Research Brief

Wisconsin Highway Research Program
Project 0092-17-03
July 2018

Evaluation of the Effects of Deicers on Concrete Durability

Research Objectives

- Identify the use of various deicing and anti-icing materials in Wisconsin
- Investigate the effects of various deicing and anti-icing materials on concrete pavement durability

Research Benefits

- Broadened WisDOT's knowledge of deicing and anti-icing materials and applications in Wisconsin
- Revealed a faster rate of concrete deterioration in counties with higher NaCl, $CaCl_2$ and $MgCl_2$ application
- Integrated winter maintenance database with pavement performance data and provided suggestions to better utilize the data in the future

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Background

Wisconsin experiences approximately 13 to 55 winter events per year, with annual snowfall ranging from 15 to 132 inches. Wisconsin has traditionally used solid rock salt (NaCl) as the primary deicing chemical in winter maintenance. However, recent changes regarding the use of liquid anti-icing solutions and newer deicing chemicals have raised concerns about the potential impacts on concrete pavement durability. Previous laboratory studies indicated that these new chemicals, especially calcium chloride ($CaCl_2$) and magnesium chloride ($MgCl_2$), cause more damage to concrete than rock salt does. Anti-icing prior to winter events causes much more rapid ingress of the deicing chemicals because the dry concrete surface absorbs the anti-icing solution very readily. The objectives of this research were to investigate the use of deicing and anti-icing materials in Wisconsin and the effects they have on concrete pavement durability.

Methodology

Researchers surveyed winter operation managers in Wisconsin's counties and major cities to determine which materials are being used and to gather anecdotal evidence of durability issues. Nearly 90,000 Storm Report records and over 6,000 Automatic Vehicle Location (AVL) records from the Wisconsin Department of Transportation's (WisDOT) winter maintenance database were analyzed and compared to historical pavement performance data. Seven sites were then selected for visual inspection to identify any relationships between concrete condition and the use of deicing and anti-icing materials.

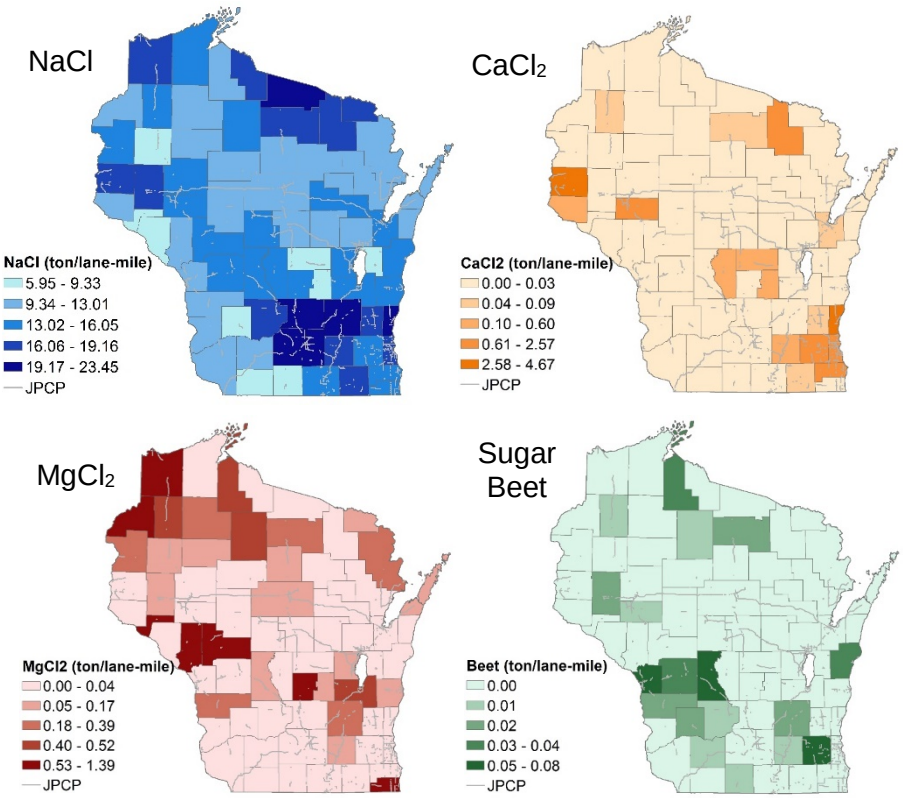
Results

Survey results and WisDOT data analysis confirmed that rock salt and salt brine are still the primary materials used in Wisconsin winter maintenance. For each lane mile in each winter event in Wisconsin, 200-400 pounds of deicing materials and 20-50 gallons of anti-icing materials are applied. This is consistent with WisDOT's Winter Maintenance Guidelines. Storm Report data, which is manually entered by county engineers, show each lane mile of roadway received an average of 13.78 tons of NaCl, 0.31 tons of $CaCl_2$ and 0.16 tons of $MgCl_2$ over the course of a winter, while the AVL database reported 9.9 tons of rock salt and 39.3 gallons of salt brine per lane mile. The application rate distribution for the various chemicals is shown on the following page.

"The findings of this research will help WisDOT reduce concrete deterioration by optimizing deicing and anti-icing material blends, application rates and technology."
– Chad Hayes, WisDOT

Interested in finding out more?

Final report is available at:
WisDOT Research website



The survey identified two problems with deicing and anti-icing materials: accelerated deterioration near joints and bridge decks. There was no statistical difference of impacts on concrete durability between solid salt and liquid brine or between different application rates. This was likely due to other factors beyond the scope of this study. However, field visits to selected locations revealed a faster rate of deterioration in counties with a higher amount of NaCl, $CaCl_2$ and $MgCl_2$ application. Joint spalling at adjoining counties in three of the seven sites was statistically different.

Recommendations for Implementation

It is recommended that rock salt and salt brine remain the primary materials for deicing and anti-icing. $CaCl_2$ and $MgCl_2$ use should be limited to winter events with temperatures below the effective limit of rock salt. Agencies should blend products to optimize deicing/anti-icing effectiveness, and should consider revising application rate guidelines to reflect material and technological advancements.

Expanding AVL coverage, providing more details of material application and making it compatible with other transportation information databases would help WisDOT continue refining its deicing and anti-icing practices to respond to safety, environment and infrastructure durability issues.

This brief summarizes Project 0092-17-03,
"Evaluation of the Effects of Deicers on Concrete Durability"
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