

## RESULTS SUMMARY

An in-depth review of the properties of non-chloride deicers will help agencies assess available alternatives to salt-based products and choose the best product for their deicing needs.

## PROJECT DETAILS

**Project Title:** Efficacy, Cost and Impacts of Non-Chloride Deicers

**Project Number:** CR21-03

**Project Cost:** \$114,946

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# UNDERSTANDING THE COSTS AND BENEFITS OF NON-CHLORIDE DEICERS

## Need for Research

Chloride-based deicers—specifically, salt brine or rock salt—are staples in winter road maintenance operations. Transportation agencies, however, continuously look to reduce salt use to avoid contaminating wells and waterways, causing corrosion on vehicles and infrastructure, and harming vegetation. Non-chloride deicers could potentially serve as viable substitutes in winter maintenance operations, limiting these adverse effects.

Choosing the right deicer for conditions given an agency's budget and other constraints requires an understanding of the advantages and disadvantages of each product. Clear Roads member agencies wanted an in-depth understanding of non-chloride deicing alternatives to guide their winter maintenance product choices and communicate with policymakers and the public about those decisions.

## Objectives and Methodology

The project's goal was to synthesize information about non-chloride deicers to support winter maintenance managers in comparing and choosing the most appropriate deicing material for specific needs. The standards and testing requirements in the [Clear Roads Qualified Products List \(QPL\)](#) specification document were also evaluated.

A review of the literature provided details about deicing, anti-icing and other pavement surface treatments. The review summarized the performance of 46 non-chloride deicing products, including environmental, infrastructure and equipment impacts. This background served as the basis for two surveys inquiring about deicing products. First, investigators queried state and local transportation agencies about their use of non-chloride deicers such as acetates, formates or agriculture-derived products. Agency respondents described the methods and application rates used and explained product choices. They also provided information about product temperature ranges, costs per gallon, and storage and handling requirements.

Non-Chloride Deicer Data Sheet		FORMATES		
Impacts	NaCl	KFm	NaFm	
 BOD COD	Low	Low to Moderate	Low to Moderate	
 Ecological Toxicity	Low to Moderate	Moderate	Moderate	
 Asphalt Pavements	Low to Moderate	Low to Moderate	Low to Moderate	

Data sheets on non-chloride deicers provide a quick visual assessment of product features to a wide range of stakeholders, from maintenance shop supervisors and other transportation agency decision-makers to elected officials.

Next, surveys of product manufacturers and vendors produced background and testing information about 20 non-chloride deicing products.

Researchers also evaluated non-chloride deicers or additives in the QPL, including reviewing data requirements for listed and proposed products. These data sources illustrated the breadth of available information and whether it is sufficient to understand costs, impacts and other considerations for using the products.

Because some parameters relevant to non-chloride deicers are not currently covered in the QPL, additional review revealed possible test methods and limits that could be applied to products. Multiple data sources identified the impacts of non-chloride deicers to common water quality measures, including biological oxygen demand (BOD), chemical oxygen demand (COD), nitrogen, phosphorus, cyanide and ecological toxicity. Finally, a review of the corrosion rates and other performance tests contained in the QPL demonstrated potential shortcomings of prescribed testing methods.

## Results

The research indicated that non-chloride deicers could be a viable option for winter road maintenance operations as some perform better at colder temperatures, provide stronger protection against corrosion and reduce environmental impacts compared to salt.

Almost half of the agencies responding to the survey indicated they use non-chloride products. The majority reported using sugar beet-derived products, which are blended with salt brine. Respondents cited better performance, including lower working temperatures, and decreased impacts to infrastructure and equipment as reasons for using the products. A few cited environmental preservation and a reduced use of salt as motivators.

Vendor information included product descriptions, average cost, and environmental and performance test results.

Researchers found that non-chloride deicers caused higher BOD values than chloride-based deicers; COD impacts showed similar trends. Nitrogen, phosphorus and cyanide also appeared as potential issues with some non-chloride deicers. Toxicity impacts showed considerable variation.

The wealth of data compiled in this effort is summarized in data sheets for key non-chloride deicer categories:

- Acetates, such as sodium acetate, potassium acetate and calcium magnesium acetate.
- Formates, including sodium and potassium formate.
- Glycols, including propylene and ethylene glycol.
- Agricultural products, such as additives of beet juice, leaf extracts and fruit pomaces.

The data sheets, available at the [Clear Roads website](#), contain costs; application rates and temperatures; storage and handling considerations; and impacts to infrastructure, equipment and the environment.

## Benefits and Further Research

Clear Roads member agencies have more tools to use to choose deicing materials. The costs and benefits revealed, in particular, will allow winter maintenance managers to evaluate each non-chloride deicer based on agencies' specific needs and priorities. A group of Clear Roads members will consider whether to amend the QPL to include recommended limits for parameters such as BOD, COD, phosphorus and nitrogen, and focus future research on toxicity testing and dilution factors.

"We now have a better understanding of alternatives to chloride deicers, including which options might give us the biggest bang for the buck while allowing us to be good environmental stewards."

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