How does road salt work?

Even though salt may be applied dry it does not begin its snowfighting job until it dissolves into brine. A chemist would explain the process in terms of colligative properties. The brine is a solute and the concentration of grains in the solute (in this case, salt brine) determines its freeze-point lowering potential. Any substance that dissolves in water has this effect, but each substance will have varying outcomes. While sugar or molasses can be a solute and lower water's freezing temperature, for example, salt's lower molecular weight gives it almost six times the effectiveness of sugar in lowering the freezing point of water – actually even more in this example since sugar isn't an electrolyte at all. This is the same principle you use when you put antifreeze into your car's radiator.

Salt applied as a liquid or prewet solid can begin to act immediately lowering the freezing point of water. On a pavement where the temperature is 30°F (-1° C), one pound of salt melts 46.3 pounds of ice. One inch of ice on one lane-mile of road would weigh 70 tons. To melt that much ice would take 17 tons of salt. But the objective is not to melt the snow and ice off the pavement, only to prevent or destroy the bond on the surface of the roadway between the pavement and the ice or snow. In our example lane-mile with an inch of ice, most road agencies would use 500 pounds or less, less than 2% of the amount of salt needed to melt the ice.

The objective being to prevent the bond if possible (not melt all the ice), liquids are appropriate when applied in a pre-storm anti-icing application to be in place before freezing precipitation arrives. It also explains why agencies use larger particles for application of dry salt to ice- and snowpack-covered roads since they need to have the weight and mass to bore down to the pavement where the real work is done.

The concentration of the brine and the temperature of the pavement are the key variables determining whether and how fast the salt will act. When salt dissolves in water, the resulting brine is generated at the saturation level, 25-26%, the same level as the salt crystals form in a solar saltworks. But the brine is quickly diluted by the snow or ice it contacts. As dilution proceeds, there is less salt to depress the water's freezing point, so the freezing point will rise, assuming the temperature is unchanged. If the temperature falls, the loss of melting power accelerates. That is why intense storms may require multiple applications, to keep the brine concentration from become too dilute to do its work.