PennDOT LTAP
technical
INFORMATION
SHEET #168
FALL/2015

WINTER OPERATIONS STRATEGIES

by Robert M. Peda, P.E., Navarro & Wright Consulting Engineers, Inc.

Pennsylvania's winter season typically runs from November through March with the potential for geographic and seasonal variations extending winter weather events to nearly half a year. When it comes to meeting the needs of safety and mobility on their roadway network, municipal road crews justifiably place high focus on their winter operations.

Our society has become fully dependent upon the road network for accomplishing both business and pleasure goals; we expect our roads to be available and accessible 365 days of the year. With such high public expectations, municipalities must stay on top of their snow and ice removal strategies. Public officials should regularly evaluate their operations along with the needs of their citizens and make determinations on how to improve winter operations through efficiency or with new technologies.

Planning for Success

Most municipalities have limited financial resources when it comes to implementing new technologies to enhance winter operations. Liquid deicing chemicals are an effective means of improving efficiency and reducing costs of snow and ice removal, but municipal officials need to perform their own comprehensive cost analyses to weigh the financial benefits of using liquid deicing agents against the additional cost of material storage and new or modified dispensing equipment. Although a transition to using liquid deicers may take many years before a payback is realized, improvements in the level of service may outweigh cost as the only consideration for this decision.

Additional technical information on pre-wetting and anti-icing using salt brine is available in the article, "Salt Brine for Winter Services," in the Fall 2014 issue of LTAP's *Moving Forward* newsletter. The newsletter can be found on the LTAP website, www.ltap.state.pa.us, under LTAP Tools, Public Resources, and Documents.

Managing Your Materials

The first step in managing your winter materials is to closely monitor the weather so that you are making the best decisions on application rates for storm fighting. Keep an eye on the weather as temperatures and snowfall intensity change, and then adjust your snow-fighting approach accordingly.

Monitoring pavement temperatures can be an additional strategy to determine appropriate application rates. The colder the temperatures, the more limiting you'll find salt's effectiveness based on the amount of chemical used. For instance, one pound of salt can melt 46.3 pounds of ice at 30 degrees F, but the same pound of salt will only melt 14.4 pounds of ice at 25 degrees F and 6.3 pounds of ice at 15 degrees F. Based on this example, it takes more than three times the amount of salt to melt one pound of ice at 25 degrees F than at 30 degrees F.

For this reason, both pavement and air temperatures should be considered

pennsylvania
DEPARTMENT OF TRANSPORTATION
PennDOT Local Technical Assistance Program

400 North Street, 6th Floor
Harrisburg, PA 17120
1-800-FOR-LTAP • FAX (717) 783-9152
www.ltap.state.pa.us

As we discuss theories, it is important to remember the greatest success will come with experience.

when determining salt application rates. PennDOT does not recommend applications of chemicals if the temperature is 15 degrees and falling.

A simple way to monitor pavement temperatures is to use a handheld infrared thermometer. You can purchase a good unit for less than $100 and will receive immediate payback when using it to manage salt application rates.

Being aware of road temperatures and understanding the melting capability of road salt will help you to manage the appropriate application rates. It is also important to remember that if excess salt is applied, not all of the salt will be consumed, and any residue may wash into surface and groundwater resources. By using just the right amount of salt, you will be a good steward of the environment in addition to saving your municipality money by not wasting materials.

To help with this, PennDOT promotes the use of TAPER logs to record material application rates based on the storm event and environmental conditions. This log is used to record: **T**emperature of the pavement, **A**pplication rate, **P**roduct used, **E**vent type, and **R**esults obtained. A copy of PennDOT's TAPER log is located in Publication 23, Chapter 4, Appendix I.

Different Storms, Different Applications

Every storm is different! Weather and environmental conditions may change during the storm event, and this may require changes in material application rates and timing of the applications. To help manage the storm-fighting effort, equipment operators must provide feedback of current field conditions to the manager: how much material was applied, how often was it applied, position of the plow (up or down), and what the results were.

With this field information, the manager can determine changes in application rates. A history of TAPER log results will also help the manager to make sure he or she is employing the most efficient snow-fighting approach based upon the type of storm and past experience in storm management.

PennDOT recently prepared application rate tables for six different types of weather events. The tables provide instructional guidance on application rates based upon pavement temperature ranges and surface conditions. The tables also address initial operations, subsequent operations, and maintenance actions, providing excellent operational guidance for most roadways using straight salt. These tables are located in PennDOT Publication 23, Chapter 4, Appendix H: Application Rate Tables. Table 10 for moderate or heavy snowstorms is shown on the next page as an example.

Table 10. Weather event: Moderate or Heavy Snow Storm

[All application rates are based on a single travel lane, double rate for centerline treatments]

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION				SUBSEQUENT OPERATIONS			COMMENTS
	Pavement surface at time of initial operation	maintenance action	material spread rate, lbs/snow lane-mi		maintenance action	material spread rate, lbs/snow lane-mi		
			dry	prewet solid		dry	prewet solid	
Above 32°F, steady or rising	Dry, wet, slush, or light snow cover	See comments			See comments			1) Monitor pavement temperature closely for drops toward 32°F and below 2) Treat icy patches if needed with material at 100 lbs/lane-mi; plow if needed
Above 32°F, 32°F or below is imminent;	Dry	Apply dry or prewetted solid material	100	100	Plow accumulation and reapply liquid or solid material as needed	100	100	1) If the desired plowing/ treatment frequency cannot be maintained, the spread rate can be increased to 200 lbs/ lane-mi to accommodate longer operational cycles 2) Do not apply liquid chemical onto heavy snow accumulation or packed snow
ALSO **30 to 32°F**, remaining in range	Wet, slush, or light snow cover	Apply dry or prewetted solid material	100	100				
25 to 30°F, remaining in range	Dry	Apply liquid or prewetted solid material	250	150-200	Plow accumulation and reapply	200	150	1) If the desired plowing/ treatment frequency cannot be maintained, the spread rate can be increased to400 lbs/lane-mi to accommodate longer operational cycles 2) Do not apply liquid chemical onto heavy snow accumulation or packed snow
	Dry, wet, slush, or light snow cover	Apply liquid or solid material	250	150-200	liquid or solid material as needed			
15 to 25°F, remaining in range	Dry, wet, slush, or light snow cover	Apply dry or prewetted solid material	300	250	Plow accumulation and reapply prewetted solid material as needed	300	250	1) If the desired plowing/ treatment frequency cannot be maintained, the spread rate can be increased to 500 lbs/lane-mi to accommodate longer operational cycles 2) If sufficient moisture is present, solid material without prewetting can be applied
Below 15°F, steady or falling	Dry or light snow cover	Plow as needed			Plow as needed			1) It is not recommended that chemicals be applied in this temperature range 2) Abrasives can be applied to enhance traction

Notes

MIX RATIO APPLICATIONS: **(1) Time initial and subsequent material applications to prevent deteriorating conditions or development of packed and bonded snow -- timing and frequency of subsequent applications will be determined primarily by plowing requirements. (2) Apply material ahead of traffic rush periods occurring during storm.**

PLOWING: Plow before material applications so that excess snow, slush, or ice is removed and pavement is wet, slushy, or lightly snow covered when treated.

Plowing vs. Salting

On what PennDOT calls "third priority routes" (numbered traffic routes with lower traffic volumes and rural and local routes), straight salt is not recommended. Instead, plowing is the primary approach to maintain a passable road. Mixes of anti-skid and salt with a 75/25 ratio at a rate of 270 pounds per snow lane mile or a 50/50 ratio at a rate of 200 pounds per snow lane mile may be applied to bridge decks, hills, curves, and intersections. Keep in mind that local conditions or the municipality's level of service goals may qualify for an increased level of service.

Here are some plowing and spreading tips for maximizing your snow-fighting efficiency:

- Windrow salting in a 4- to 8-foot-wide swath along the centerline on narrow and low-volume secondary roads may be sufficient.
- Give salt time to melt before plowing it off with the next operation.
- Salt provides immediate anti-skid-like traction along with immediate melting.
- Reapply salt when melting snow is kicked out behind tires rather than fanning out like soft slush or water.
- Safeguard the environment by avoiding overuse or misuse of salt.
- Use higher material application rates on hills, curves, and intersections.
- Plow at slower speeds in residential areas to minimize windrowing into driveways.
- A minor buildup of snow and ice may be left in place if the forecast indicates warming temperatures.
- Widening and cleanup operations should be done after the travel lanes have been properly treated. Cleanup enables properly functioning drainage systems and room for future snowfall.
- Clean up stockpile facilities after the storm to prevent chloride contamination of soils and waterways.

NOTE: All of PennDOT's guidance on application rates is based upon spreading the material in one direction.

Resources

This tech sheet is intended to provide general information for preparing for winter operations. Additional resource information may be found in the following documents:

- *PennDOT, Maintenance Manual, Publication 23, Chapter 4*
- *The Salt Institute, The Snowfighter's Handbook*