CLEAR ROADS
research for winter highway maintenance

RESEARCH BRIEF

JUNE 2024

STANDARDIZED TEST METHODS FOR DEICER ICE MELTING PERFORMANCE

RESULTS SUMMARY

Further investigation and refinement of a new ice melting test method has moved the laboratory test toward becoming a national standard, giving state DOTs a simple, low-cost way to ensure the most effective deicers are used to clear roads in winter.

PROJECT DETAILS

Project Title: Standard Method of Test for Mechanical Rocker Ice Melting

Project Number: CR18-06

Project Cost: $74,087

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Need for Research

While winter maintenance managers rely on the Clear Roads Qualified Products List to choose safe deicing products that protect infrastructure and the environment, they also need to ensure ice melting performance. With the wide variety of deicing products available, testing the ice melting capacity is one way to compare deicers and ensure they are working as intended.

One test method for comparison and quality control of deicers measures the volume of brine produced in the melting process. Due to concerns over the accuracy of this test for solid and liquid deicers, other methods have been developed over the years. Ice melting tests, however, have been historically difficult to perform in a repeatable, reliable manner.

Since 2009, two Nebraska Department of Transportation (Nebraska DOT) projects have developed and continued refining a shaker ice melting test method for liquid deicers, which ultimately became the mechanical rocker test. Clear Roads agencies wanted to build on this foundational work to create a standard test protocol to ensure optimal performance from deicing materials.

Objectives and Methodology

To provide a standardized laboratory test method that is repeatable, low cost and user friendly, researchers evaluated and refined the mechanical rocker test. In previous research, the shaker test started with an insulated cocktail shaker, ice cubes and deicer material. The protocol was simple and the equipment low cost. Unlike previous test methods, the shaker test measured the change in mass of the ice cubes when shaken with the deicer, which is an advancement over brine volume measurement. With relatively modest equipment improvements and refined methods, the mechanical rocker test showed significant promise in simulating the impacts of vehicular traffic on ice.

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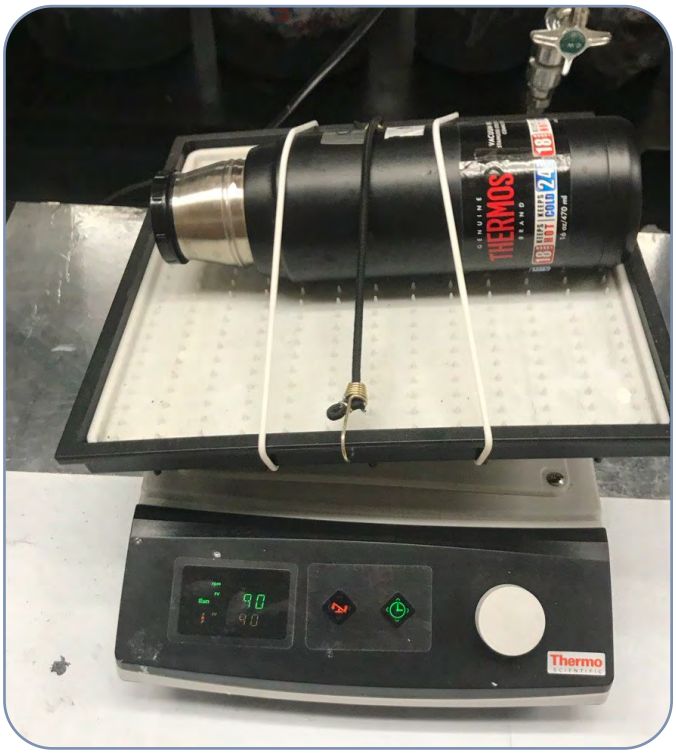

By approximating the impacts of traffic on road ice, the mechanical rocker test for ice melting capacity gives state DOTs an objective, easy-to-use method to compare and have confidence in deicer choices. (Photo courtesy of Washington State University)

This project used a round-robin strategy consisting of eight laboratories performing the mechanical rocker test on seven commercial liquid deicers while varying test parameters. By using the same methods with slight differences in equipment and different personnel, the consistency of results between labs could be explored to determine the reproducibility of the test method and assess its repeatability. Variables examined included the tilt angle, rotational frequency and duration of the mechanical rocking, ice cube tray capacity and shape of the thermos. Ice melting capacity was measured at 15°F and 0°F, depending on the active ingredient of the deicer. Researchers evaluated the test results and protocol against ASTM standards for precision and conducting an interlaboratory study.

Results

The interlaboratory testing indicated a strong ice melting test method ruggedness, meaning that external factors have little influence on the reproducibility of the results across labs, staff and equipment. Any observed changes in ice melting capacity due to tilt angle, rotational speed and duration of the mechanical rocking were not statistically significant. The thermos shape and volume of ice cubes also did not correlate with significant change in ice melting capacity.

While no significant variability of results among labs occurred when ice melting capacity was measured at 15°F, a statistically significant difference in results occurred among labs when the measurement was taken at 0°F. The variability likely resulted from varying ambient temperatures as the ice cubes were being transferred. Recommendations to minimize interlaboratory differences include limiting the variability between samples tested and using certified reference values for existing products to compare to deicer melting performance.

Benefits and Further Research

With the capacity to validate performance and compare products, the mechanical rocker test for ice melting capacity is an inexpensive and quick method for transportation agencies to choose the right liquid deicing material at the right time and application rate. Project champion Jasmine Dondlinger and colleague Mike Mattison, both from Nebraska DOT, described project results and benefits in *Shaken Not Stirred—The Rocker Ice Melting Test Method*, a recent episode of the American Association of State Highway and Transportation Officials (AASHTO) *Talkin' Winter Ops* podcast.

Clear Roads representatives and other state DOT officials presented the test method to the relevant AASHTO committees in late 2022. AASHTO has provisionally approved the test method as a national standard, which will lead to further use, feedback and refinement.

"A standardized, repeatable test method for deicers will allow DOTs to quickly and inexpensively compare products to have confidence in their procurement choices."

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