



Snow and Ice Control Treatments – Popular Materials

Winter weather events present roadway agencies responsible for Snow & Ice removal with options on treatment materials to improve roadway safety. In this Route of Navigation (RON) technical update, we will cover the materials considered by the industry as the most widely used options for treating a roadway.

Material Types:

Abrasives

Anti-skid materials or abrasives can be sand, blotter sand, fine stone, coal cinders, crushed rock, crushed gravel, crushed limestone, 7mm washed Gyra rock, metallurgical slag, natural river sand, ash, crushed coal boiler bottom ash, fly ash, tailings, ore, chips, brash, rubble, sawdust, aggregates, cat litter, coke, burned anthracite coal mine refuse, and rock quarry screenings. **Caution:** natural river sand is rounded (not angular), and sawdust and chips become slippery when wet. Abrasives are sometimes referred to as grits.

Abrasives have always played a significant role in snow and ice control. Even with newer technologies, strategies and understanding, abrasives will continue to have a place in effective snow and ice control programs. **That role is very narrow** and very clear. They are typically used when it is too cold for chemicals to work, on low volume and unpaved roads that have a low level of service (LOS), and in areas where significant friction is always required to maintain traffic flow (steep hills, etc.)

Abrasives by themselves are inert and do not melt snow and ice. The key thing about a good abrasive is angularity. The more rough, angular edges an abrasive has, the more friction it will provide. The use of abrasives has been a longtime reactive strategy as a low-cost approach to improving pavement friction in addition to plowing. However, when abrasives are placed on the road surface, they provide, at best, a very short-term or temporary increase in road surface friction and traction control. The longer an abrasive is on a roadway, the more it is broken into smaller pieces and its edges are rounded which reduces the amount of friction it provides. Also, as roadway traffic levels and speeds are increased, any benefit from abrasive use diminishes.

Abrasives have substantial clean-up costs due to repeated applications that are needed. Abrasives can negatively impact water quality and aquatic species, air quality, vegetation and soil. Abrasives accumulate in storm water inlets and pipes and travel into waterways via storm water runoff and snowmelt. The risks include increased water turbidity from suspended solids, clogging of streams and storm water drains, and reduced oxygenation within the stream and river beds for macro-invertebrates and fish eggs. The detrimental environmental impacts of abrasives are generally greater than those of chemical deicers due to much higher application rates for abrasives.

A typical abrasives standard shall consist of washed granular particles free of stones (3/8" or larger), loam, clay debris, and chloride salts or other corrosive substances, and shall be clean and hard with the following gradation:



Sieve Size	Percent by Weight Passing	
	Minimum	Maximum
3/8"	100	100
1/4"	95	100
8	50	75
16	20	55
50	0	10
200	0	2

As a general precaution, it is important to monitor use of abrasives to avoid buildups or accumulations of excess material (debris deposits) on roadways, especially on paved surfaces. **Rounded abrasives can reduce friction below what can be measured on the surrounding pavement. It also must be cleaned off the pavement before motorcycle season. Loose piles of abrasives can cause motorcyclists (and other road users) to lose control.**

Salt

Salt is sodium chloride, NaCl, a white crystalline substance with its characteristic taste found in natural beds, in seawater, etc. The mineral form is *halite*, also called “rock salt”. Salt used for winter maintenance operations is sometimes referred to as “road salt”.

Salt was first used to treat snow and ice covered roads in the mid-1940s, but its use wasn’t fully embraced until the fifties. Use increased as more agencies became aware of the higher level of service salt could provide in addition to plowing and as the North American road system expanded.

Brine

Brine is made by mixing salt in water to approximately a 23% solution by weight (23% salt / 77% water). Brine is commonly used in anti-icing operations and for pre-wetting solid rock salt.

The proportion of salt to water is critical to the effectiveness of the brine. Too much or too little salt affects the freezing point depressing qualities of the brine. The proper brine mixture is 23.3% at which the freezing point is -6°F. **Caution:** If the solution of brine dilutes below its effective concentration, you will not achieve any reduction of ice bonding to the pavement.

Brine is widely used because it is:

- Readily available (easy to produce)
- Very economical
- Effective for events occurring at moderate subfreezing temperatures

Green brine is recommended to be used as much as possible. It is the salty water runoff from washing snow plow trucks after each snow storm which is collected in an onsite storm water retention pond that also collects storm water from the salt barn(s), loading area, and remaining site area. This water is beneficially reused by transferring it to a tank specially designed to mix brine.



EPA regulations must be met when using this green brine. This usually means running the wastewater through an oil-water separator, collection and storage, and filtration of heavy metals. Contact your local Ohio EPA office when considering this alternative.

Calcium Chloride

Calcium chloride comes in two forms – liquid and dry. Liquid calcium chloride and the corrosion-inhibited versions as purchased by the Ohio Department of Transportation (ODOT) are a 30 to 33% solution. These products are typically used for pre-wetting salt and can be used to pre-wet abrasives.

Calcium chloride is also available in a dry flake form to be mixed with salt or abrasives for effective melting at low temperatures.

The higher cost of calcium products frequently prohibits use for routine purposes. These products can also be used in anti-icing; however, at the higher cost they quickly become uneconomical. The use of calcium chloride (or a corrosion-inhibited version) is recommended for use at temperature ranges below 20° F.

Treating Asphalt, Brick, and Concrete Surfaces:

If conditions and timing allow, operators should apply anti-icing materials to the road prior to a snow fall.

Anti-icing is the application of an anti-icing material to the roadway prior to a snowfall event to prevent the bond from occurring between the snow and the roadway. Anti-icing materials are typically a brine, or in some cases rock salt. Anti-icing practices can also be used to prevent the formation of black ice on roadways.

Deicing is the application of a deicing material to the roadway after a snowfall event has occurred and the snow has bonded to the roadway. Always plow before applying treatment material to a snow-covered roadway. Plowing is the most cost-effective means of removing snow and ice from the roadway. Reversing the order will result in plowing deicing material off the roadway. It is usually not cost-effective to apply salt alone at pavement temperatures below 15 degrees Fahrenheit.

Salt's effectiveness can be increased by pretreating and pre-wetting.

Pretreating is mixing a non-caking liquid into the stockpile of salt before it is applied. It does not require changes to an agency's plow trucks and requires no new capital investment for application equipment if it is applied by a vendor.

Pre-wetting is adding a liquid to the salt as it is being applied – either at the spinner or through a soaker pipe in the auger box to reduce bounce and scatter and to accelerate the melting process. Although pre-wetting requires some changes to an agency's plow truck, it provides flexibility to switch the liquid chemical makeup depending on conditions.



Use an appropriate **amount** of salt. Use a calibrated, speed-synchronized spreader and good judgment in selecting application rates and truck speeds. Apply just enough material to prevent or loosen the bond between the road and the snow or ice so it can be plowed off.

These guidelines are a starting point. Reduce or increase rates incrementally based on your experience according to your local conditions.

Application Rates:

Application rates vary among different agencies, due to diverse weather conditions and roadway scenarios. The following salt application rates are for typical 24' two-lane roads, during the specified pavement temperatures, with the listed precipitation.

Dry Pavement Light Snow Less Than 2"/Hour					
Above 32° F (Rising)	Above 32° F (Falling)	32° F to 25° F	25° F to 20° F	20° F to 15° F	Below 15° F
Bridges and Icy Spots	Acceptable	Recommended	Recommended	Recommended	Recommended
Plow and treat @ 50 to 100 lb./mile #	Plow and treat @ 50 to 100 lb./mile #	Plow and treat @ 50 to 100 lb./mile #	Plow and treat @ 100 to 200 lb./mile #*	Plow and monitor conditions	Plow and monitor conditions
Wet Pavement Light Snow Less Than 2"/Hour					
Above 32° F (Rising)	Above 32° F (Falling)	32° F to 25° F	25° F to 20° F	20° F to 15° F	Below 15° F
Bridges and Icy Spots	Acceptable	Recommended	Recommended	Recommended	Recommended
Plow and treat @ 50 to 100 lb./mile #	Plow and treat @ 50 to 100 lb./mile #	Plow and treat @ 50 to 100 lb./mile #	Plow and treat @ 100 to 200 lb./mile #*	Plow and treat @ 300 to 400 lb./mile #*	Plow and treat @ 200 to 300 lb./mile with Calcium Chloride*
Dry Pavement Heavy Snow More Than 2"/Hour					
Above 32° F (Rising)	Above 32° F (Falling)	32° F to 25° F	25° F to 20° F	20° F to 15° F	Below 15° F
Bridges and Icy Spots	Acceptable	Recommended	Recommended	Recommended	Recommended
Plow and treat @ 50 to 100 lb./mile #	Plow and treat @ 50 to 100 lb./mile #	Plow and treat @ 100 to 200 lb./mile #	Plow and treat @ 300 to 400 lb./mile #	Plow and monitor conditions	Plow and monitor conditions

- Pre-wet the material @ 8 to 10 gallons of brine/ton of salt

* - Abrasives are recommended at these temperatures if road drainage is open



Wet Pavement Heavy Snow More Than 2"/Hour					
Above 32° F (Rising)	Above 32° F (Falling)	32° F to 25° F	25° F to 20° F	20° F to 15° F	Below 15° F
Bridges and Icy Spots	Acceptable	Recommended	Recommended	Recommended	Recommended
Plow and treat @ 100 lb./mile #	Plow and treat @ 100 to 200 lb./mile #	Plow and treat @ 100 to 200 lb./mile #	Plow and treat @ 400 lb. max/mile #*	Plow and treat @ 400 lb. max/mile #*	Plow and treat @ 400 lb. max/mile with calcium chloride *

Freezing Rain					
Above 32° F (Rising)	Above 32° F (Falling)	32° F to 25° F	25° F to 20° F	20° F to 15° F	Below 15° F
Bridges and Icy Spots	Recommended	Recommended	Recommended	Recommended	Recommended
Plow and treat @ 100 lb./mile #	Plow if needed and treat @ 200 to 300 lb./mile #*	Plow if needed and treat @ 300 to 400 lb./mile #*	Plow if needed and treat @ 400 lb. max/mile #*	Plow if needed and treat @ 400 lb. max/mile #*	Plow if needed and treat @ 400 lb. max/mile with calcium chloride *

Black Ice					
Above 32° F (Rising)	Above 32° F (Falling)	32° F to 25° F	25° F to 20° F	20° F to 15° F	Below 15° F
Bridges and Icy Spots	Recommended	Recommended	Recommended	Recommended	Recommended
Apply anti-icing material prior to the formation of black ice ^	Apply anti-icing material prior to the formation of black ice ^	Apply anti-icing material prior to the formation of black ice ^	Apply anti-icing material prior to the formation of black ice ^	Apply anti-icing material prior to the formation of black ice ++	Apply anti-icing material prior to the formation of black ice ++

- Pre-wet the material @ 8 to 10 gallons of brine/ton of salt

* - Abrasives are recommended at these temperatures if road drainage is open

^ - Apply anti-icing brine @ 20 to 40 gallons/lane mile

++ - Treat with salt @ 150 to 200 lb./mile prior to the formation of black ice. Pre-wet the material @ 8 to 10 gallons of brine/ton of salt with either Calcium Chloride or an agricultural deicer to enhance the brine for cold temperatures. *Do not apply liquid anti-icing material when the pavement temperature is below 20° F.*

Information Sources:

Federal Highway Administration – www.fhwa.dot.gov

Ohio DOT – www.dot.state.oh.us; Scott Lucas, Office of Maintenance Operations – 614-644-6603.

Salt Institute – www.saltinstitute.org

Minnesota Local Road Research Board – www.lrrb.org

