



How to use liquid anti-icers

Know anything about eutectic temperature? Read on to be a smarter product buyer and snow removal specialist.

By DALE KEEP

All ice control products work the same. Their function is to lower the freeze point temperature of water. This ability is dependent upon the percentage of chemical in solution that is expressed as the "eutectic temperature" of the solution.

The eutectic temperature is the freeze point temperature of a solution based on the percentage of material in solution, not volume.

While this may seem complex, the freeze chart on an anti-freeze container is an example.

For example, let's say you have a 12-quart capacity radiator system. You fill it with six quarts of anti-freeze and the remainder with water. This is a 50 percent solution that provides protection down to -34° F. However, if you fill the system with three quarts of anti-freeze and the remainder water, the volume of material is the same, but the 25 percent concentration protects only down to +10° F.

The same holds true for all ice control products. These products melt snow, which creates water and dilutes the concentration. As the concentration changes, so does melting temperature of the material. I call this concept DOS, or "Dilution of Solution."

Some products actually become more effective (melts at a lower temperature)

as they dilute to the optimum eutectic temperature.

Dilution of solution

Understanding DOS provides the key for understanding how ice control products work. Specifically, an ice control product will work until the eutectic temperature of the solution meets the pavement surface temperature. At this point, the material will stop melting and you may experience refreeze. Refreeze occurs when an ice-control product dilutes to the point that it can no longer melt ice at the given surface temperature.

DOS also provides the foundation for determining how long a product application will last.

Let's say, for example, that your own experience indicates that it will take 0.2 inches (0.5 cm) of water to dilute your application to the point of refreezing. Let's also say that each inch (2.5 cm) of snow contains 0.1 inches (0.25 cm) of water. How long will the application last before it refreezes?

The answer: As long as it takes to accumulate 2-inches (5 cm) of snow. Two inches of snow provides 0.2 inches of water to dilute the application to the point of refreeze. If it takes 12 hours to accumulate two inches of snow, then the application lasted 12 hours. If it takes one hour to accumulate two inches of snow, then the application lasted one hour.

DOS also explains why one application rate will not fit all storm events. The temperature and moisture of each storm event varies, therefore, the application amount needed to control each storm varies.

Remember: the effectiveness of any deicing chemical is dependent on four factors:

- 1) Surface temperature
- 2) Application rate
- 3) Moisture
- 4) Beginning concentration

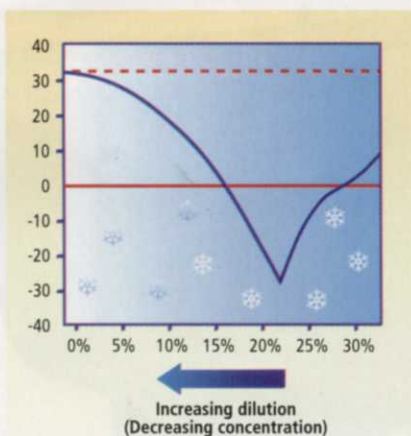


Figure 1: A sample freeze point curve



Equipment issues for chemical roadway clearing

First, list your equipment usage requirements, then select the equipment to fit that need.

Remember: equipment selection is based on user requirements

1. Product to be used.

Consider corrosiveness: Set up for corrosive material.

Recirculation: Set up to allow for recirculation mixing.

Tank material: plastic vs. stainless steel.

Deicer weight: Set up tanks to allow for at least 12 lbs./gal (142 kg/lit.)

2. Pumps

Material: what are they made of, especially the impellers?

Tolerance: how much tolerance is there between the case and the impellers of the pump?

VPM maximum: what is maximum volume per minute output?

VPM minimum: what is minimum volume per minute output?

3. Application rate

Maximum volume per area desired per application

Minimum volume per area desired per application

4. Application pattern

Anti-icing: spray pattern

Deicing: concentrated stream

Lanes to shoot: number of lanes to cover per application

5. Speed

How fast do you want to travel while applying?

How slow can you safely travel while applying?

6. Controls

Speed vs. volume per area of application

Ground speed controls

Easy to use

7. Tank capacity

Area: how much area must you cover per tank full?

What is the minimum acceptable application rate per mass with the machine?

8. Is retro-fitting an option?

Pesticide trucks

Flusher trucks

Oil distributors

Water tanks

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Quality control

A good quality control program is essential to any reliable anti-deice program. The potential for inconsistencies in delivered products will result in inconsistent performance. Without a good quality control program, performance results can differ even though applications and circumstances are the same.

Knowing the specific gravity of a liquid chemical deicer and the associated information, as presented on the previous chart, is the heart of a good quality control program.

Specific gravity is defined as the mass of a substance, given as a multiple of the mass of the same volume of a standard substance (usually distilled water) under prescribed conditions of temperature and pressure.

The specific gravity of aluminum is 2.70; therefore, a cubic foot of aluminum weighs 2.70 times as much as a cubic foot of water.

For measuring the specific gravity of liquids, a hydrometer is commonly used. For more accurate measurements, the

weight of a known volume of liquid is determined under controlled temperature conditions. Hydrometers must be calibrated according to the type of liquid to be tested, and at a standard temperature, usually 4° C (39.2° F) or 20° C (68° F).

Various types of hydrometers measure density or purity in storage batteries, ship boilers, soil and milk.

Know what you're getting

The deicer contract clearly states that the magnesium chloride-based product must be delivered at 28 percent. A variance of plus or minus one percent is acceptable. Water weighs 8.34 lbs. per gallon. The product that exactly meets specifications has a specific gravity of 1.262. Multiply the weight of water times the specific gravity to determine the weight of the liquid deicer. The weight of a gallon of product is outlined:

$$27\% = 1.251 \text{ specific gravity} \times 8.34 \text{ lbs./gal.} = 10.43 \text{ lbs./gal.}$$

$$28\% = 1.262 \text{ specific gravity} \times 8.34 \text{ lbs./gal.} = 10.53 \text{ lbs./gal.}$$

$$29\% = 1.273 \text{ specific gravity} \times 8.34 \text{ lbs./gal.} = 10.62 \text{ lbs./gal.}$$

Effective temperature is the lowest temperature in which the cost of the application is justified by the results obtained. Effective temperature is based on an economic decision.



EXAMPLE FREEZING POINT OF MAGNESIUM CHLORIDE BRINE

% by weight	Specific gravity*	Freezing point Celsius	Freezing point Fahrenheit
5	1.013	-2.11	26.4
6	1.051	-3.09	25.0
7	1.060	-4.72	23.5
8	1.069	-5.67	21.8
9	1.070	-6.67	20.0
10	1.086	-7.83	17.9
11	1.096	-9.05	15.7
12	1.105	-10.5	13.1
13	1.114	-12.1	10.3
14	1.123	-13.7	7.3
15	1.132	-15.9	4.0
16	1.142	-17.6	0.4
17	1.151	-19.7	-3.5
18	1.161	-22.1	-7.7
19	1.170	-25.6	-12.2
20	1.180	-27.4	-17.2
21	1.190	-30.5	-23.0
22	1.200	-32.8	-27.0
23	1.210	-28.9	-20.0
24	1.220	-25.6	-14.0
25	1.230	-23.3	-10.0
26	1.241	-21.1	-6.0
27	1.251	-19.4	-3.0
28	1.262	-18.3	-1.0
29	1.273	-17.2	1.0
30	1.283	-16.7	3.0

*Specific gravity at 15.6 degrees C or 60.0 degrees F.

Therefore, any product delivered with a specific gravity reading between 1.251 and 1.273 and corresponding weights between 10.43 and 10.62 lbs. would be within the terms of the contract.

To tie this all together, when a load comes in, get a sample and check the specific gravity of it with a hydrometer. Reference the hydrometer reading to the correlating information on the chart.

When possible, get certified weight slips on delivered loads. With the weight slip and knowledge of the quantity delivered, you can quickly determine the quality of the product delivered.

Assume you have ordered 5000 gallons of product as described here, and the weight of the load as verified by a certified weight slip is 51,000 pounds. Quick math tells us that the product delivered weighs 10.20 lbs. per gallon. (51,000 lbs. ÷ 5000 gal. = 10.20) and does not meet specifications.

More quick math (10.20 ÷ 8.34) tells us that the specific gravity of this product is 1.223. Checking the chart, we find that this product is only 24 percent and clearly does not meet specifications.

Dry equivalents

Remember that with liquid deicers, water is only a carrier, and that water does not melt ice. So the question is, How much chemical is actually put out during an application?

Determining the dry equivalent will provide this answer.

To determine dry chemical equivalents, again specific gravity and the weight of water comes into play. In the previous example, the 28 percent product weighed 10.53 pounds per gallon. □

The author is maintenance methods specialist for the Washington State Department of Transportation.

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Use plows in concert with anti-icers

- ▶ Extra snow and loose ice on the road surface can cause excessive dilution of product applications.
- ▶ Product dilution will decrease its effectiveness.
- ▶ Plow to remove snow and loose ice before anti-icing applications.
- ▶ If snow accumulates before or after applications, plowing directly before your next application will minimize product dilution.
- ▶ Anti-icing trucks should be equipped with front-end plows.