ENVIRONMENTAL Fact Sheet

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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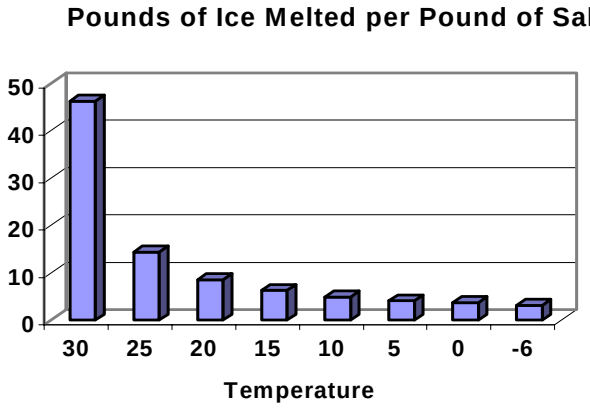
Road Salt and Water Quality

The amount of snowfall in New Hampshire and the necessity of overland travel require winter snow and ice management by the state, the municipalities, and the private sector. Deicing materials are often used in order to keep the public safe during these winter weather events. The most commonly used de-icing chemical is sodium chloride (NaCl) also known more commonly as road salt. Road salt is relatively inexpensive with an average cost of $50 - $60 per ton. Road Salt is readily available and easy to handle, store, and spread. Its purpose is to reduce the adherence of snow and ice to the pavement, preventing the formation of hard pack. Once hard pack forms, it is difficult to remove by plowing alone.

In the United States from 2005-2009 an average of 23 million tons of salt were applied to our roads, parking lots, sidewalks and driveways each year.[1] Studies have shown that, in urbanized areas, about 95 percent of the chloride inputs to a watershed are from road and parking lot deicing. In four impaired watersheds in the southern I-93 corridor of New Hampshire, road salt sources were 10-15 percent from state roads, 30-35 percent from municipal roads, and 45-50 percent from private roads and parking lots.

How Salt Works

The first step in melting ice is to lower its freezing point. This is done through the formation of brine where salt crystals pull water molecules out of ice formation. Once the brine is formed, melting is greatly accelerated. The rate at which melting occurs is dependent on the temperature. Sodium chloride loses its effectiveness (has difficulty going into solution) when temperatures fall below 15° F. Applications below this temperature, even at high rates, will not result in significant snow or ice melting; therefore, it is critical to know the current and expected temperature range of the winter weather event.



Graph obtained from The Salt institute FY03 Snow & Ice Fact #20

What Happens to Salt in the Environment

The applied salt dissolves into 40 percent sodium ions (Na+) and 60 percent chloride ions (Cl-) in the melting snow and ice and make their way into our environment.

[1] U.S. Geological Survey, Mineral Commodity Summaries, January 2010

Chloride(Cl-)*:* Chloride is highly soluble, very mobile, and its density allows for it to settle to the bottom of a waterbody. Chloride is toxic to aquatic life at levels above 230 mg/l, which is the state water quality standard. There is no natural process by which chlorides are broken down, metabolized or taken up by vegetation. In 2008, New Hampshire listed 19 water bodies impaired by chloride; in 2010 that number increased to 40. Trends show that chloride levels continue to rise with increasing use of road salt. Although chloride does not pose a human health concern, it can affect the taste of drinking water.

Sodium (Na+): The transport of sodium in the environment is not as prominent as chloride due to ion exchange; however, this exchange can alter the soil chemistry by replacing and releasing nutrients such as calcium, magnesium and potassium into the groundwater and surface water. This can lead to increased nutrient concentrations and affect the ability of the water to buffer acid deposition impacting the aquatic environment. Contamination of sodium in drinking water is a concern for individuals restricted to low-sodium diets due to hypertension (high blood pressure). The USEPA has set an advisory limit for drinking water for public water systems at 20mg Na/L to assist doctors in making recommendations for those patients on a salt restricted diet.

Road Salt Additives: Additives to road salt like ferrocyanide, which is used as an anti-caking compound in large salt supplies, can have impacts on both the environment and human health due to cyanide ions being released by certain types of bacteria as well as from exposure to sunlight. The USEPA in 2003 added this compound to its list of toxic pollutants under section 307(a) of the Clean Water Act.

Road Salt Management Issues

For many road managers and parking lot maintainers the winter maintenance goal is to obtain bare and dry pavements at the earliest practical time following cessation of a storm for effective regular high speed travel and pedestrian safety. Traffic, volume, speed and gradient are the primary factors in determining the level of winter maintenance service for State and municipal roads. Pedestrian travel along with slip and fall liability are the priority for land owners and private sector operators.

A road manager's duty entails awareness of the current and expected weather events, temperatures, equipment capabilities, de-icing chemical inventories, application rates, driving routes, as well as staffing availability for each winter storm event. Expectations from the driving public, property managers and customers along with balancing the environmental effects of de-icing chemicals makes the job of these managers challenging.

Another concern to road managers, property owners, and to citizens is the damage and cost to infrastructure and vehicles associated with road salt use. Corrosion of concrete reinforcing rods in roads, bridges, parking garages along with the cost of corrosion protection practices for highways and the automobile industry cost a staggering $16 billion-$19 billion a year.[2] Road salt alternatives that help reduce the cost to infrastructure and limit the environmental impact are critical.

[2] Adapted from Report of the Salt Use Subcommittee to the Commission on the Environment on Road Salt Use and Recommendations City of Madison, Wisconsin December 2006

Best Management Practices
Following best management practices and recommendations can help in effective and efficient use of de-icing materials while reducing the impact and preserving the quality of our freshwaters.

Application of Road Salt

- Plow, shovel, and blow the snow. Use mechanical means to remove snow, do not use salt or other de-icing chemical to "burn-off" snow and ice.
- Calibrate your equipment. Knowing your equipment is calibrated and the application rate is accurate will save chemical cost and will reduce the environmental impacts. Calibrate annually and keep a record in the vehicle for spreader settings.
- Choose the right material and apply the correct amount. Know the limits of deicing chemicals. Rock salt is not effective at temperatures below 15°F no matter how much is applied. Check application rates given the current weather conditions.
- Use ground speed controls on your spreader. Application rates should correspond with vehicles speed.
- Pre-wet the salt. Adding brine to salt before it is applied will jump start the melting process and help keep the salt in place by reducing bounce and scatter. Pre-wetting salt can reduce application rates by 20 percent. Typical rates are 8-10 gallons of pre-wet liquid to 1 ton of salt.
- For road applications place salt in a windrow near the centerline. Less salt is wasted and traffic will help work the salt into brine and move it to the shoulder of the road.
- Use anti-icing. Be proactive by applying de-icing chemical prior to snow and ice accumulation. It can reduce the amount of chemical needed by 30 percent. Know when to take action; time plowing operations to allow maximum melting by salt before snow is plowed off the road or parking lot.
- Don't mix salt and sand. Salt is for melting and sand is for traction on top of the ice, they work against each other.
- Be familiar with sensitive areas, such as public water supplies, impaired waters and other water sources. Consider designating reduced salt areas or identifying safe alternatives to road salt in these areas.
- Create a winter snow and ice control policy. Outlining your levels of service, application rates, and plowing frequency and practices provide a reference for decision makers and staff.
- Keep a winter storm log. Record storm events, time, application rates, and other important information describing maintenance activities and results.
- Attend training workshops and stay up to date with new technologies and practices.
- For additional information on training, please refer to UNH Technology Transfer Center at http://www.t2.unh.edu/

Storage and Handling
Salt, sand, and snow storage facilities have the potential to cause water pollution due to runoff. For maximum environmental protection, all salt storage facilities and piles should be covered and placed on an impervious surface with adequate drainage controls to prevent runoff. This is also important for sand piles that may contain a small percentage of salt to prevent the pile from

freezing. Take care while loading salt, sand or chemicals and clean up any spills that occur. Snow piles should be kept away from water sources and below areas where salt is stored. Vehicle washing facilities should have proper drainage to avoid discharge into surface and ground waters.

To obtain more information, please see the following DES fact sheets at: http://des.nh.gov/organization/commissioner/pip/factsheets

- Snow Dumping WD-WMB-3
- Holding Tanks for Floor Drains WD-DWGB-22-8
- Wastewater Discharges from Vehicle Washing WD-DWGB-22-10
- Storage and Management of Salt Deicing Materials WD-DWGB-22-30

Alternatives to Road Salt

Environmental impact should be considered when selecting any de-icing chemical or product. Many of the road salt alternatives have a relatively short history or limited amount of use. It is unclear what the potential long term impacts will be for many of these chemicals. Ongoing research, data analysis, and documentation in scientific literature of non-corrosive and environmentally friendly chemicals are necessary.

Calcium Chloride (CaCl) – is the second most common used chemical, it is available in flake, pellet or liquid. It is effective at lower temperatures with a practical melting temperature of -20°F. In liquid form it can be used to pre-wet salt or applied directly as an anti-icing technique which can help in preventing snow and ice from bonding to the pavement and reduce the application amount needed. Several disadvantages to CaCl include a higher cost, environmental impact due to chloride, corrosive to metal, it can be difficult to handle and store, and can contribute to slippery conditions if applied incorrectly.

Potassium chloride (KCl) – is a naturally occurring material (muriate of potash) that also is used as fertilizer. It is available in liquid or crystal with a practical melting temperature of 20°F. It can be damaging to concrete, has environmental impacts due to chloride and can inhibit plant growth and burn foliage.

Magnesium Chloride (MgCl) – is available in liquid or crystal form that melts faster than rock salt; it has a practical melting temperature of 5°F. MgCl attracts moisture and can lead to slippery conditions if applied incorrectly. It is corrosive and contributes to the chloride load in our waters.

Urea – is used primarily as fertilizer with a practical melting temperature of 25^{o}F. It releases nitrogen into the soil and can lead to a chemical imbalance in water systems due to nutrient loading. Urea is corrosive and breaks down rapidly into ammonia, which is released into the environment.

Potassium Acetate (KA) – has a practical melting temperature of -15°F and is biodegradable and non-corrosive. It can cause slick road conditions if applied in excess and can lower oxygen levels in the waterbody. This is a commonly used deicer in the airline industry and is relatively non corrosive.

Calcium Magnesium Acetate (CMA) – is made from limestone and acetic acid. Its lowest practical melt temperature is 20°F. It is less damaging to soils and vegetation, less corrosive to concrete and steel, less toxic to aquatic organisms, and has limited impact on ground water in comparison to road salt. It is much more expensive than road salt but a full cost analysis may show that is it an economically viable choice given its benefits. It is currently being used in environmentally sensitive areas and on bridges prone to salt corrosion.

Agricultural by-products – are mostly proprietary to the manufacturer and can be derived from sources such as corn, beet, grain, alcohol, or molasses. These products are not good at melting snow and ice; however, they do slow down the formation of ice crystals by having a lower freezing point. They are less corrosive than conventional materials and in many cases act as tackifiers to keep product on the road surface. These attributes make the product good for anti-icing and pre-treating salt. They do have environmental impacts in aquatic systems due to their organic nature and can lead to biological oxygen demand, heavy metals, and nutrient enrichment by nitrogen and phosphorus in our waters.

For Additional Information

For more road salt and water quality information, visit the DES New Hampshire Road Salt Reduction Initiative website at http://des.nh.gov/organization/divisions/water/wmb/was/salt-reduction-initiative/index.htm or contact the DES Watershed Assistance Section at (603) 271-7889 or watershed@des.nh.gov .

For information on road salt and drinking water, see fact sheet “DWGB-3-17 Sodium and Chloride in Drinking Water” at http://des.nh.gov/organization/commissioner/pip/factsheets/dwgb/documents/dwgb-3-17.pdf , or contact the Drinking Water and Ground Water Bureau at (603) 271-2513.

Note: This fact sheet is accurate as of December 2010. Statutory or regulatory changes or the availability of additional information after this date may render this information inaccurate or incomplete.