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Measuring Salt Retention

tech transfer summary

This study supports Iowa Department of Transportation efforts to target areas of efficiencies specific to salt and brine delivery methods for winter road maintenance.

Background

The Iowa Department of Transportation (DOT) is addressing winter road maintenance efficiency through a variety of activities.

Overview

This project involves measuring and reporting the retention of salt and brine on the roadway as a result of using different salt spreaders, application speeds, and brine quantities. The research develops an evaluation methodology, directs the field collection effort and compliance, provides the laboratory facilities for the measurement and dehydration of samples, and documents the results in a final report.

Methodology

The research team worked with Iowa DOT staff who served as the project technical advisory committee (TAC) for input and feedback throughout the duration of the project. This collaboration included several work sessions to refine field collection and procedures and a final meeting, held after the laboratory measurements were finalized, to discuss the results.

The research team compared three salt spreaders that the Iowa DOT uses routinely during winter maintenance operations: standard, chute, and zero-velocity.

Salt sample collection per run and grid square

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RESEARCH PROJECT TITLE
Measuring Salt Retention

SPONSOR
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The project evaluated each spreader at different speeds (20, 30, and 40 mph) and brine rates (10, 20, and 30 gal per lane mile). A full-factorial experimental design was used to study the three variables distinctly at three levels with a total of 27 runs. (Six additional runs with no brine at 25 and 40 mph for each spreader type were added at the request of a district staff person for comparative purposes and not as a comparative variable for this study.) Overall, a total of 33 truck runs were completed.

The methodology included the number of passes per variable such as speed, equipment, and brine quantity, as well as labeling and measurement details. In addition, a high-speed video camera was used to record the salt distribution for each run.

To measure salt distribution laterally, a 3 x 24 ft wide rubber mat was installed to allow for the salt and brine to be removed from the mat after each run. The mat was segmented into eight 3 x 3 ft squares. All samples were labeled by run number (identifying spreader, truck speed, and brine rate) and sample for each 3 x 3 ft square. The trucks followed a paint line on the roadway to travel over the mat at the same location each time.

A total of 264 samples (33 runs with 8 grids per run) from the field evaluation were containerized and the water was removed using sublimation laboratory equipment. Following this, the samples were weighed.

The results compare each spreader by total salt delivered, delivery by sample square on the mat, and the combinations of speed and brine rates.

High-speed video camera position and clean up between truck passes

Key Findings

The project results by run and sample were presented to the project TAC along with a series of pivot tables that show the amount of salt content by spreader type, brine rate, truck speed, and so forth. This discussion led to the following observations (with additional details shown in the final report).

Spreader Type

The chute spreader delivered the most salt followed by the zero-velocity and standard spreaders.

The distribution pattern for the chute and zero-velocity spreaders resemble each other as opposed to the flatter pattern of the standard spreader.

Salt by Spreader, Speed, and Brine

Using 200 lbs per lane mile of salt, no brine included, the maximum weight per run should be 51.54 grams. The chute spreader exceeded 51.54 grams three times (one at 20 mph and two at 30 mph) and the zero-velocity spreader exceeded the limit twice, both at 30 mph.

These values hint toward a need to verify that the spreaders are calibrated and delivering consistent quantities at varying truck speeds.

Implementation Readiness and Benefits

The research results support Iowa DOT efforts to progress winter maintenance efficiencies and ultimately motorist safety. The TAC discussion resulted in several opportunities for implementation as follows:

- The results will assist the Iowa DOT in understanding the performance of each of the three salt spreader types in terms of truck speed and brine rate.
- The results will guide future investigations toward more-detailed comparisons such as material loss, material migration after application, truck calibration by speed, and the effectiveness of varied brine rates.
- The high-speed video enhanced DOT abilities to see each of the three salt spreaders in motion and to observe salt placement and loss across the lane.
- These results will help target future investigations specific to speed of application and salt and brine delivery methods.