Blends of corn-based deicers and salt brine showed promising performance in lab tests at deicing at low temperatures and inhibiting corrosion.

RESEARCH SOLUTIONS

New research examines the performance and potential of corn-based deicers

For treating icy roadways, rock salt—sodium chloride—is agencies' go-to choice: effective and inexpensive. But since salt and other deicers can cause corrosion and impact the environment, Iowa DOT is continually exploring alternatives. While not yet widely available, corn-based deicers have shown some promise as an environmentally friendly alternative that could reduce the use of salt. Researchers conducted tests on three types of corn-based deicer solutions, identifying specific blends that performed well and merit future evaluation.

THE NEED

Chloride- and acetate-based deicers are widely used for removing snow and ice from pavement surfaces during the winter. Although chloride-based deicers are inexpensive, they can cause corrosion damage to infrastructure and vehicles. Chlorides can also pollute soil and groundwater and affect aquatic ecosystems. Acetate-based deicers, while biodegradable and less toxic, are more expensive. In addition, they can also damage concrete and galvanized steel, and their melting rates are slower.

Iowa DOT saw an opportunity to explore the development of agro-based deicer solutions that use extractions from corn, the most abundantly grown crop in the state. Ideal corn-based deicers would have better freezing-point depression, higher corrosion inhibition, and enhanced ice-melting capacity compared to chloride- and acetate-based deicers.

RESEARCH APPROACH

Researchers developed several blends of corn-based deicers by

(continued)

"We're always looking to add new options to our toolbox of roadway treatments. Based on the lab testing results, corn-based deicers offer some interesting performance advantages that are worthy of continued research and testing."

— **CRAIG BARGFREDE,**
Iowa DOT Winter Operations Administrator

combining corn juice or corn-derived alcohols (polyols) with salt brine in different proportions. The deicing properties of three polyols—sorbitol, maltitol, and mannitol—were the focus of this research.

To ensure that the research would address the needs of maintenance practitioners, Iowa DOT staff provided input about the most important characteristics of effective pavement deicers. Researchers considered these qualities while developing the test solutions, designing the experiments, and evaluating the results. Through a series of laboratory tests, they measured the performance of the different polyol-brine solutions based on several characteristics:

- Freezing-point depression.
- Corrosion inhibition.
- Ice-melting capacity.

To help identify the best blends, researchers also measured the solutions' viscosity, the skid resistance they generated on pavement samples, and their effect on the dissolved oxygen levels of river water specimens.

WHAT IOWA LEARNED

In assessing polyol-brine combinations, researchers found that specific blends performed especially well in terms of freezing-point depression, corrosion inhibition, and ice-melting capacity characteristics compared with salt brine alone.

The results from the freezing-point depression tests indicated that adding corn juice or corn-based polyols to standard salt brine enhanced the freezing-point depression of the solution. Sorbitol lowered the freezing point the most.

Further testing showed that corrosion damage was suppressed when a blend of corn-derived polyol and salt brine was used. The highest level of corrosion inhibition came from a mixture of maltitol and salt brine.

Ice-melting tests revealed that the blends of corn-derived polyols and salt brine exhibited superior ice-melting capacity at very low temperatures (–10 C to –30 C) when compared to salt brine alone. Of the three polyols, mannitol added to salt brine improved the ice-melting capacity the most at these temperatures.

Based on the test results, researchers ranked the polyol-brine blends and provided recommendations for specific blends that are most ideally suited for melting ice at low temperatures or inhibiting corrosion on concrete pavements and bridge decks.

PUTTING IT TO WORK

While corn-based deicers are effective under laboratory conditions, the practicality of these products is a topic to explore further. Iowa DOT maintenance facilities are currently designed to store and process rock salt, and a shift to agro-based deicers would require significant logistical changes. In addition, these deicers are not yet widely available, and similar products have been cost-prohibitive in the past.

Still, the findings of this research demonstrate the potential of corn-based deicer blends as an alternative to standard salt brine. The next step for Iowa DOT is to explore the real-world implications of the use of these alternative deicers.

ABOUT THIS PROJECT

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