



# Anti-Icing

NH Best Management Practices

## GET OUT EARLY

Typically anti-icing is most effective if applied 1-2 hours before the precipitation begins however it can be applied up to 24 hours in advance.

## TRY IT FIRST

Trying anti-icing for the first time? Make a 23.3% brine solution and before a storm spray pavement on your own property using a masonry/plant sprayer. Use this experiment to determine how best to use it with your clients.

## LEAVE SOME PAVEMENT BARE

It's always best to use stream nozzles instead of fan tip to avoid creating a slippery condition. If the anti-icing liquid freezes the bare pavement will still provide a traction surface.

## USE A FILTER

Having a filter in your liquid dispensing system will reduce clogs in your nozzle. Automotive in line fuel filters work quiet well. If your liquid dispenser is not functioning properly be sure to check the filter first.

## A Proactive Treatment

Anti-icing before a storm is very similar to using a non-stick spray on a pan before cooking. Just like a non-stick spray prevents food from bonding to the pan, anti-icing prevents snow and ice from bonding to the pavement so that it can be plowed away. Anti-icing can save you **money** as it costs 50% less than reactive deicing.



## How Much Should I Use and When?

You can apply brine up to 24 hours in advance of the storm. Typical application rates range from 0.5 to 0.75 gallon per 1000 sq.ft. (10' x 100' area). Other chemicals such as magnesium are also available—consult your supplier for application rates. Anti-icing is **not** advised prior to freezing rain events.



## Make Your Own Salt Brine

When making brine it is important to add enough salt to produce a 23.3% solution which freezes around 0°F. Roughly 2.5lb per gallon of water will produce a 23.3% solution. You can verify using a salometer (~\$20) a 23.3% solution will have a specific gravity of 1.176, or 85% salinity. Consult the Brine Making BMP sheet for more info.



## Getting Started

Try making your own salt brine by putting 13 lb of salt in 5 gallons of water to get a 23.3% salt brine solution. Mix the brine until all of the salt is dissolved. Using a masonry sprayer apply the liquid several hours before a storm. Start by applying about 0.25—0.5 gallons to a 10' x 50' area. Adjust the application rates based on your experience. Being careful not to over apply and cause a slippery condition.

Produced in partnership with:





# Brine Making

NH Best Management Practices

## GET THE LOWEST FREEZE POINT

When salt brine is 23% salt (measured with a hydrometer: 1.176, or with a salimeter: 85%) it has the lowest freeze point possible (about 0°F).

## BRINE STORAGE

23% brine solution may be stored outside, however if temperatures get below 0°F the brine may freeze. A circulator pump will reduce the risk of freezing. If possible store brine indoors to eliminate risk of freezing.

## COST OF BRINE

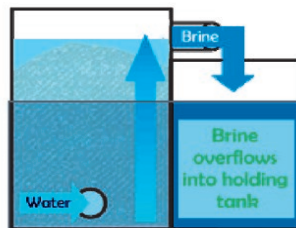
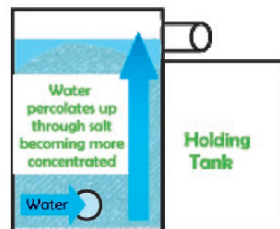
Calcium chloride brine costs about 7¢ / gallon (assuming \$58/ton for salt) after you have your equipment setup.

## MULTIPLE USES

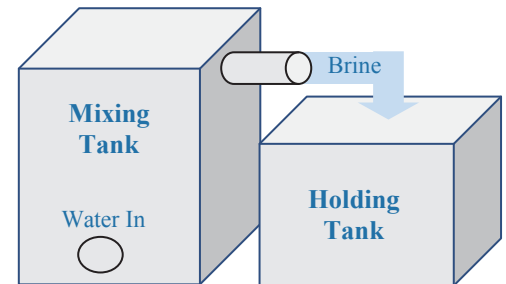
Brine can be used directly for anti-icing, for prewetting salt as it is dispensed from your truck, or to pretreat salt before it is loaded into your truck. Brine can be safely stored for up to a year, however, the concentration should be tested before use.

## What Do You Need?

Brine making is a fairly simple process—the only ingredients are salt and water, and the only equipment you'll need is an open top mixing tank, a holding tank, a small pump, and a salimeter.



Images courtesy of Iowa DOT



## Step 1: Fill Mixing Tank

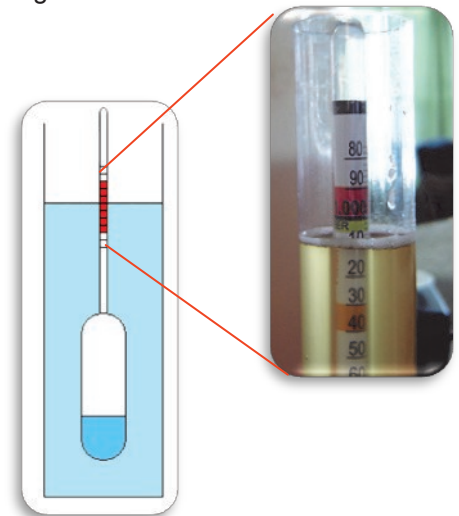
**Add Salt:** Add about 2.5 lb of salt per gallon of water you plan to add. Make sure your mixing tank has a large opening to make adding salt easy.

**Add Water:** Slowly add water from the bottom of your brine mixing tank. This will allow it to percolate up through the salt and overflow into the holding tank.

## Step 2: Check Concentration

Float a hydrometer or salimeter directly in your holding tank and read the value at the surface of the water. The number should be either 85% or 1.176 depending on the units of your device.

If the values are too low, pump some brine from your holding tank back into the mixing tank and allow it to overflow. If values are too high simply add some fresh water



## Quality Control & Documentation

Make sure that you record the date when you create each batch of brine and document who mixed it and checked the concentration. It is also a good idea to note the final concentration. These records should be kept for at least two years to protect your group in the event of litigation.

Produced in partnership with:



## 9 ANTI-ICING

**A** relatively new weapon in the sustainable snowfighting arsenal in North America is anti-icing. But it has a long history of keeping European roads safe and passable.

Anti-icing differs significantly from deicing because brine is applied before precipitation to prevent the formation or development of bonded snow and ice on the road surface. It is a proactive approach to snowfighting and is often the first in a series of strategies employed for a winter storm. By applying freezing point depressant materials before a storm it is possible to prevent the bond from forming between the pavement and snow or ice. Research has shown that timely applications of anti-icing materials can cut the cost of maintaining a safe road surface by 90% compared to traditional deicing. Liquid sodium chloride (NaCl) is the most effective choice for anti-icing above 15°F.

### Anti-icing has many advantages.

- Anti-icing returns road surfaces to normal faster, resulting in fewer accidents and delays.
- Anti-icing can reduce airborne dust and salt particulates.
- Salt needs moisture to be effective. Applying brine jumpstarts the melting process.
- Brine sticks to the road surface. It will not be as easily blown off the road by wind or traffic, so material is more efficiently used.
- If the storm is delayed, salt residue remains on the road ready to begin work when precipitation begins.
- Crews can begin treatment in advance of a storm. Because anti-icing prevents the bonding of snow and ice to pavement, snowfighters have less work to maintain safe roadways as the storm progresses.
- Increased efficiency results in use of less deicer and manpower, therefore lowering the cost of maintaining safe road conditions. The use of less deicing materials also minimizes environmental concerns.

Products available for use in an anti-icing program are sodium chloride, calcium chloride, magnesium chloride, potassium acetate, and calcium magnesium acetate.

Each product has its own advantages and disadvantages. The most common material in use is sodium chloride (salt) in the form of a brine made from a mixture of rock salt and water. Salt brine is effective to -6°F and is a proven anti-icing agent in use throughout the snowbelt.

Some agencies use calcium or magnesium chloride in a brine solution which is effective down to -6° F, but is more than six times more expensive than salt, and is more difficult to handle. Also, calcium and magnesium chloride residue on road surfaces can attract moisture at lower relative humidity than salt resulting in dangerous, slippery conditions under certain circumstances.

### Salt Brine Manufacture

Salt brine is made by mixing rock salt or solar salt with water. The process is simple: the resulting brine should be approximately 23% NaCl.

The proportion of salt to water is critical to the effectiveness of the brine. Too much or too little salt affects the freeze point depressing qualities of the brine. The proper brine mixture is 23.3% salt content by weight. This is the concentration at which salt brine has the lowest freezing point, -6° F. Can we keep adding salt to water until the freezing point goes down much further? No. The solubility of salt in water decreases with decreasing temperature. We eventually reach what is called the eutectic point. This is the point at which a solution achieves a maximum salt concentration. Any colder and salt will begin to leave the solution and raise the freezing point. At the eutectic temperature, ice, saltwater, and solid salt exist in equilibrium. For water, the eutectic temperature is -6° F. The percentage of salt is measured with a salometer, a specialized hydrometer, until a 88.3% measurement on the salometer is obtained. This results in the proper 23.3% salt content.

Commercial brine makers are available at a cost of approximately \$5,000. Many agencies have made their own brine makers using water tanks and PVC pipe for substantially lower cost. Brine is usually made at the local maintenance facility sites and stored in large tanks in locations convenient for loading into saddle tanks on the sides of the V-box or anti-icing equipment. It is essential to clean out brine makers after brine is prepared to reduce the potential for corrosion.

### Application Equipment

Brine applicators are commercially available for about \$1,500. Some agencies have manufactured their own application equipment using large tanks and PVC piping. Some equipment is designed to be

**Hydrometer/Salometer  
Chart for Salt Brine**

% Salt	Hydrometer Specific Gravity	Salometer Using 0-100%
0	1.000	0
1	1.007	4
2	1.014	7
3	1.021	11
4	1.028	15
5	1.036	19
6	1.043	22
7	1.051	26
8	1.059	30
9	1.067	33
10	1.074	37
11	1.082	41
12	1.089	44
13	1.097	48
14	1.104	52
15	1.112	56
16	1.119	59
17	1.127	63
18	1.135	67
19	1.143	70
20	1.152	74
21	1.159	78
22	1.168	81
23	1.176	85
24	1.184	89
25	1.193	93
26	1.201	96
27	-	100



loaded onto the bed of spreading trucks, towed behind maintenance equipment or permanently mounted on truck beds. It can be as simple as a gravity fed spraying system with a operator controlled cut-off valve or a more complex (and more controllable) pump driven sprayer system. Fan sprayers are not recommended. Control should be available to vary spreading rates from 25 to 60 gallons per lane mile.

If large, horizontal tanks are used in the design, consider installing baffles inside the tanks to help prevent the liquid from suddenly shifting in the tank, creating a hazardous control situation for the operator.

## Application

Accurate weather and road surface information are critical for the efficient use of anti-icing materials. Road surface temperatures, precipitation amounts and form, wind conditions, and road environment (sunlight exposure, surface condition, bridges, etc.) all affect the use and application of anti-icing measures.

Understanding the freeze point depressing qualities of brine is important to its use and application as an anti-icing agent. (See the Phase diagram below.) As you can see from the chart, the minimum freeze point of salt brine is -6°F at a concentration of 23.3%. Road surface temperatures are indicated on the side of the chart, solution concentrations along the bottom. The line represents the freeze point of the solution at a given temperature. The colored portion in the center of the chart shows the melting range of brine solutions. The area to the left shows the results of a solution with too little salt, the road surface will refreeze unless more salt brine or deicing salt is applied. The area to the right shows the results with too much salt, with a resultant non-functional loss of material to the environment. As you can see, additional precipitation and heavy traffic can dilute the brine solution allowing the road to refreeze.

ADDITIONAL PRECIPITATION ALWAYS RESULTS IN A DILUTION OF BRINE AT THE ROAD SURFACE.

Weather information is getting better with everything from air temperature, dew point, optical weather identifiers, to pavement temperature, surface status, and compound information being available. Some agencies utilize remote television cameras to monitor traffic and bridge conditions. This information will help agencies accurately determine the appropriate application of anti-icers.

Do not apply anti-icer under blowing conditions, particularly in areas prone to drifting and anywhere else that might be problematic for salt, such as all areas subject to wind issues.

Don't apply too much or the roadway may become slippery. Always follow application recommendations.

Don't apply  $\text{CaCl}_2$  or  $\text{MgCl}_2$  to a warm road (above 28°F pavement temperature). It can become very slippery and cause crashes!

## Summary

Anti-icing measures are an important weapon in the snowfighter's arsenal. The appropriate use of anti-icing techniques results in:

- Returning to bare pavement conditions more quickly, saving lives and reducing property damage due to fewer accidents, as well as the reduction of traffic delays and the resulting reduction of losses to local economies;
- Reduction in the quantity of deicer use, resulting in cost savings and less environmental concerns; and
- Reduction in the manpower necessary to maintain safe road conditions, resulting in less overtime costs, less operator fatigue and safer working conditions. ❄

## Phase Diagram for Salt

