to reduce the amount of material used in winter highway maintenance, aiming for that target of 'the right amount at the right time in the right way,'" Taylor said.

"Before this research project, we had already been transitioning our fleet to exclusively use the closed-loop type of ground-speed-controlled spreaders and had established calibration as a best practice," she said. "The results from this research project and the calibration guide drove home the importance of calibration and helped us address all the necessary issues to make sure that we're doing calibration correctly.

"As an added bonus, the project brought to light features on ground-speed controllers in our fleet that we didn't even know about," she said. "Minnesota has been taking advan-

tage of these advanced control features to make the most of assets that we already own."

Mn/DOT has shared what it has learned among field offices around the state and has incorporated the lessons from the study into its training programs. "We've made believers out of maintenance staff across the agency," Taylor said.

Spread the blame

"We have always stressed calibration in our state," said Tim Jackson, maintenance liaison engineer for Clear Roads member agency Missouri DOT. "But this research did more than just look at spreader controllers. It brought out the importance of looking at the rest of the system as well, such as the hydraulics, gears and motors. These have to be integrated and calibrated properly if they're going to perform the way they're expected to."

Iowa DOT's Burkheimer agreed. "It's important to select components that will work together and do the job that's required," he said. "Only then can you turn to calibration for fine-tuning. If a system is incapable of delivering what you want, all the calibration in the world won't make much difference. For example, the Clear Roads research project looked into why a certain salt-spreading system was underperforming, and it turned out that spreader calibration wasn't the problem at all. Instead, the auger used to deliver the salt simply wasn't designed to handle the combination of the high vehicle speeds and high distribution levels that it was being called upon to deliver. Clearly, a systems approach on the hardware you're actually using is the only way to maximize performance."

Since every material delivery system is configured differently and every user has unique needs, the Clear Roads research results and calibration guide are good starting points for state, county, local and private users alike to make the most of their hardware with the least amount of material. As salt prices continue to go up and snow continues to come down, proper selection, integration and calibration of material spreaders is a clear necessity. R&B

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