CLEAR ROADS
research for winter highway maintenance

RESEARCH BRIEF

APRIL 2025

USING ADDITIVES IN DEICING SALTS

RESULTS SUMMARY

Laboratory tests of eight deicers with additives did not identify a clear-cut best performer. But the results could help select a deicer for specific temperatures or management scenarios.

PROJECT DETAILS

Project Title: Effects of Additives in Deicing Salts at Lower Temperatures

Project Number: CR22-03

Project Cost: $149,993

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Need for Research

During winter weather events, transportation agencies treat roads to improve highway safety. One of their primary tools for improving safety and keeping roads open during winter is the use of rock salt.

Some products claim to have improved performance over road salt due to various additives; insolubles, such as naturally occurring minerals; or variations in particle size. For example, some mined salt contains minerals other than sodium chloride, such as calcium or magnesium chloride, which may work at colder temperatures than sodium chloride. They can also contain various particle sizes, which can contribute to longevity of performance. Combining salts with common additives such as corrosion inhibitors, anticaking agents, cold temperature modifiers, thickeners and friction enhancers can increase the effectiveness of the deicer, allowing it to work more quickly or remain on the pavement longer.

To inform winter maintenance operations, Clear Roads member agencies sought an evaluation of the effects of additives commonly used in deicers for winter maintenance operations. An investigation of the performance and benefits of deicers would contribute to project findings. Winter operations managers could then incorporate the results from these efforts with their on-road application experiences to provide a more comprehensive picture of deicing alternatives available to effectively treat roads.

Objectives and Methodology

This project's objective was to investigate and evaluate the effects of common additives used with deicers for winter road maintenance. As part of this effort, investigators explored the qualitative and quantitative benefits of the additives and deicer performance relative to sodium chloride.

A literature review investigated the effects of additives on the three most common chloride-based deicers: sodium chloride (rock salt or salt brine), magnesium chloride and calcium chloride. The review included an examination of the impact of additives on performance, such as changes in eutectic temperature, ice-melting capacity, ice undercutting, ice penetration, and road grip or friction.

Investigators obtained information about commonly used deicers with additives by surveying state and local transportation agencies along with vendors and

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Selecting a deicer with additives can increase the deicer's effectiveness and limit the negative impacts of application.

manufacturers of deicers and additives. The surveys specifically inquired about the use of deicers with additives, their benefits and impacts, and the availability of any data or resources regarding their use.

In the laboratory, eight solids and prewet solids were tested to evaluate the influence of additives on chloride-based deicer performance, including the freezing point or eutectic temperature, ice-melting capacity using the rocker test and pavement friction. Rock salt served as the control for solids, and rock salt prewet with salt brine served as the control for prewet solids.

Results

Findings from the literature review indicated that chloride-based salts are the most common deicers used in winter maintenance operations, based on cost and practicality. However, their use can have negative impacts on infrastructure and the environment. Additives can mitigate these effects, such as using an anti-corrosive additive to limit corrosion to metal or a cold temperature modifier to increase effectiveness in extreme weather.

State and local transportation agencies identified five reasons for using additives in chloride-based deicers: better snow and ice removal performance, cold temperature modification, longer residual on the pavement, cost-effectiveness and reduced corrosion.

The laboratory results showed little difference among all solids and prewet solids with a eutectic temperature range of -4.0° to -7.4°F, primarily because all of the tested materials were composed of rock salt. However, prewetting solid salt at higher application rates may result in a significant difference in eutectic temperatures.

In the unvalidated mechanical rocker test, the prewet solids performed better than solids that were not prewetted by melting the most ice at both 25°F and 15°F (after 15 minutes). Top performers were sodium chloride prewet with beet juice, sodium chloride prewet with magnesium chloride and sodium chloride prewet with a commercial additive.

The laboratory results for friction did not identify a best performer. The friction testing results changed over time for each temperature and pavement type, which indicates that additive performance may improve at different times or due to varying conditions.

Implementation and Benefits

While no definitive rankings of additives were achieved, individual agencies can reference the results to help them determine the best deicing additives for their specific situations.

"Although these findings are the result of testing in a laboratory-controlled environment, when used in conjunction with real-world performance and observation data, they could be used to further inform winter operations managers when selecting potential deicers."

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