Stormwater Best Management Practice

Deicing Material Application and Storage

Minimum Measure: Pollution Prevention/Good Housekeeping for Municipal Operations
Subcategory: Municipal Activities

Description

In areas where snow and ice are common during winter months, municipalities and transportation authorities apply deicing materials—most commonly salts, gravel or sand—to sidewalks, parking lots, and roadways to reduce ice buildup and improve traction for pedestrians and vehicles. Salts help lower the melting point of ice, allowing sidewalks, parking lots, and roadways to stay free of ice buildup during cold winters. But they are also soluble, can be toxic to some biota and environmentally persistent: applying and storing them can cause them to mix with stormwater, leading to water quality problems. Problems range from aquatic life impacts in downstream waters to contamination of drinking water supplies (Fay & Shi, 2012; Labashosky, 2015).

For more information on alternative deicers, see Terry et al.'s (2020) "Alternative Deicers for Winter Road Maintenance—A Review" and the comprehensive Transportation Research Board (2007) report *Guidelines for the Selection of Snow and Ice Control Materials to Mitigate Environmental Impacts.*

Applicability

Deicing materials are applied and stored in areas that receive heavier snowfalls. Municipalities in these areas should use techniques to ensure proper storage and application for equipment and materials.

Deicing Materials Management Program Considerations

During deicing materials application, certain best management practices can limit potential environmental impacts. Roadway managers and others generally outline these practices in a deicing materials management program or plan, which can help improve the efficiency of deicing efforts. Such a program plan should account for local considerations, as well as the general ones described below.

Keeping salt stored inside protects water quality and reduces salt loss from exposure to rain and snow.

Photo Credit: Staff Sgt. Jorge Intriago/Wikimedia

Material Selection

U.S. municipalities and transportation departments use sodium chloride for deicing more than any other material, due to its low cost and wide availability (Table 1). Sodium chloride has its drawbacks, including minimal effectiveness at temperatures less than 15°F, high potential for contamination of downstream waters, and high corrosivity. Because of these drawbacks, roadway managers have looked to other chemicals or materials including other salts (e.g., calcium chloride, magnesium chloride), organic compounds (e.g., acetate compounds, glycol) and biomass-based agricultural byproducts (Terry et al., 2020; Transportation Research Board, 2007). Most of these alternative products are more expensive than sodium chloride and each has its own strengths and weaknesses. For example, municipalities should consider less corrosive alternative deicing materials like glycol, urea, or calcium magnesium acetate (CMA) for bridge deicing.

Table 1 does not include sand and gravel—often referred to as "abrasives"—which can improve traction on ice-covered roadways but do not melt ice.

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Table 1. Deicing Material Alternatives

Material	Annual Usage, North America (Tons)	Median Cost per Ton (2020 Dollars)[a]	Characteristics
Sodium chloride (NaCl)	4,773,000	$51	■ Low cost ■ Widely available ■ Moderately effective at temperatures between 15°F and 25°F, most effective at temperatures above 25°F
Calcium chloride ($CaCl_2$)	47,679	$171	■ Melts ice at temperatures below 25°F ■ If used as recommended, will not harm vegetation
Magnesium chloride ($MgCl_2$)	149,724	$135	■ Lowest practical temperature: 5°F ■ If used as recommended, will not harm vegetation; however, $MgCl_2$, on a percentage basis, contains 17–56% more chloride ion than other salt-type deicers
Calcium magnesium acetate (CaMgAc)	21,817	$1,820	■ Will work below 0°F ■ Low toxicity and biodegradable

Sources: Keating, 2004; Kelting & Laxson, 2010

[a] Cost data adjusted from 2009 to 2020 dollars using the Bureau of Labor Statistics CPI Inflation Calculator

Application

Before applying salt, it is important to blow, shovel or plow accumulated snow to ensure more effective melting (NHDES, 2016).

Roadway managers should set application rates that reflect site-specific characteristics such as pavement temperature, road width and design, traffic concentration, and proximity to surface waters. Application rates should be as low as possible while remaining effective. Application plans should specify alternative deicing materials for areas too sensitive for chemical use.

To apply deicing materials to roadways and parking lots, most municipalities use specialized dump trucks with spreaders. When possible, they should employ electronically controlled spreading equipment that can lock in specific application rates, preventing operators from using more salt than necessary (MDOT, 2019). Municipalities should also calibrate all deicing material spreading equipment before the start of a winter season and check it periodically during the season for accuracy.

Monitoring and Tracking

Keeping accurate records of application practices can help optimize deicing effectiveness and reduce harmful impacts. Roadway managers should develop a tracking system that maps application routes, logs application rates and notes areas of high accumulation of ice/snow. Benchmarking is also a good way to reduce salt use over time. For example, roadway managers can log application rates per degrees below 32°F or inch of snow and set reduction goals each year (MPCA, 2020).

Many DOTs are implementing road weather management strategies focusing on tools and technologies using real-time or archived road weather data from fixed and mobile road weather observations. In addition to vehicle location data from automatic vehicle location systems and radio communication between the driver and the maintenance center, mobile road weather observations can include more detailed maintenance vehicle information such as plow status and material usage, and/or road weather measurements such as pavement surface and air plus pavement temperatures. Survey data from the Federal Highway Administration (2017) reports that overall, 23 of the 40

States collect real-time field data from maintenance vehicles with plow status and material usage being the most common data collected.

Storage

Municipalities should store deicing material piles in covered areas, protected from weather throughout the year. Although covering stored deicing materials may be costly, the benefits are often far greater than the perceived costs. Properly storing deicing materials prevents it from lumping together, which makes it easier to load and apply. Covering deicing materials storage piles reduces loss, as exposed piles will slowly dissolve from rain and snow throughout the year and wash into downstream waterbodies. Municipalities often store deicing materials in barns, domes, silos or other permanent structures. These structures should be outside the 100-year floodplain for further protection against flooding and surface water contamination.

Training

Municipalities should regularly train their staff and contractors on proper storage and application practices. This training should stress the importance of using the smallest amount of material that will make roadways safe and passable (MDOT, 2019). Program managers should receive additional training on effective winter storm management, winter materials inventory management, the properties of salt and other winter deicing materials, and data collection and analysis.

Maintenance Considerations

Salt is highly corrosive, so application equipment and storage facilities need regular maintenance to maintain functionality and integrity. Importantly, maintenance activities should also help reduce salt export as much as possible.

As well as carrying out standard vehicle and equipment maintenance, staff should wash applicator vehicles down after every use. To prevent contamination of downstream waters, municipalities should capture, treat, or recycle the salt-containing wash water. Staff can reuse this water as brine for salt pre-wetting (MPCA, 2020). Installing a wash area adjacent to a storage area so that it can also collect any spilled brine from the storage area is a good way to eliminate another potential source of salt contamination and improve overall salt use efficiency.

Staff should routinely inspect storage structures. During active months, they should immediately collect any material spilled during loading or unloading operations and return it to the storage structure. During the off-season, they should identify and fix any leaks, weak points or corroded areas.

Limitations

Salt application requires specialized equipment that needs rigorous maintenance to limit corrosion from the salt. It also requires designated personnel and storage facilities that are generally only in use for a fraction of the year. Deicing becomes expensive at very cold temperatures: below 15°F, a community would typically need a prohibitive amount of sodium chloride, and suitable replacements are much more expensive (Kelting & Laxson, 2010).

Salt application also leads to long-term environmental impacts as well as infrastructure and automobile corrosion problems. Particularly across the northeast and Midwest, salt application has led to the designation of thousands of miles of streams and thousands of acres of lakes, reservoirs and ponds as threatened or impaired for chloride (U.S. EPA, 2020).

Cost Considerations

Costs associated with a deicing materials application program include both direct and indirect costs. Direct costs, including the cost of the deicing materials (see Table 1), application equipment, storage facilities and labor, will vary depending on the frequency and duration of deicing materials activities. Using a typical range of application rates for sodium chloride of 200 to 800 pounds per lane mile (Transportation Research Board, 2007) and the median cost from Table 1, material costs can range from $5.10 to $20.40 per lane mile.

Indirect or “hidden” costs, on the other hand, tend to accumulate over time and are harder to quantify. In a review of the literature, Dindorf and Fortin (2014) found estimates of damage to infrastructure, automobiles, vegetation, human health and the environment due to salt to range from $800 to more than $3,000 per ton of salt used.

Additional Information

Additional information on related practices and the Phase II MS4 program can be found at EPA's National Menu of Best Management Practices (BMPs) for Stormwater website

References

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Disclaimer

This fact sheet is intended to be used for informational purposes only. These examples and references are not intended to be comprehensive and do not preclude the use of other technically sound practices. State or local requirements may apply.