iv. It is important to remember that salt requires energy to dissolve

a) During lower temperatures (times of less available energy)

1) More salt is required

2) Salt requires an even longer time to take effect

3) This explains why placing dry salt on a dry road is not effective

v. In addition, dry salt does not adhere very well to a dry surface because it is prone to blow or bounce off before it has the chance to go into solution

vi. Here are some facts about rock salt

a) At 30 degrees F, 1 pound of salt can dissolve 46.3 pounds of ice

b) At 20 degrees F, 1 pound of salt can dissolve 8.6 pounds of ice

c) At 15 degrees F, 1 pound of salt can dissolve 6.3 pounds of ice

d) At 6 degrees F, 1 pound of salt can dissolve 3.2 pounds of ice

6. Salt Brine

a. What is salt brine?

i. Salt brine is commonly used in anti-icing operations and for pre-wetting solid rock salt

ii. Salt brine is made by mixing rock salt in water to approximately a 23% solution

iii. The proportion of salt to water is critical to the effectiveness of the brine

a) Too much or too little salt affects the freezing point depressing qualities of the brine

b) The proper salt brine mixture is 23.3% (the optimum solution for salt brine) at which the freezing point is –6 degrees F (the eutectic temperature)

iv. Most of the ODOT garages across the state are equipped with salt brine production equipment and storage tanks

Figure 12-1 Salt brine mixing hopper

Figure 12-2 Automated brine system (mixing hopper and 2 – 6,000 gallon holding tanks)

b. How is salt brine used in anti-icing?

i. In anti-icing, the application is made before an event to

    a) Prevent frost

    b) Prevent black-ice

    c) Prevent freeze-bond to pavements

    d) Buy critical response time

ii. The brine is applied directly to the pavement surface in anticipation of an upcoming event

    a) The material is applied

        1) With a liquid application unit in streams

        2) At controlled amounts

        3) In an application that leaves the surface only damp

    b) The brine streams are placed about 8” to 12” apart and will dry on the pavement surface

iii. Once frost forms or snow begins to fall, the moisture will activate the dried strips into brine that helps prevent frost from forming on the surface or snow/ice from bonding

iv. Anti-icing applications do not result in the flow of liquid on the pavement, so the uniformity of spread must be achieved at the time of application

    a) Anti-icing applicators use the typical series of stream nozzles to allow for uniform coverage without excessive mist and fanning of the liquid (early models of applicators used fan nozzles and created problems with premature freezing of the mist)

Figure 12-3 Brine applicator, applying pre-treat

Figure 12-4 Brine being applied

Figure 12-5 Brine after drying

c. Brine used in pre-wetting solid material

i. In the pre-wetting of solids, the brine is usually placed in a holding tank on the salt truck and sprayed on the salt at the time of spreading

ii. Pre-wetting the solid material improves its effectiveness in many ways

a) Accelerates the solution process

b) The pre-wetted material adheres to the road surface more readily than a dry material and results in less loss through bounce and scatter

c) Provides faster effect of the chemical

d) Reduces material requirements because more stays on the road surface

iii. Salt brine is widely used

a) Readily available (easy to produce)

b) Very economical

c) Effective for events occurring at moderate subfreezing temperatures

Figure 12-6 Tailgate mounted brine tank

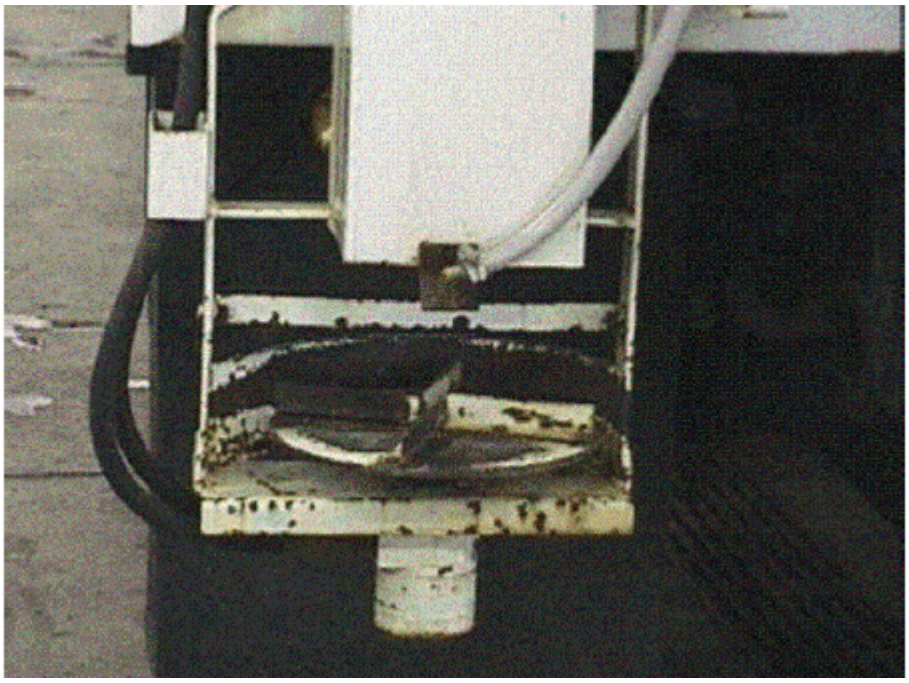

Figure 12-7 Tailgate mounted material spinner

7. Other Chlorides (Calcium or Magnesium)

a. What are chlorides?

i. These materials are naturally occurring, and are liquids in their natural state. They maintain an affinity for returning to a liquid.

ii. Both calcium and magnesium are commercially manufactured by either an extraction or a chemical process

iii. Both are produced and sold in a liquid solution form, and in a solid flake form

a) ODOT typically uses calcium chloride since it is more readily available and slightly less expensive than magnesium

b. How do calcium and magnesium chlorides work?

i. Unlike salt (sodium chloride), these chemicals do not require heat energy to go into a solution

ii. Instead, they emit heat when they go from a solid into solution

a) Releasing heat when going into a solution is referred to as "exothermic"

iii. Calcium and magnesium chloride also attract moisture from their surroundings

a) This improves their effectiveness in dry, cold conditions

iv. These materials have low eutectic temperatures so they provide more melting action at lower temperatures

v. Both materials are also very corrosive by nature and are frequently purchased with added corrosion inhibitors

c. How is calcium chloride used?

i. The liquid calcium chloride and the corrosion-inhibited versions as purchased by ODOT are within a 30-33% solution

a) This is the concentration that relates to the eutectic temperature (-60 degrees F)

ii. These products are typically used for pre-wetting salt and can be used to pre-wet abrasives

iii. It is also common to purchase calcium chloride in a dry flake form and mix it with salt or abrasives for effective melting at low temperatures

iv. The higher cost of calcium products frequently prohibits use for routine purposes

a) These products can also be used in anti-icing

b) However, at the higher cost they quickly become uneconomical

v. As detailed on ODOT's Route Application Guidelines and Goals document, the use of calcium chloride (or a corrosion-inhibited version) is recommended for use at temperature ranges below 25 degrees F

8. Agricultural By-Products

a. Agricultural by-products work in basically the same way as other snow and ice control chemicals, but they do not form a brine

i. They are soluble in water; the resulting solution acts by depressing the freezing point of water

b. In addition to the melting characteristics, the agricultural by-products are environmentally friendly and less corrosive than many conventional materials

c. These products are the concentrated liquid residues from the processing of grains and other agricultural products

i. They are derived from the processing of agricultural raw materials and are often used in combination with other materials (for example, mixed with magnesium chloride)

ii. Like the chloride materials, their higher cost frequently prohibits use for routine purposes

C. Material Handling and Storage

1. Material Handling

a. Exercising awareness and following requirements for personal protection can help prevent hazards

2. Materials Safety Data Sheet

a. All chemical manufacturers are required to have a Materials Safety Data Sheet (MSDS) for each of their products

i. These sheets are required by law to be available to the user, and the safe user will be familiar with all of the information on these sheets

b. All necessary information about the chemical is included in the MSDS

i. The manufacturer's name, address, and telephone number

ii. Identification numbers for the chemical

iii. A list of the major components of the chemical

iv. The chemical's characteristics and reactivity with other materials

v. Requirements for personal protective clothing and equipment needed in handing the chemical

vi. Emergency procedures in case of exposure or a spill

c. All materials are to be handled in accordance with their respective MSDS