

Snow and Ice Control Treatments – Brine Enhanced with Additive(s)

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 address the scenario where brine with additives might be the most advanced methods and main materials being used at the local agency for treating a roadway.

Material Types:

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. Recently it has been used for deicing snow and ice.

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.

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.

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.

Liquid and Agricultural Deicer

Products such as BeetHeat, GEO-Melt and AMP are used for pre-wetting salt and as a blended product with brine for Direct Liquid application.

Blends = 80% brine to 20% Liquid Deicer; also 90% to 10%.

Natural Well Brine

Products such as AquaSalina and XO-Melt2 are used for pre-wetting and for blending or 100% application. These products can be applied directly to roadway as a blend with brine or by themselves.

Blends= 90% brine to 10% Natural Well Brine, all the way to 50% to 50%.

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. In this case brine would be the anti-icing material to be used. Anti-icing practices can also be used to prevent the formation of black ice on roadways. It is usually not cost-effective to apply brine alone at pavement temperatures below 20 degrees Fahrenheit.

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 brine alone at pavement temperatures below 20 degrees Fahrenheit.

Note that the Ohio Department of Transportation may sell brine to local government agencies at local sites where brine is produced. Contact your local ODOT facility for more details.



Use a liquid application unit in streams, at controlled amounts, in an application that leaves the surface merely damp 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.

Direct Liquid Application (DLA) is the act of directly applying liquid treatment material – typically either regular brine, or a brine enhanced with additive(s) – to the roadway surface during or after a storm event. DLA is sometimes supplemented with granular application. *DLA treatment must be reapplied every two hours during a snowfall to prevent black ice from forming.* Every winter storm is different. For some storm event types, DLA has proven to be the most effective. DLA can help us:

- Optimize material usage producing cost savings.
- Minimize necessary post-storm cleanup, allowing us to “get done earlier” producing time savings and often better (and quicker) post-storm level of service which reduces accidents.
- Because it is the most effective application in some storm conditions, it helps us maintain a more continuous target level of service for a wider variety of conditions.
- “Instantaneous” effect (no solid to liquid phase change) producing results.

Under favorable conditions, DLA has been found to require 50% less salt. Areas using DLA often find that they generally are “done earlier” after the storm.

DLA has been used by some agencies as a proactive approach when working with environmental organizations. Some regulations require street and shoulder sweeping to remove all salt after storm events. DLA can satisfy this requirement by not leaving salt granules on the street or shoulder after a storm.

DLA is a relatively recent concept as a possible treatment option for winter maintenance. One important consideration is *pavement temperature*. **It should be noted that most of the published case studies regarding use of DLA have been based on pavement temperatures above 20° F.** Caution should be used when considering DLA for lower pavement temperatures, as liquid brines become less effective and more susceptible to freezing or black ice formation during colder conditions – particularly if the brine solution becomes diluted.

When to use DLA?



Parameter	Most Favorable For DLA	Consider DLA
Pavement Temperature	25°F or above	20°F or above
Storm Intensity (inches/hour)	0.5 inches/hour or below	1.0 inches/hour or below
Moisture Content	Ordinary	Dryer Snowfall (consider plow-only)

Source: ClearRoads DLA Presentation – 2010.

Application Rates:

The following brine application rates are for typical 24’ two-lane roads, during the specified pavement temperatures, with the listed precipitation.

IMPORTANT – All roadways must be reapplied every two hours during a snowfall to prevent black ice from forming. This is critical – do not treat more miles than you can cover in two hours during a storm including reloading time.



Dry Pavement, Light Snow Less Than 0.5"/Hour					
Above 32° F	32° F to 30° F	30° F to 27° F	27° F to 24° F	24° F to 21° F	Below 21° F
Bridges and Icy Spots	Acceptable	Recommended	Recommended	Recommended	
Plow and treat @ 35 gallons/mile	Plow and treat @ 35 gallons/mile	Plow and treat @ 40 gallons/mile	Plow and treat @ 45 gallons/mile	Plow and monitor conditions	Plow and monitor conditions
Wet Pavement, Light Snow Less Than 0.5"/Hour					
Above 32° F	32° F to 30° F	30° F to 27° F	27° F to 24° F	24° F to 21° F	Below 21° F
Bridges and Icy Spots	Acceptable	Recommended	Recommended	Recommended	
Plow and treat @ 35 gallons/mile	Plow and treat @ 35 gallons/mile	Plow and treat @ 40 gallons/mile	Plow and treat @ 45 gallons/mile	Plow and treat @ 50 gallons/mile	Plow and treat @ 60+ gallons/mile**
Dry Pavement, Medium Snow 0.5" to 1"/Hour					
Above 32° F	32° F to 30° F	30° F to 27° F	27° F to 24° F	24° F to 21° F	Below 21° F
Bridges and Icy Spots	Acceptable	Recommended	Recommended	Recommended	
Plow and treat @ 40 gallons/mile	Plow and treat @ 40 gallons/mile	Plow and treat @ 50 gallons/mile	Plow and treat @ 60 gallons/mile	Plow and monitor conditions	Plow and monitor conditions
Wet Pavement, Medium Snow 0.5" to 1"/Hour					
Above 32° F	32° F to 30° F	30° F to 27° F	27° F to 24° F	24° F to 21° F	Below 21° F
Bridges and Icy Spots	Acceptable	Recommended	Recommended	Recommended	
Plow and treat @ 40 gallons/mile	Plow and treat @ 40 gal./mile	Plow and treat @ 50 gallons/mile	Plow and treat @ 60 gallons/mile	Plow and treat @ 70 gallons/mile	Plow and treat @ 90+ gal./mile**
Dry Pavement, Heavy Snow More Than 1"/Hour					
Above 32° F	32° F to 30° F	30° F to 27° F	27° F to 24° F	24° F to 21° F	Below 21° F
Bridges and Icy Spots	Acceptable	Recommended	Recommended	Recommended	
Plow and treat @ 50 gallons/mile	Plow and treat @ 50 gallons/mile	Plow and treat @ 70 gallons/mile	Plow and treat @ 90 gallons/mile	Plow and monitor conditions	Plow and monitor conditions
Wet Pavement, Heavy Snow More Than 1"/Hour					
Above 32° F	32° F to 30° F	30° F to 27° F	27° F to 24° F	24° F to 21° F	Below 21° F
Bridges and Icy Spots	Acceptable	Recommended	Recommended		
Plow and treat @ 50 gallons/mile	Plow and treat @ 50 gallons/mile	Plow and treat @ 70 gallons/mile	Plow and treat @ 90 gallons/mile	Plow and treat @ 110 gal./mile**	Plow and monitor conditions

** Note: these tables are based on pavement temperature. If the *air temperature* is below 21° F, increase by 10 gallons/lane mile for each 10° F. If the *air temperature* is below 10° F, reapply liquid or apply 50 to 100 pounds of salt per lane mile with the liquid to maintain surface from refreezing.



Freezing Rain					
Above 32° F	32° F to 30° F	30° F to 27° F	27° F to 24° F	24° F to 21° F	Below 21° F
Bridges and Icy Spots	Recommended	Recommended	Recommended	Recommended	Recommended
Plow and treat @ 40 gallons/mile	Plow if needed and treat @ 60 gallons/mile	Plow if needed and treat @ 70 gallons /mile	Plow if needed and treat @ 80 gallons max/mile	Plow if needed and treat @ 110 gallons/mile**	Plow if needed and treat @ 150+ gallons/mile**
Black Ice					
Above 32° F	32° F to 30° F	30° F to 27° F	27° F to 24° F	24° F to 21° F	Below 21° 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++

** Note: these tables are based on pavement temperature. If the *air temperature* is below 21° F, increase by 10 gallons/lane mile for each 10° F. If the *air temperature* is below 10° F, reapply liquid or apply 50 to 100 pounds of salt per lane mile with the liquid to maintain surface from refreezing.

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

++ - Do not apply liquid brine when the pavement temperature is below 20° F.

Additional Treatment Materials:

For information about additional treatment materials commonly used for winter roadway maintenance, please refer to the separate RON technical update on *Snow and Ice Control Treatments – Popular Materials*.

http://www.dot.state.oh.us/Divisions/Planning/LocalPrograms/LTAP/Documents/Popular_Materials_for_Snow_and_Ice_Control_Treatments.pdf

Information Sources:

Federal Highway Administration – www.fhwa.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

DLA Presentation, Clear Roads (2010) –

http://www.tspec.com/TruckTrailerSpecialties/media/files/monroe-bus-trip-budd-presentation-DLA_2012.pdf

DLA Presentation, Ohio DOT (2016) – <https://www.apwa.net/library/meetings/snow/10389.pdf>

