FACT SHEET

Bio-Based Renewable Additives for Anti-Icing Applications (Phase II)

PROJECT TITLE
Bio-Based Renewable Additives for Anti-Icing Applications (Phase II)

STUDY TIMELINE
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FURTHER RESOURCES
https://www.wsdot.wa.gov/research/reports/fullreports/883-1.pdf link to final report

Introduction or Problem Statement

This project identified the performance and impacts of 21 anti-icer mixtures that were designed using the central composite design method based on the preliminary experiments of the authors.

Automated trafficking machine used for simulating vehicle traffic in the laboratory

Methodology or Action Taken

Selected constituent materials pose minimal toxicity to the environment (e.g., no heavy metal content) and were derived from eco-friendly, cost-effective processes. Agro-based solutions derived from locally sourced agro-based materials mixed with salt brine, and commercial additives (with little toxicity) were tested for their ice-melting capacity, ice-penetration rate, ability to protect asphalt binder and concrete, effect on the friction coefficient of deiced and anti-iced asphalt pavement, and anti-corrosion performance. The main criterion for choosing the best-performing anti-icer was ice-melting capacity. A decision-making process based on an analytical hierarchy process (AHP) was used to determine the best-performing anti-icer. The best-performer anti-icer mixture

contained 0.89% Concord grape extract, 4.57% glycerin, 4.54% sodium formate, 0.19% sodium metasilicate, 18.4% NaCl, and water. This mixture was an alkaline solution with half of the chemical oxygen demand of traditional beet juice blend. Differential scanning calorimetry thermograms showed the critical role of glycerin and sodium formate in the relatively low critical temperature of this mixture (-11°F) and the mixture's superiority over sugar beet blend and salt brine. In addition, aging of best performer sample had a minor impact on the key properties of best performer sample.

Conclusions or Next Steps

A considerable decrease in the snow–pavement bond shear strength was observed when the best-performer solution was used for anti-icing. Friction tests showed that the effect of deicing and anti-icing on the friction coefficient is highly dependent on pavement type.

Potential Impacts and Benefits

Laboratory data shed light on the selection and formulation of innovative agro-based snow- and ice-control chemicals that can significantly reduce the costs of winter maintenance operations.