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BETTER Roads®

Randall Reilly

SPECIAL SNOW REPORT

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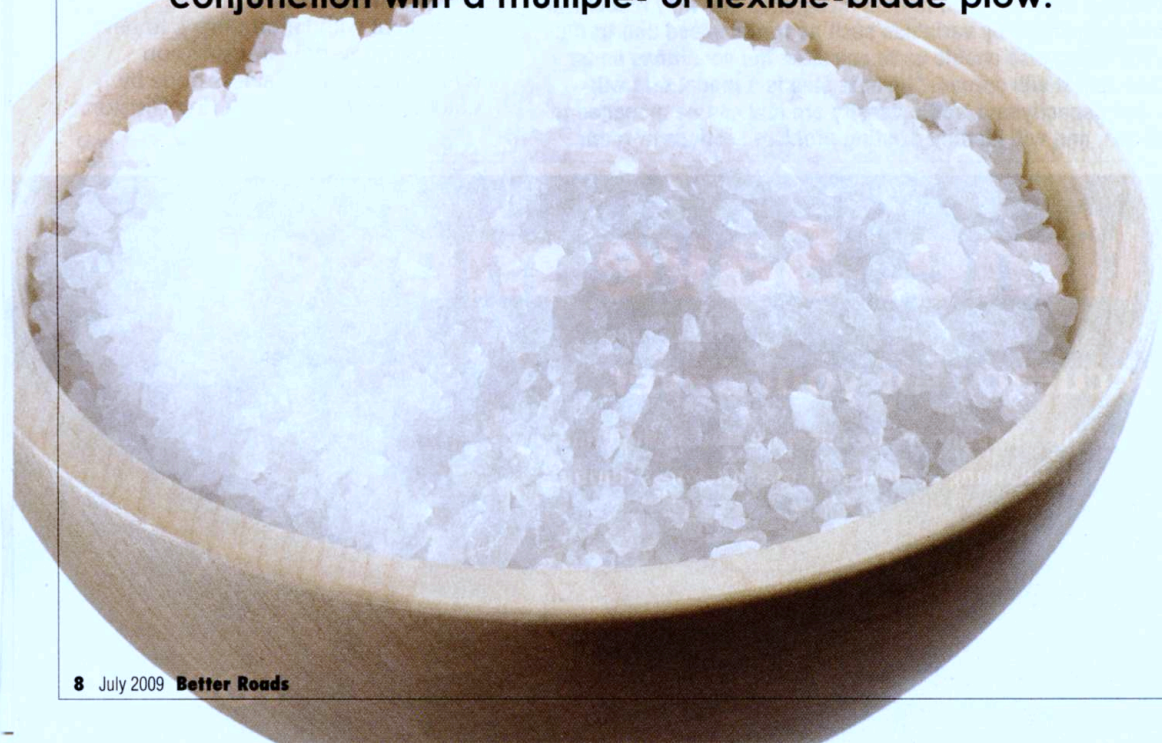
JULY 2009 www.BetterRoads.com

by Tina Grady Barbaccia

On the [Clear] Road Again

Add equal parts calcium chloride and sugar beet — corn syrup or sugarcane may be substituted — to a saltwater brine mixture and apply to roads before salting. When finished, you'll have a recipe that will keep the salt on the road and ice at bay. The recipe serves federal, state and local agencies. For added oomph, use in conjunction with a multiple- or flexible-blade plow.



Winter maintenance can be like cooking. Sometimes it takes a little experimentation to get exactly the right combination of ingredients. But once you do, you have a recipe for success.

▲ ***Training is essential*** *for a proficient winter maintenance program. The Salt Institute has a free "Snowfighter Training" program to help agencies manage their winter operations most effectively. Materials may be downloaded at www.saltinstitute.org/content/download/484/2996.*

Photo courtesy of McHenry County (Illinois) Division of Transportation

Illinois' McHenry County Division of Transportation stumbled on a great "recipe" for de-icing through in-house blending of liquids. As liquid technology for de-icing continues to evolve, state and local agencies have started in-house blending with saltwater as the base and a mix of various organics.

"Agencies commonly use more than one liquid – saltwater when it's warm and calcium chloride when it's cold," says Mark DeVries, maintenance superintendent, McHenry County Division of Transportation. "When one of our [county] operators was changing from one tank [of liquid] to another, we discovered a mix of liquids that works well."

DeVries says it's difficult for an equipment operator to tell what's in a tank inside the truck. And the liquids can only be mixed in certain amounts. If the wrong amounts are mixed, he says, it makes a mixture with the consistency of mayonnaise.

"We thought, 'Why can't we put a valve in the building and control what comes out so no one makes mistakes?" DeVries notes. "We came up with a system to do this. Then we said, 'Why can't we mix some other liquids together?' We ended up building a system that could blend liquids and then discovered a good mix."

Blending liquids in house "is much less expensive for us to do than to purchase mixes and have it trucked in," DeVries says. "Now we have the ability to change a mixture when we need to. We can be versatile–we can use only saltwater if that's what we need; if we want to make a hotter mixture, we can add calcium chloride when it gets very cold. Or we can add organics such as sugar beet products, corn syrup and sugar cane."

An order of sweet and sour

Adding in sugar-based organics helps the liquids stick better to the roads, which ultimately reduces the amount of salt that needs to be used in tandem with the liquids, and it provides a residual effect. "Think about spilling a Coke on the floor," DeVries says. "Two days later, you can walk through it and it's still sticky. The sugars help our products stay on the road longer so we get a longer residual effect. The salts being put down on the roads stay longer, too. There's less bounce [of salt] off of the roads."

Helping the salt to stick also helps reduce the amount of salt needed and how often it must be reapplied. DeVries says if an agency isn't using liquids, it should be. "Use them in pre-wetting to get the salt wet as it adheres to the pavement," he says. "You should never put salt down dry. Studies have shown that you can lose 30 percent off the roadway from scatter, bounce, and traffic. Get it wet with saltwater and reduce that number to 4 percent. That is huge in itself."

Sugars and salts also have a synergy that can provides myriad benefits, DeVries explains. When mixed together, the freezing temperature remains unchanged, but the working temperature changes and there are some benefits.

The most common mixture DeVries says his county is using is 85 percent saltwater, 10 percent of an organic sugar (whether is sugarcane, corn syrup, sugar beet products, or another type of natural sugar), and five percent calcium chloride – a mixture that has been dubbed "Supermix." The other recipe for deicing the county uses is 80 percent saltwater, 10 percent sugar beet and 10 percent calcium chloride. "This mixture gives you a little more kick," he says.

Although it's common practice for manufacturers to produce in-house blends, it's a relatively new practice for local and state agencies in the United States. Austria and Sweden have regularly producing in-house mixes for about the last five years. "It's common for agencies to use more than one liquid," DeVries says, but not for them to have their own system for blending the various liquids. "But now combining liquids on your own has really taken off."

A handful of transportation agencies have begun investing in in-house blending systems. The Washington state DOT just spent nearly $500,000 building its own blending sys-

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tem. Ohio has at least two sites for blending, some agencies in Minnesota have started using in-house systems, and the City of Beloit, Wis. – which won the Excellence in Snow and Ice Award from the American Public Works Association – also is now using an in-house blending system, with the help of a contractor.

But even these advances in liquid technologies don't lessen the concern for good salt management practices. Sure, less salt may need to be used. But the need for it hasn't gone away. Neither has concern about the environment.

Brine has been shown to be an effective tool in the battle against snow and ice and should be carefully considered for use when preparing for winter storms. The percentage of salt in the brine solution is one of the keys to success with the use of brine. But use of too much or too little salt brings up the freezing point when direct liquid applications are being used. If the liquid is being used to pre-wet salt, though, it is only important that the brine has enough salt to keep it from freezing on the truck. When dry salt is pre-wet, the brine coming off that salt is saturated (>23% salt, up to about 26% salt depending on temperature). Once a saturated brine is put onto the pavement, it either dries – i.e. increases its concentration and can crystallize – or it dilutes if moisture is present, such as if it's snowing and the dilution raises the temperature at which salt works.

▲ ***Organics such as sugar beet, sugar cane or corn syrup** can be mixed with saltwater and calcium chloride to make an anti-icing blend that's applied prior to a snow or ice event to keep salt on the road longer. This residual effect helps to reduce the amount of salt needed and how often it must be reapplied.*

Photo courtesy of the McHenry County (Illinois) Division of Transportation

Not only is managing salt in a pre-wet or liquid application situation important, but so is salt management as a whole. Proper salt management ranges from how it's stored, when it's used, how much is used and the equipment through which it's delivered.

For the past two years, salt availability has been an issue for many areas of the United States, particularly the Midwest. This was a problem that agencies anticipated even prior to the start of the snow and ice season, although it's usually not until the end of the season – or during a particularly rough winter – that the salt supply becomes an issue, points out Dick Hanneman, president of the Salt Institute. The problem was that the past few winters have been particularly harsh, with record-setting snowfall totals for much of the Midwest and Canada, he says. But there wasn't an actual shortage of salt. Hanneman says that there is "an inexhaustible supply of salt, but the logistical bottlenecks and current market conditions were augmented by a severe capacity crunch" as the salt supply pipeline was restocked.

Moving the salt was – and is – the real issue. Some of the salt that is used, for example, in northern Illinois is being shipped in from the United Kingdom, and other areas are getting their salt from Chile, Brazil, India, and Saskatchewan, Canada. When the winter season starts out with some severe

The Salt Guessing Game

Planning for a party, it's sometimes hard to discern how much food and beverage you need. You don't want to go overboard, but at the same time, you want to be well stocked so you don't run out. The same could be said about your salt order for the snow and ice season. Estimating future salt requirements is tough, but the following guidelines from the Salt Institute can help:

- Calculate your average usage during the past five years to arrive at your target for pre-season delivery.
- Be sure to take into account new mileage added to your road or street system.
- Take into account improvements in winter maintenance, such as going to straight salt or adding more salt routes. When anticipating needs, make realistic estimates, but be sure to consider the possibility of unseasonable or prolonged cold spells, with more snow or ice than usual. All of these conditions, often unpredictable, can affect your use of salt.
- Order salt by mid-Summer to ensure delivery by early to mid-Fall.
- Check the calibration accuracy of manual and ground-speed-control spreaders.

The Salt Institute suggests using the S-A-L-T-E-D advice when choosing where to store your salt: **Safety**, **Accessibility**, **Legality**, **Tidiness**, **Economy**, and **Drainage**. The organization gives these tips about making your decision:

- **Safety** means good visibility for operators, no direct access onto heavily traveled roads, warning signs at entrances, security fencing, and safety for the surrounding environment.
- **Accessibility** means easy access for equipment and delivery trucks, big enough for front-end loaders to maneuver, room for a 20-foot extension of the pad in front of storage buildings, and doors large enough to accommodate equipment.
- **Legality** means complying with local zoning ordinances and any required discharge permits.
- **Tidiness** means making buildings as attractive as possible, keeping buildings well maintained, good housekeeping around the storage site, and screening the storage site with fencing or plantings.
- **Economics** means permanent covered storage and locating the storage site to avoid long distance hauling.
- **Drainage** means good drainage away from the stockpile, sloping bituminous pads (1/4 inch per foot downward from the center), containing runoff, installing retention curbs if necessary, and disposing of salt brine in conformance with applicable federal and state regulations and local ordinances.

ice storms, the salt supply for which agencies have contracted early in the season becomes depleted. So though salt is physically available, it's often under contract for other agencies or salt reserve sources have been exhausted. That means salt has to be secured from other non-local avenues, driving up prices because of transportation costs. Adequate storage ensures enough salt to fight winter storms, without the problem of arranging emergency shipments throughout the winter months, the Salt Institute advocates.

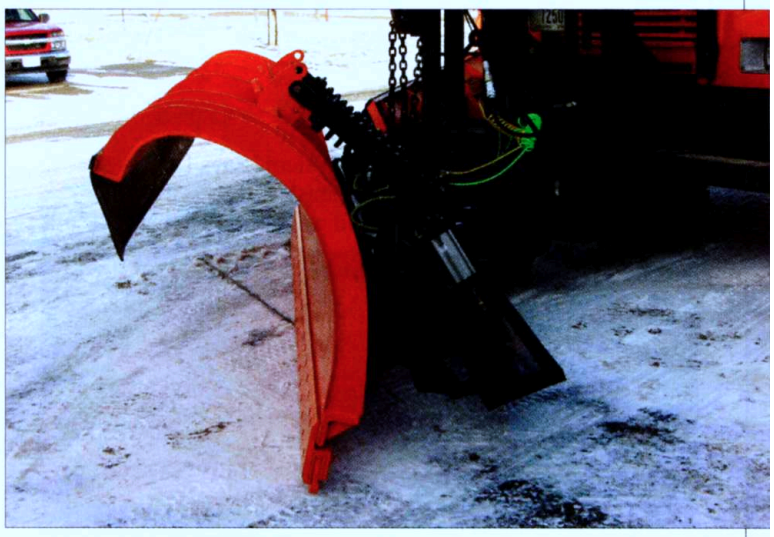
That's just one salt management technique. "Salt tracking"– keeping track of where it's placed – is another. Although this management practice is "very much a work in progress right now," notes Wilfrid Nixon, professor of civil and environmental engineering for the University of Iowa, but it's becoming more widely adopted. "Conceptually, if you have electronic controllers on your spreader and GPS

> **"It's important to use only what deicing material is needed to do the job and a properly calibrated ground speed control system can help conserve valuable resources."**
>
> — Dennis Burkheimer, winter operations administrator with the Iowa DOT and Clear Roads project adviser

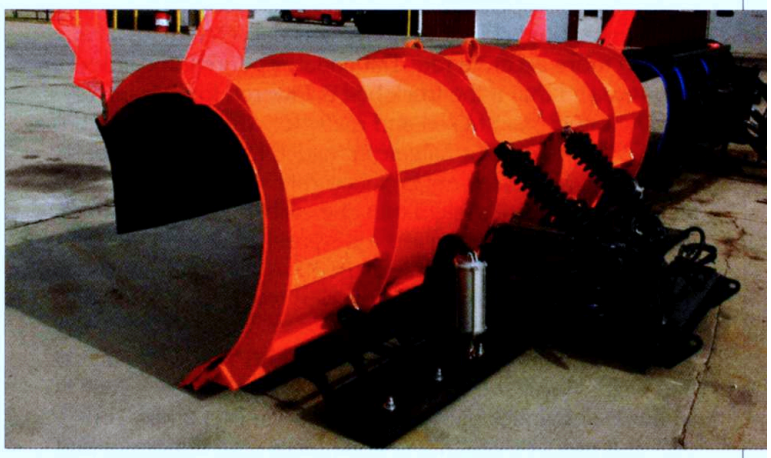
or AVL (automatic vehicle locator) capability for your truck, then you simply need to combine data from the two and you should have a pretty good record of how much salt was put where." However, Nixon says, "Going from concept to reality is not necessarily easy."

The Clear Roads project (*www.clearroads.org*), a pooled fund research program through a consortium of state DOTs aimed at rigorous testing of winter maintenance materials, equipment and methods for use by highway maintenance crews, spent two years researching ground-speed controller systems. Every state has a system on plow trucks that monitors the amount of salt coming out of it, "but no one has ever verified that [the systems] work as advertised," Burkheimer explains. "If there is a truck going 45 mph and it's supposed to put out 250 pounds of salt per lane mile, if it slows down to 10 mph, will it still put out the same amount?"

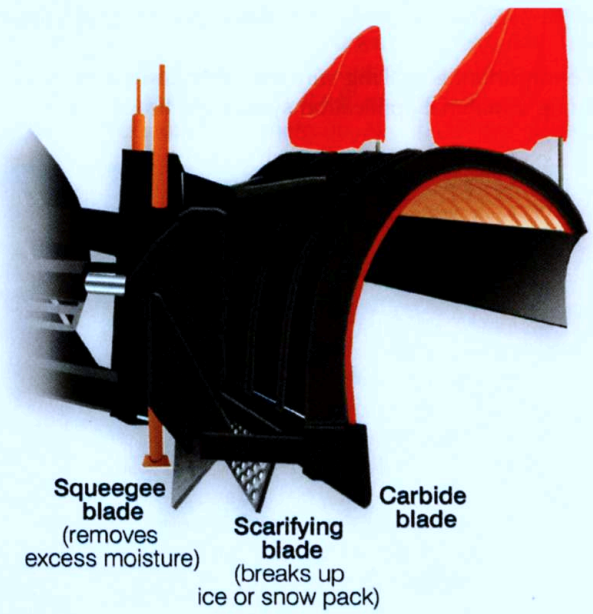
The project, headed up by the Wisconsin Department of Transportation, compared the automatic ground-speed-control systems to manual systems to determine the accuracy of the precision and accuracy of the different systems with delivery the desired quantities of salt and other chemicals – essentially tracking the materials dispensed onto the roads. The study, *Calibration Accuracy of Manual and Ground-Speed-Controlled Salters* (project CR2005-02). Researchers also found greater savings for variable-speed roadway tests that included stop-and-go conditions than for freeway tests at a more constant speed, which may be of particular interest to municipalities. "It's important to use only what deicing material is needed, a a properly



▲ ***This prototype multiple-blade plow built by Flink*** *for the Iowa Department of Transportation has a flexible edge, referring to the flexible carbide-cutting edge. It is currently being tested in Iowa.*



▲ ***The Iowa DOT designed and built this multiple-blade plow at the shop level. Four different companies subsequently made multiple-blade plows based on the Iowa DOT prototype after the agency enlisted their help. The blades are being tested in five states.***



Photos courtesy of Iowa Department of Transportation/Clear Roads

calibrated ground-speed- control system," says Dennis Burkheimer,winter operations administrator with the Iowa Department of Transportation and an advisor to the Clear Roads project.

The Iowa DOT developed a "Wanted" poster showing that when ground-speed-control systems apply just 10 percent more material than indicated, it costs more than $1 million per year.

Other key findings include the revelation that closed-loop control systems perform better than open-loop systems, and highly integrated closed-loop systems delivered material at a much more accurate rate. Data analysis during the study also revealed that if the truck bed is lowered for storage or loading rather than raised and ready for roadway operation during calibration of a tailgate spreader, the calibration and resulting spread rates will be inaccurate. According to the study, "This kind of system must be calibrated with the truck in its in-service configuration…[because]…a truck's ground-speed-control system is only as good as the components that make up its solid material delivery system, including hydraulics, gear ratios and motors."

This study served as the impetus for the "Spreader Calibration Guide" (available on the Clear Roads Web site) – for winter maintenance operators. Calibration isn't a new concept. But properly calibrating equipment is so important and sometimes overlooked. "Calibration is an old practice, but a lot of people assume when they buy something, they can just 'plug it in' and it will be accurate 100 percent of the time. That's not always true. You need to adjust systems appropriately. Train your operators to do this properly," Burkheimer says.

Also important is making sure the other components that make up a material application system are tuned into it, Burkheimer explains. "The hydraulics and auger should be matched to the ground-speed-control system," he says. "If you set the system at 250 pounds per lane mile, you need to make sure it's actually putting out 250 pounds."

Burkheimer says that through the Clear Roads study and field tests, "We discovered that many systems did not perform well at all speeds or all application rates.

In cities where trucks are in constant stop-and-go traffic, it's especially important to make sure ground-speed-oriented systems are putting out the correct amount of material "and not putting out gobs of salt when they're stopped," Burkheimer quips.

To emphasize this point, Burkheimer's agency developed a "Wanted" poster showing that when ground-speed-control systems apply just 10 percent more material than indicated, it costs more than $1 million per year. "Depending on the size of a fleet, that can add up to a significant amount of money. We're really stressing the importance of calibration when using these systems and to conserve salt and the environment when using the systems."

The third blade is the charm

Triple-blade razors have been all the rage, with their manufacturers touting a cleaner and closer shave. Now, multiple-blade of multiple-rate plows are being tested to get cleaner and clearer roads. The Clear Roads project developed a multiple-blade plow concept and has worked with plow manufacturers Henke, Flink, Monroe Truck Equipment and Henderson Manufacturing. The prototype blades were tested last year – and will be further tested this coming winter – in Iowa, Ohio, Indiana, Wisconsin and Minnesota, Burkheimer says. The front blade is a flexible-edge blade, allowing it to adjust to the contours of the roadway, followed by a scarifying blade to help break up any hard-packed snow or ice. The final blade is made of rubber to help remove any snow, slush or other material left by the first two blades. "The goal is to make sure we remove as much snow as we can from the roadway with this plow combination so we have a clean road surface, and so that any is ready to work," Burkheimer says.

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How much liquid do I need?

The amount of liquid de-cier needed when pre-wetting varies on the mixture, but the typical suggestion is between 4 and 8 gallons of liquid per ton of dry material, explains Wilfrid Nixon, professor of civil and environmental engineering for the University of Iowa. "However, there is increasing evidence out of Europe that much higher rates of pre-wetting — up to 50 gallons of liquid per ton — may bring even more benefits," he points out. Some of the more sophisticated spreaders, such as the Assaloni spreader, have this type of capability. But this means adjusting how much liquid versus how much solid is loaded onto a truck.

Oftentimes, a standard front plow with rigid blades will often go over the top of the snow or leave 1/4-inch to 1/2-inch of snow, Burkheimer says, adding that then any material that comes from the back of the truck will have to work on the leftover snow. "If we can clear the roads bare or as close as possible to the bare road, we can potentially cut back on the material used," Burkheimer points out.

The Iowa DOT also developed a flexible-edge blade to better clear the roads. "We felt a front blade in smaller segments with the ability to adjust to the contour of the roadway would be beneficial," Burkheimer says. "Since no manufacturers were currently making blades in 1-foot sections, we decided to build our own."

Burkheimer says that the agency is hoping that manufacturers will begin offering blades in 1-foot sections, like the one that the Iowa DOT developed. "We just built at the shop level," he says. "But we've done all we can do with it. Now we need someone that knows about rubber densities and that can really refine it into the manufacturing process."

But the blade doesn't stop here. Burkheimer says his agency – and others – continue to try to find new ways to improve equipment and methods.

In doing so, you may just stumble upon that recipe for winter maintenance success. ❖

Did You Know?

From a typical base of 16 million to 17 million tons of highway salt sold annually in the United States (adjusted from the 12 million that was noted as typical just a few years ago), 20.5 million tons were sold in 2005, says Dick Hanneman, president of the Salt Institute. In 2006, 12.1 million tons of highway salt was sold, and in 2007, 20.3 million tons were sold — about a 2/3 increase from 2006 to 2007, he points out. Last year, that number jumped to 22.2 million tons of highway salt sold.

Creating stronger salt supplier relationships

The Snow & Ice Management Association (SIMA) is holding a Webinar titled, "Creating Stronger Relationships with Bulk Salt Suppliers" on July 15 at 3 p.m. EST. The session will feature speakers Mike Betts and Todd Martin of With a Grain of Salt, and will focus on managing salt as a snow and ice management professional.

The Webinar will be available in an archived on-demand format, as well as on CD-ROM. For more information or to register, call 414-375-1940 or visit *http://webinars.sima.org*.