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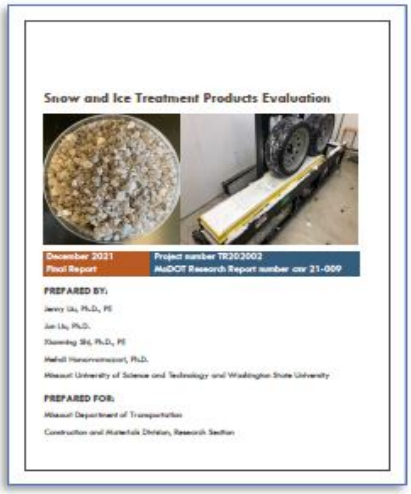
Research Summary

Snow and Ice Treatment Products Evaluation



The Missouri Department of Transportation (MoDOT) Maintenance Division uses different materials to reduce the negative impact of snow and ice on the friction performance of state travelways. These materials include abrasives, rock salt, and other chemical deicers that emerged in recent years. The use of chemicals and abrasives for highway winter maintenance operations is an essential strategy for ensuring a reasonably high level of service, yet the performance of such materials has to be balanced with their cost effectiveness and potentially detrimental effects on transportation infrastructure, the natural environment, and motor vehicles.

The objectives of this study are to: (1) evaluate the effective operational temperature ranges of designated products; (2) evaluate any infrastructure impacts of products on bridges and pavement structures; (3) evaluate the performance characteristics of the products; (4) evaluate cost effectiveness of various solid de-icing agents and liquid anti-icing and de-icing agents currently used by or proposed by MoDOT; and (5) provide a final report detailing testing and analysis results, findings of the evaluation, and recommendations for best practices.

Nine deicer products were collected in this study, including (1) rock salt – untreated; (2) rock salt – brine treated; (3) "Snow Slicer" treated rock salt; (4) "Ice Ban" treated rock salt; (5) "Clear Lane" product; (6) calcium chloride (flake/pellet) treated rock salt; (7) calcium chloride (liquid) treated rock salt; (8) beet juice treated rock salt; and (9) "Top Film" treated rock salt.

> *"The use of chemicals and abrasives for highway winter maintenance operations is an essential strategy for ensuring a reasonably high level of service, yet the performance of such materials has to be balanced…"*

Laboratorial tests were conducted to evaluate the performance, effectiveness, and infrastructure impacts of the collected deicer products. The ice-melting test was conducted to quantify the performance characteristics of deicers as a function of time, by measuring the amount of ice melted by each deicer over time. The thermal properties of deicers were quantified by measuring their characteristic temperature (Tc), and the enthalpy of fusion (H, integrated surface area of the peak). Eutectic phase diagrams were obtained to quantify the performance characteristics of deicers as a function of deicer concentration; the lower the freezing point temperature, the more thermodynamically powerful a deicer is. Snow–pavement bond and friction tests were carried out to quantify the performance characteristics of deicers for anti-icing strategy, i.e., prevention of the bond of compacted snow to the pavement (to facilitate subsequent mechanical removal). The corrosion

rates of the carbon steel samples in diluted deicer solutions were measured to quantify the corrosive effect of deicers to carbon steel. Biological oxygen demand (BOD) measurements were conducted to quantify the environmental effects of deicers to species in soil and water bodies. Freeze-thaw test of concrete in the presence of deicer was conducted to quantify the negative effects of deicers to concrete. Low-temperature behavior of asphalt binder and mixture affected by deicers was quantified by asphalt binder bending beam rheometer (BBR) and asphalt mixture indirect tensile (IDT) tests.

In light of the findings from lab testing, the research team developed an evaluation matrix to assess the cost-effectiveness and potential impacts (to the infrastructure, motor vehicles, and water bodies) under a holistic and multi-criteria framework. According to this evaluation matrix, three products scored above 60 out of 100: products #5 ("Clear Lane" Produce, score: 67), #7 (Calcium Chloride (liquid) Treated Rock Salt, score: 66) and #3 ("Snow Slicer" Treated Rock Salt, score: 64). They are recommended due to better performance for winter maintenance operations and less impact on the environment, infrastructure and motor vehicles compared to other deicers tested in this research.

Figure 1: Automated trafficking machine used in this research.

Project Information

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