Research Brief

Wisconsin Highway Research Program
Project 0092-21-03
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Evaluating the Impact of Anti-Icing Solutions on Concrete Durability

Research Objectives

- Quantify the impact of applied anti-icing solutions on dry concrete surfaces
- Recommend countermeasures to reduce adverse impacts on concrete pavement and bridge deck durability

Research Benefits

- Determine long-term impacts of anti-icing solutions on Wisconsin roads
- Address concerns regarding possible chloride ingress to concrete
- Establish recommendations for future use of anti-icing solutions on Wisconsin roadways

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Background

Deicing is a snow and ice control strategy of removing compacted snow or ice already bonded to a pavement surface by chemical and/or mechanical means. Anti-icing is a snow and ice control strategy of preventing the formation or development of bonded snow and ice to a pavement surface by applications of a chemical freezing-point depressant before, or in the early stage of, a winter weather event.

Many laboratory studies and field evaluations have been conducted proving the benefits of anti-icing. However, it is also proven that deicing and anti-icing materials cause damage to concrete infrastructure through deterioration of the concrete paste or corrosion of the reinforcing steel.

As anti-icing becomes more popular in Wisconsin, there are concerns that the direct application of anti-icing solutions to pavement may result in much higher anti-icing agent ingress to concrete compared to traditional deicing methods where rock salt is applied to a wet, saturated concrete surface. The penetration of anti-icing solutions may impact long-term durability of the concrete.

Methodology

Three different methods were used to achieve the research objectives. First, researchers conducted a series of tests in controlled environments to compare the damage from deicing and anti-icing on typical Wisconsin concrete. Another method was an analysis of pavement and bridge management system data. Historical performance data of Wisconsin pavements and winter records were analyzed for any correlation between increased use of anti-icing chemicals and damage to concrete infrastructure.

The research team also conducted an accelerated field study at MnROAD where concrete panels from a Wisconsin project were placed and anti-icing and live traffic were applied from 2021-2023. Researchers hypothesized that the hydrostatic pressure from tire load in the field test would lead to more penetration of anti-icing chemicals, causing more damage to the concrete.

Results

Laboratory test results proved that the high-quality Wisconsin concrete mixture exhibited very good freeze-thaw performance. The

"The results of this study show that current WisDOT practice is using 50% less salt with anti -icing and the salt's penetration into concrete has reduced by up to 50%. This is not only beneficial for the environment, but also helps in increasing the lifespan of concrete pavements in Wisconsin."

–Tirupan Mandal, WisDOT

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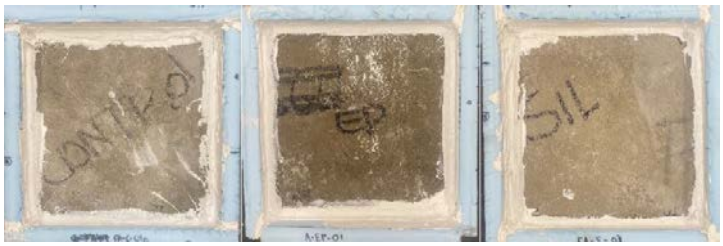
anti-iced concrete samples had roughly half the amount of material loss from surface scaling as the deiced concrete samples.



Deicer scaling specimens before testing
(from left to right: A-FA Control, A Epoxy, A-FA Silane)

Deicer scaling specimens after 50 cycles

Silane surface treatment provided a significant reduction in chloride penetration of around 50% for most conditions and epoxy effectively blocking chlorides low to no chloride penetration into concrete.

Additionally, similar results occurred for the chloride content. Anti-icing uses less salt than deicing, and anti-icing had a similar amount of chloride runoff with deicing, hence less chloride retained in concrete. Therefore, the stated concern of anti-icing possibly leading to more chloride ingress to concrete is unfounded.

However, results from the field study showed the effect from traffic loads and in all cases confirmed the hypothesis that tire pressure greatly increases the ingress of chloride to concrete.

Recommendations for implementation

Based on the results, the research team recommends WisDOT continues the increased use of liquid brine by assisting more counties and municipalities with mixing equipment, storage facilities, tank trucks, staff training and other resources.

Furthermore, current policies on deicing and anti-icing application should be updated based on recent studies such as Clear Roads Project 19-01, and applying protective surface treatment to bridge decks should be continued to extend the service life of the bridge.

This brief summarizes Project 0092-21-03,
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