AQUALIS

SMART SALTING FOR PROPERTY OWNERS AND MANAGERS

De-icing impervious surfaces such as roads, driveways and walkways is a critical aspect of winter maintenance for property owners and managers to keep their properties safe and accessible. However, excess salt use can have negative impacts on the environment, infrastructure and motor vehicles.

The goal of this white paper is to inform property owners and managers of the risks associated with excessive salt use, while also providing a range of tools to help with choosing the most efficient options while using the minimum amount of salt necessary to get the job done.

The use of excessive salt for de-icing can have significant and harmful effects.

Potential Damages

ENVIRONMENTAL IMPACTS

SALT IN GREEN STORMWATER INFRASTRUCTURE AN UNINTENDED CONSEQUENCE

Green Stormwater Infrastructure (GSI) is not currently designed to remove salt, but it may help reduce its impact on surface waters. However, there are some unintended consequences for soil infiltration based GSI:

Chloride cannot be effectively removed by GSI as it is highly mobile and leaches into local waterways such as groundwater. When chloride levels are high, GSI can release harmful substances, including heavy metals and phosphorus, stored in sediment (Finlay, 2018). Increased phosphorus can fuel algal blooms, which degrade water quality. Ongoing research is investigating the effects of chloride and phosphorus release in GSI.

Salts (Na, Ca, Mg, and K) in GSI Soils: Salt can accumulate in the soils used in GSI systems, leading to problems like the leaching of heavy metals and nutrients. This can stress plants, reduce the ability of the system to filter pollutants, and hinder evapotranspiration, a key function of some GSI designs.

WATER QUALITY

The introduction of de-icing salt can alter water quality in several ways, including:

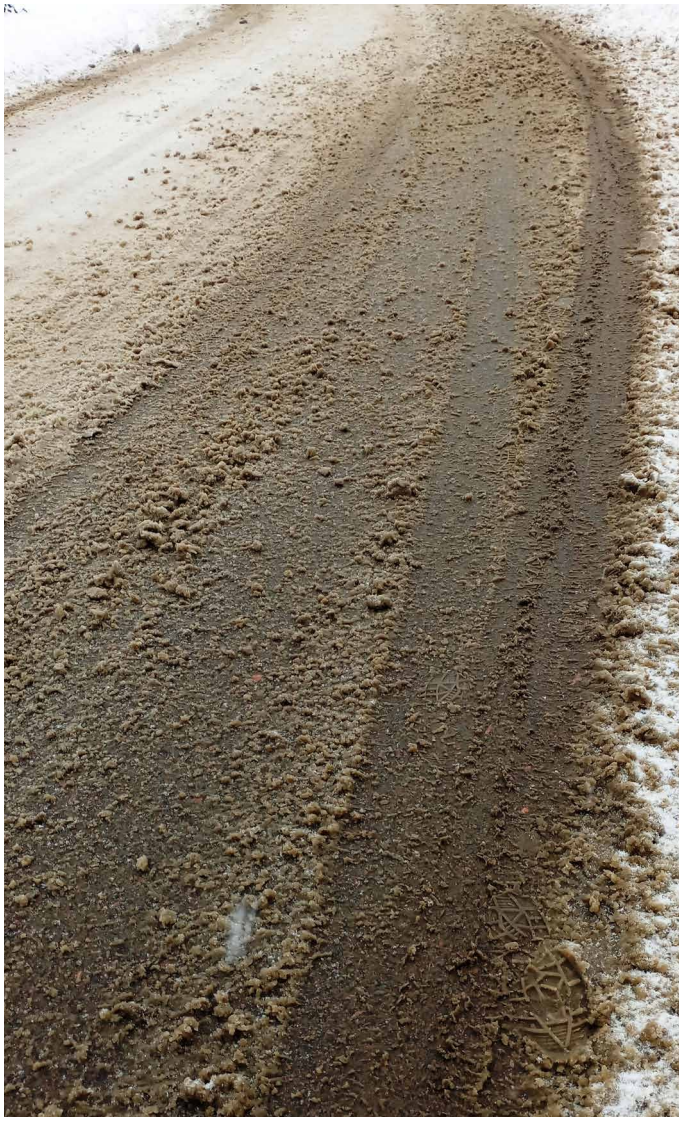
- **Disruption of Ecosystems:** High chloride levels can disrupt aquatic ecosystems by changing the water's chemical balance and electrical conductivity, which affects nutrient availability, algae growth and biodiversity.
- **Eutrophication:** Chloride can affect how nutrients like phosphorus cycle in water, leading to algal blooms. These blooms can deplete oxygen, causing hypoxia (low oxygen) and fish kills.
- **Groundwater Contamination:** Salt can seep into groundwater, making it too salty for drinking or farming. This is especially concerning in areas with shallow wells or those reliant on groundwater.
- **Drinking Water Standards:** The U.S. Environmental Protection Agency (EPA) has set a secondary drinking water standard for chloride at 250 mg/L. While not a health hazard at this concentration, higher levels of chloride can affect the taste of drinking water, making it unpleasant.

FRESHWATER AQUATIC LIFE

Beyond lethal effects, increased salinity can impair the health and survival of aquatic organisms. Sub-lethal effects can include:

- Oxidative stress
- Delayed growth
- Reduced feeding efficiency
- Movement of organisms away from their habitat
- Malformations

These stressors can reduce the fitness of organisms and disrupt ecosystems, affecting the biodiversity of freshwater environments.



SOIL HEALTH

Salt-laden soil loses its ability to retain water and store essential nutrients, leading to poor soil quality and increased erosion. De-icing salts can cause significant changes in soil structure, resulting in:

- Nutrient imbalances
- Movement of fine particles
- Mobilization of heavy metals

This runoff can contribute to sedimentation and negatively affect nearby water quality.

PLANT LIFE

De-icing salts can damage plants by disrupting their ability to take up water and nutrients. Salt can accumulate in the soil, leading to osmotic stress, which reduces a plant's ability to absorb water. Over time, this can cause plants to wilt, become stunted or even die.

WILDLIFE AND PETS

De-icing materials can be toxic to animals if consumed, whether by eating it directly, licking their paws or drinking runoff from snowmelt. Exposure to salt can cause painful irritation, inflammation and cracking of animals' paw pads.

The use of de-icing salts containing chlorides can damage infrastructure, such as pavement, and lead to corrosion of water pipes, particularly those made of copper and lead.

Potential Damages

INFRASTRUCTURE

DEGRADATION OF PAVEMENT

The use of salt on roads can breakdown road surfaces. Salt can penetrate cracks of asphalt and concrete, causing the pavement to deteriorate due to freeze-thaw cycles. When salt mixes with water, it can cause concrete to crack, weaken and eventually erode.

Salt that seeps into concrete structures (like sidewalks, buildings and parking garages) can cause chloride-induced corrosion of the steel reinforcement inside the concrete. As this corrosion expands significant reduction of the durability and safety of the structure can occur.

BRIDGE DAMAGE

Saltwater runoff from roads can corrode the steel reinforcement inside concrete bridges. Over time this corrosion can weaken the structural integrity of bridges, increasing maintenance costs and the risk of failure.

CORROSION IN WATER SYSTEMS

High chloride levels, often from de-icing salts, make water more corrosive. This can damage pipes and increase the risk of metals, like lead, leaching into drinking water.

Potential Damages

MOTOR VEHICLES

Salt is highly corrosive to metal, which can lead to rust and deterioration of vehicle bodies and undercarriages. The salt that accumulates on roads can spray onto vehicles, causing long-term damage to parts like the exhaust system, brakes and suspension components.

Salt-related damage to vehicles can lead to costly repairs, increased maintenance needs and a shorter lifespan for vehicles.

WHAT IS SMART SALTING?

Smart salting involves keeping sidewalks and driveways safe while minimizing damage to infrastructure, soil and water. It's about using the right amount of salt at the right time to balance safety and protection of the environment and property.

Smart Salting

1 | PRE-TREATMENT

Pre- treat impervious surfaces with a small amount of liquid de-icer (e.g., Magnesium Chloride (MgCl2) or Calcium Chloride (CaCl2)) before a storm hits to prevent snow and ice from building up. An alternative is to make a brine. To make a brine, dissolve salt in warm water (or use salt from a water softener). Then, apply to impervious surfaces.

- A typical salt brine concentration is around 23.3% (~2.29 lbs/gal).
- Hydrometers are an easy and inexpensive tool to measure brine density. They work like floating thermometers.

Table 2. Brine and Magnesium Chloride application rates suggestions

Gallons/1000 sq.ft.

Condition	Salt Brine (NaCl)	MgCl2
Regular schedule application	0.25-0.30	0.10-0.20
Prior to frost or black ice event	0.25-0.30	0.10-0.20
Prior to light or moderate snow	0.20-0.40	0.10-0.20

Source: Fortin Consulting Inc.2006; Hosseini, 2015

Smart Salting

BENEFITS OF USING SALT BRINE

- **Reduces Salt Use:** Especially effective during light snowstorms, reducing the amount of salt needed. The pavement does not need to be evenly covered, applying brine in lines effectively melts ice.
- **Faster Road Clearance:** Achieves bare/wet pavement conditions more quickly. Brine can be applied up to 48 hours before, during or after snowstorms, allowing for increased flexibility.
- **Improved Pavement Safety:** Enhances pavement friction, making roads safer.
- **Cost-Effective:** The benefits of using salt brine outweigh the investment cost of switching from traditional salt applications due to the overall use of less salt.

COST BENEFIT ANALYSIS

A study conducted by Dutchess County, New York, found that it took between 0.3 and 0.9 years to recoup the cost of equipment used for salt brining. The County maintains 100 lane miles per year, requiring 2,000 tons of salt when using traditional methods, or 1,400 tons when using the brining method. They saved 30% of their annual salt cost by switching to brining over traditional methods.

Brining equipment differs from traditional salt application equipment. A typical salt truck uses a truck-mounted spreader, while a brine truck requires tanks, pumps and sprayers. Converting an existing salt truck into a brine truck cost the County approximately 32% less than purchasing a full brining system, resulting in the payback period for the equipment ranging from 0.3 to 0.9 years, depending on the investment option chosen.

2 | REDUCTION

These are suggestions for salt reduction:

1. Use salt only where necessary

Apply salt only in areas that really need it. When spreading salt on pavement, space the granules about 3 inches apart. This spacing works just as well as using more salt and helps reduce overall usage. For example, one 12-ounce cup of salt is enough to cover 10 sidewalk squares or a 20-foot driveway.

2. Check the temperature

Rock salt is less effective when the pavement temperature drops below 15°F (-9°C). If it's that cold, use sand or cherry grit for traction instead, or choose a different deicer that works better in low temperatures. Pavement temperature can often vary from air temperature. Being mindful of the temperature of the ground will ensure the most effective ice control method is chosen.

3. Clear snow before it turns to ice

Removing snow early can help reduce the amount of salt needed. The sooner you clear walkways and driveways, the less ice will form, making it easier to manage and reducing salt use.

4. Choosing the right substance for you

See next page for Table 2. Summary of common solid and liquid snow and ice control materials

5. Aftercare

If any salt crystals remain visible after application, sweep up the excess to reuse next time. This helps reduce waste and ensures you're using less salt in the future.

6. Get trained and certified.

Here are additional resources to learn about smart salting techniques:

Wisconsin: Wisaltwise.com

Minnesota: Pca.state.mn.us/business-with-us/smart-salting-training

Illinois: Saltsmart.org

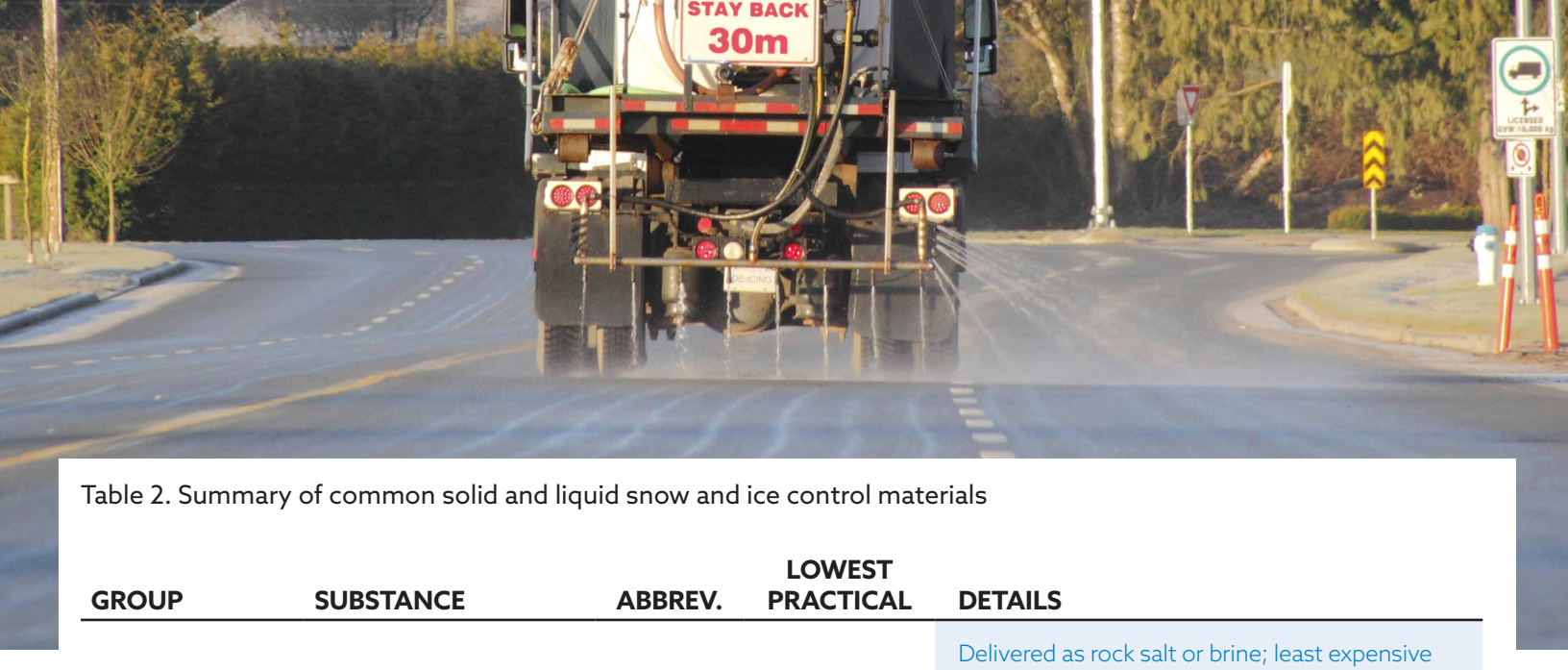


Table 2. Summary of common solid and liquid snow and ice control materials

GROUP	SUBSTANCE	ABBREV.	LOWEST PRACTICAL	DETAILS
Chloride-Salt	Sodium Chloride	NaCl	15°F	Delivered as rock salt or brine; least expensive deicer, but hard on the environment, infrastructure, and motor vehicles.
	Magnesium Chloride	MgCl2	-10°F	Delivered as liquid; less harmful to vegetation than NaCl.
	Calcium Chloride	CaCl2	-20°F	Available as flakes, pellets, or liquid; less harmful to vegetation than NaCl.
Acetate	Potassium Acetate	KAc	-25°F	Delivered as liquid; biodegradable and non-corrosive to steel; Rated as "Relatively Harmless" by US Fish & Wildlife.
	Sodium Acetate	NAAC	-7°F	Delivered as pellets; commonly used on roads, bridges, and parking structures; non-hazardous.
	Calcium Magnesium Acetate	CMA	20°F	Delivered as pellets; safer for vegetation and concrete; non-hazardous.
Formate	Sodium Formate	NaFo	-16°F	Delivered as pellets; more commonly used at airports, but also used on roads and bridges.
Agriculture	Beet juice			Biodegradable but can deplete oxygen in water and soil, possibly causing algal blooms or fish kills.
	Molasses			
Other	Sand			Provides traction at any temperature but will not melt ice. Recommended for walking areas where bare pavement is not needed.

Source: Minnesota Pollution Control Agency, August 2022