New Temperature-Based Cost Model Compares Effectiveness of Deicers

What Was the Need?
With shrinking budgets, rising prices for winter maintenance materials and an interest in limiting environmental impacts, MnDOT and other transportation agencies are seeking tools that can help snowplow operators apply deicers and anti-icers in “the right amount at the right time in the right way.”

While researchers have long been examining the effectiveness of deicers under laboratory conditions to predict how they will perform in the field, relatively few studies have examined the temperature-specific ice melt capacity of deicers: the amount of ice melted—or brine created—given the amount of deicer applied. Coupling an assessment of ice melt capacity with performance factors such as application rates and roadway surface will help winter maintenance supervisors reduce reliance upon anecdotal observations and vendor claims when trying to select the most appropriate deicer for a given situation.

What Was Our Goal?
The objective of this research was to develop a temperature-based cost model for comparing the relative field performance of deicers and deicer blends by evaluating the ice melt capacity and other factors that can contribute to deicer performance.

What Did We Do?
Researchers began by meeting with MnDOT staff to assess existing winter maintenance practices and identify samples for testing based on differences observed among deicers and deicer blends most often used by MnDOT. The test method, developed specifically for this study based on Strategic Highway Research Program methodology, analyzed more than 1,200 samples of 20 granular and liquid deicers of three types:

- Individual deicers.
- Salt brine blends (a liquid deicer blended with salt brine).
- Rock salt stockpile treatments, in which a liquid deicer is applied to rock salt as an additive.

Samples were tested at 11 temperatures that ranged from +30 °F to -50 °F, in 5 °F increments. In addition to ice melt capacity, researchers examined four other factors that could contribute to better relative performance of the deicers: bounce, ice penetration, ice undercutting and grain size.

What Did We Learn?
Researchers found that of these factors, ice melt capacity has the greatest impact on deicing, with the ice melt capacities of both individual deicers and brine blends closely related to application temperature. However, in the temperature range tested (5° F to 30° F), none of the three deicer types tested demonstrated substantial improvement in ice melt capacity over the control (rock salt). While some of the individual deicers showed a dramatically reduced ice melt capacity as compared to rock salt, researchers
noted that the other benefits of these deicers, such as improved adhesion to the roadway and a low chloride content that limits environmental impacts and corrosion, may outweigh the products’ more limited ice melt capacity.

Using the results of the ice melt analysis, researchers developed a spreadsheet-based cost model that compares the cost and effectiveness of a deicer or deicer blend with a commonly known control—rock salt at 28 °F—across a range of temperatures to generate a cost per lane mile. The model can be used with neutral field conditions so that only ice melt capacity, cost and temperature are considered. Alternatively, other performance factors such as application rate, ice thickness, pavement material and sun/wind conditions, which have been given subjective weights by the research team, can be added to the cost per lane mile equation.

The spreadsheet tool’s input screen allows users to select or specify:

- Deicers to consider and show on graphs.
- Delivered costs of deicers.
- Performance factors to be considered.

A graphical output displays two graphs (one each for granular and liquid deicers) with deicer cost per lane mile by temperature with and without performance factors. The model can analyze products used in deicing, anti-icing and prewetting applications.

What’s Next?

This study provides strong evidence that ice melt capacity is a substantial factor in determining the cost-effectiveness of deicers and anti-icers at a given temperature. A second phase of this project, expected to begin by early 2013, will expand on the results of the current project’s lab studies of ice melt capacity with real-world tests on actual pavements under conditions comparable to those tested in the lab. By quantifying the significance of other factors affecting deicer performance—traffic levels, truck volumes, weather, pavement type and age, plow cutting edge, application frequency and others—researchers will refine an evaluation tool that can help MnDOT’s winter maintenance managers select the most effective treatment for a wide range of winter conditions.

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