

Winter Maintenance Best Practices

MINNESOTA DEPARTMENT OF TRANSPORTATION SALT SUSTAINABILITY PROJECT

February 2019

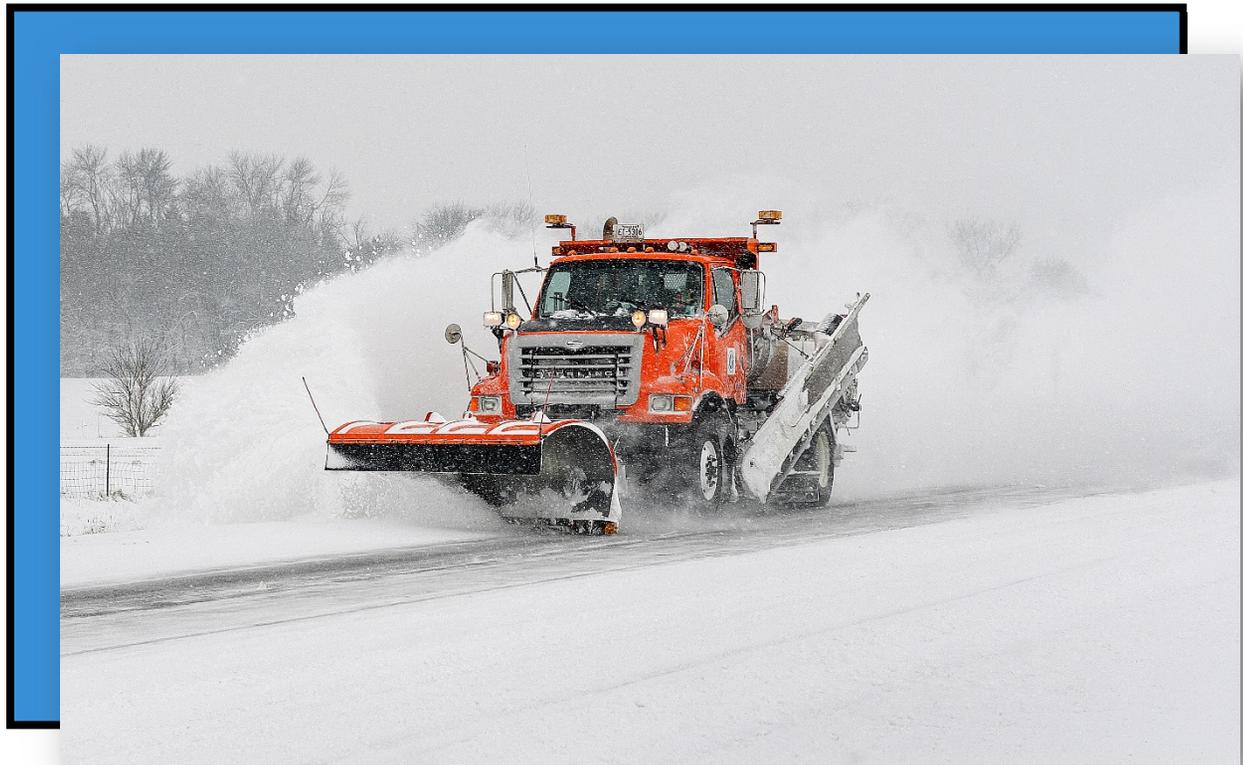


TABLE OF CONTENTS

- Introduction 1
- Training and Information Sharing 2
- Calibrating Equipment 3
- Decision Making 4
- Material Handling and Storage 6
- Estimating Effectiveness 8



ACKNOWLEDGEMENTS

We wish to thank CTC & Associates and SRF Consulting for the coordination and research involved in making this report a reality. We would also like to extend thanks to all members the Technical Advisory Committee (TAC) from other transportation agencies that helped define the goals and focus of this project. This report would not be possible without the contributions of the TAC members.

INTRODUCTION

Salt can have an adverse effect on nearby environments and groundwater sources. MnDOT seeks to reduce the use of salt on roadways, while maintaining a high level of performance with regard to level of service recovery in winter operations. This document offers suggestions regarding the use of salt for roadway snow and ice control, with an emphasis on sustainable practices.

A literature review of 30 published document from a wide variety of sources and interviews with experts and practitioners in each of the MnDOT districts are the basis for the practices recommended.

DEFINITIONS

Below of definitions of technical terminology used in this document:

- **Deicing** – the practice of removing snow and ice from the surface of a roadway.
- **Anti-icing** – the practice of preemptively applying chemicals to prevent future bonding between the roadway surface and the snow.
- **Pre-wetting** – the practice of adding liquid brine to granular salt at the time of application.
- **Stockpile Pre-treatment** – the practice of adding liquid brine/deicer to granular salt while establishing a stockpile.
- **Maintenance Decision Support System (MDSS)** – a decision-making logic system that integrates current weather, maintenance, and road condition information with forecasted weather and road surface conditions to evaluate and recommend treatment options. Feeds to the MDSS system give operators recommendations directly in the truck.
- **Automatic Vehicle Location (AVL)** – a device that makes use of the Global Positioning System (GPS) to enable a business or agency to remotely track the location of its vehicle fleet using the internet.
- **Direct Liquid Application (DLA)** – the practice of applying liquid deicing or anti-icing agents directly to a roadway in place of granular material.
- **Level of Service (LOS)** – a method for describing the condition of a roadway using a simple grading scale. LOS A representing ideal conditions to LOS F representing failing conditions.

TRAINING AND INFORMATION SHARING

A continuous and free exchange of information and ideas between operators and supervisors is the key to finding what works, and making sure that knowledge is available to everyone.

- Meet with staff frequently.
- Ensure that the meeting place has sufficient seating capacity for an entire area (or sub area).
- During meetings, emphasize the Department's overall goal of salt use reduction.
- Engage staff in MDSS and AVL training to ensure drivers and staff are aware of the decision-making factors involved in MDSS and the functions of AVL.
- Emphasize that operator input of road conditions at the beginning of a shift and during the event is necessary for accurate MDSS recommendations.
- Explain the physical/chemical mechanisms of how salt application works to melt ice or break the bond between ice and pavement, how pre-wetting/stockpile pre-treatment improves effectiveness of granular salt, and how anti-icing or expanding the use of liquid and other alternatives decreases the need for granular salt. For example, emphasize that a sustainable salt application should only be enough to break the pavement bond to enable mechanical removal, not to melt ice unless ice is a thin layer.
- Explain the principles of how salt builds up along roadsides (destroying soils over time), and travels with storm water to nearby streams and lakes (harming natural ecosystems and infiltrate groundwater, to reinforce why reducing salt use is important. This can be a long term effect that doesn't show up immediately or go away quickly.
- Use hands-on activities during annual pre-snowfall meetings to keep staff engaged. Precision loader "Olympics", quizzes and other competitions based on performance measures featuring modest recognition have proven effective in holding interest and fostering ownership in winter maintenance performance.
- District Management should promote salt reduction, such as rewarding drivers whose performance most closely matches MDSS recommendations during a given winter storm event.



CALIBRATING EQUIPMENT

Proper spreader calibration is the key to understanding how much material has been applied. All measurements of salt use, reduction and effectiveness rely on accurate information about application to the roadway.

- Ensure all spreaders and liquid application equipment are calibrated at the beginning of the snow season as well as at the beginning of each quarter.
- Ensure re-calibration after any change or repair to the vehicle systems (hydraulic system, liquid deicer pump system, or other) involved in material application.
- Try to use a consistent material sample in terms of salt content, granule size and moisture content when calibrating.
- Ensure spreader and pump settings or nozzle size are correct based on the materials used.



DECISION MAKING

Choosing the proper material and timing for snow and ice control can substantially reduce salt use.

- When making chemical application decisions, emphasize that MDSS recommendations should be followed, if at all possible, with the understanding that operators may deviate from MDSS recommendations based on their understanding of current conditions due to their experience and training.
- Equip all vehicles to pre-wet material when using salt.
- Ideally, all truck station facilities should have their own brine-making system or adequate storage to ensure availability.
- Ensure sufficient brine-making capacity, generally enough to completely replenish each vehicle once during a snow event.
- The use of slurry has been found to be an efficient practice and effective in keeping granular material on the road, thus reducing material use. Rely on MDSS recommendations and operator experience to determine appropriate application rates.
- Consider liquid-only application when: temperatures are above 25 degrees and expected to rise, and wind speeds are below 10 MPH.
- If there are long stretches of roadway that are environmentally sensitive, consider equipping one or more vehicles to use potassium acetate (or other alternative) for anti-icing/DLA. Identify environmentally sensitive areas (for example long segments of roadway that border wetlands, rivers or lakes) in your district. The Office of Environmental Stewardship is available for consultation.
- When conditions for DLA are infrequent, consider using slide-in tank/applicator systems or the use of a trailer. These allow the vehicle to be equipped for both granular and liquid material use.
- Encourage continuous feedback from operators on the recommendations made by the MDSS display. Establish a simple mechanism to aggregate feedback from operators to supervisors.
- Use mechanical means to remove snow and ice to prevent compaction as this can reduce the need for chemical application.
- Utilize overtime as needed to keep the roadway as clean as possible which reduces the need to apply chemicals to the roadway

While MDSS should be the guide for applying material, the tables below give general guidelines for both granular salt and brine application rates. MDSS recommendations will likely fall in these ranges.

Dry Granular Salt Application (in lb/lane mile)					
Storm Type	Pavement Temperature Range				
	Above 32° F and constant	Above 32° F but dropping	20-32° F	5-20° F	Below 5° F
Light Snow	Apply nothing – just monitor	100-150	100-150	150-250	Apply no salt
Light to Moderate Snow	Apply nothing – just monitor	100-200	200-250	250-350	Apply no salt
Moderate to Heavy Snow	Apply nothing – just monitor	100-150	200-250	250-500	Apply no salt
Freezing Rain	Apply nothing – just monitor	75-100	150-300	250-500	Apply no salt

DLA Brine Application (in gal/lane mile)				
Event Type	Pavement Temperature Range			
	32-30° F	29-27° F	26-24° F	23-21° F
For 2-Hour (or less) Cycle Times				
Light Snow (less than 0.5"/hr.)	20	35	40	55
Medium Snow (0.5"/hr. to 1.0"/hr.)	35	45	55	Not Recommended
For 3-Hour Cycle Times				
Light Snow (less than 0.5"/hr.)	35	50	65	80
Medium Snow (0.5"/hr. to 1.0"/hr.)	50	65	80	Not Recommended

MATERIAL HANDLING AND STORAGE

Ensuring that salt piles are properly protected and measured helps reduce contamination at the storage site and can save money by reducing material loss.

- Ensure deicer storage tanks and production systems are built and operated in accordance with OES Aboveground Storage Tank guidance.
- Always store granular salt material and salt/sand mixtures (winter sand) on impermeable surfaces with controlled drainage that reside under protective structures to control moisture content and prevent leeching.
- Delivery vehicles are required to cover material with tarps in transit. Refuse delivery of material if transported without a proper tarp.
- If pile toe slope will extend beyond shed threshold lines, use perimeter control to prevent exposure of pile to elements, such as tarps or appropriate erosion control measures. Salt sheds in environmentally sensitive areas (e.g. near Drinking Water Protection Areas, streams, wetlands, or floodplains) may need to take additional protective measures. The Office of Environmental Stewardship is available for consultation.
- Whenever possible, load and unload material under a structure or awning. Load in one location to minimize spill area and do not overload trucks.
- Broom any material spilled during delivery, equipment calibration, mixing of chemicals, or vehicle loading into the stockpile as soon as possible. In preparation for an upcoming event, broom loose salt into shed, or if there is snow accumulation, plow snow and slush away from loading areas and front of shed before loading begins.
- At end of shift, allow operators time to pre-clean box, auger, and spinner, in the salt shed before washing and always wash truck indoors.



- Identify a “responsible person” for each salt shed, who will ensure pile clean up and pile protection is done properly.
- Salt sheds should be emptied, inspected, and repaired at a minimum of once every three years.
- Develop a site snow storage plan. Snow piles should drain to ponds or grassy areas. Do not store snow directly in ponds. In spring, pick up debris/trash and re-establish vegetation in eroded and tracked areas.
- Report major drainage issues at facilities to the area maintenance engineer and district facility manager in order to stay in compliance with environmental permits. District Hydraulics/Water Resources should be consulted, especially if it affects salt shed or brine tanks.
- Encourage staff to develop accurate stockpile estimation skills to prevent ordering too much salt for a site to limit the risk of exposure of salt piles to the elements. Competitions to estimate the size of a pile during annual pre-season meetings have been effective.



ESTIMATING EFFECTIVENESS

Achieving a sustainable level of salt usage is a long-term goal that will require the implementation of these best practices. To gauge the overall effectiveness of your salt sustainability practices, consider implementing a data collection and tracking plan that includes the following:

- Track the estimated loaded material weights/volumes of solid salt materials as well as the total material delivered.
- Record the weights of salt used to make pre-wetting or direct application salt brines.
- Be sure to keep records of the total distance traveled by trucks and the total length of your plow routes each year.
- Keep a 'running' record of the total salt used, as well as the salt used per traveled mile and salt used per mile of designated plow routes.
- As the record grows, use the Winter Severity Index data and compare it to salt usage. Over time, there should be a downward trend in the amount of material applied for a given set of weather conditions.