c. The most commonly used winter maintenance materials

i. Abrasives (sand, grits)

ii. Salt (Sodium chloride) – rock salt

iii. Salt brine - 23% brine solution

iv. Calcium chloride (liquid or dry)

v. Magnesium chloride (liquid or dry)

vi. Agricultural by-products

**2. Material selection**

a. Numerous factors are considered within the selection process for determining which material(s) to use in snow and ice control

i. Material performance

ii. Use requirements

iii. Infrastructure impact

iv. Environmental impacts

v. Availability

vi. Cost

b. The variables within a storm event will dictate the material type and application rates best suited for the particular event

i. Through established guidelines and practices the selection process is narrowed to the best practice for the particular storm event

**3. How chemicals work**

a. Generally, all snow and ice removal chemicals work by lowering the freezing point of water and turning snow and ice into a liquid or semi-liquid slush

i. The function of lowering the freezing point of water is dependent upon the percent of chemical in solution

a) This means that dry chemicals do nothing until they take on moisture and go into solution or liquid form

b) Some chemicals, when dissolved into water, will lower the freezing point of water to below 32 degrees F

c) We know that water freezes at 32 degrees F. If we mix certain chemicals in water (such as the antifreeze normally used in our cars) the water will not freeze until it reaches a much lower temperature. This is how snow and ice chemicals work (in the same way as with antifreeze).

b. Dilution of solution

i. The effectiveness of the chemical depends upon the percent of chemical in solution

a) It is well known that a proper mix of water and anti-freeze will provide optimum protection to keep our cars from freezing in the wintertime

1) A mix of half water and half anti-freeze, or 50% solution, will provide protection down to –34 degrees F

2) A mix of three parts water and one part anti-freeze, or a 25 % solution, will protect only to 10 degrees F

b) Snow and ice chemicals require the proper mix to work effectively. When a chemical is mixed with water, or goes into solution, and changes the freezing point of water, the newly created lowest temperature at which the solution will now freeze is called the eutectic temperature.

1) As we see from the above example on anti-freeze, this freezing point is based on the percent of material in solution

(a) It is important to remember that as this concentration changes, or as the mixture dilutes, the melting temperature also changes. This is commonly referred to as the “dilution of solution.”

(b) The solubility of chemicals varies with temperature. The lower the temperature, the less the solubility.

c. Solid chemicals

i. Solid chemicals used for snow and ice control, such as rock salt, must first mix with moisture to create brine before it has melting capabilities

a) That is, the chemical must be in solution

ii. Rock salt will bore through snow and ice, dissolving to form a strong brine solution that spreads under the ice or hard-packed snow, undercutting and breaking the bond to the road surface

a) Once the bond is broken, the ice and snow can be plowed off

iii. By applying chemical materials prior to a storm, we can prevent the bonding to the road surface and melt the snow and ice as it comes into contact with the brine

**4. Abrasives**

a. What are abrasives?

i. Abrasives are solid particles of sand, cinders, ashes and crushed aggregate

ii. Most of these materials vary in specifications and size

a) Depending upon material type, the size can range from fine sand to ½ inch diameter particles

b) Specifications detail material size, type, shape, hardness and moisture content and environmental issues

b. How do abrasives work?

i. Abrasives have the ability to give a rapid increase in traction on the surface of ice and snow pack or at very low temperatures when chemical agents are not effective

ii. Disadvantages

a) Abrasives have no melting action

1) This relates directly to the need for mixing salt or other chemicals with abrasives

b) Cleanup

1) Excess material must be removed to eliminate possible drainage problems, safety hazards, and air pollution

**5. Salt (sodium chloride)**

a. What is salt?

i. Salt is a natural material that has been used for ice control since early in the nineteenth century

ii. Rock salt is mined by conventional mining processes and is the most commonly used product for snow and ice control

b. Why is salt used?

i. Effectiveness at moderate subfreezing temperatures

ii. Relatively low-cost

iii. Availability and ease of application in the solid form with current spreader equipment

iv. When pavement temperatures are above 20 degrees F

a) Salt is effective for combating ice and light snow

b) Greatly enhances the effectiveness of plowing under heavy snow conditions

c. How does salt work?

i. In order for salt to act as a freezing point depressant, it must go into solution

a) A dry particle of salt spread on a dry surface will remain there until it can absorb enough energy from the environment to form a liquid film on the surface of the salt particle

ii. This initial "brine" then triggers the solution of the rest of the salt

iii. As salt dissolves, it continually absorbs energy from its surroundings

a) Requiring heat energy when going into solution is referred to as "endothermic"

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)