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# USE OF MAGNESIUM CHLORIDE DURING SNOW STORMS

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**USE OF MAGNESIUM CHLORIDE**

DOT uses magnesium chloride to pre-wet the salt it applies during snowstorms. The chemical reduces the scattering of the salt when it hits the pavement and helps it dissolve more quickly, increasing its effectiveness.

## QUESTION

Does magnesium chloride, which the state uses in combination with salt to remove snow from the roads, cause more corrosion than other deicers? Is it possible to add a rust inhibitor to this chemical to reduce the amount of corrosion? How much would that cost?

## SUMMARY

The state Department of Transportation (DOT) uses liquid magnesium chloride to pre-wet salt it applies to roads during snowstorms. Magnesium chloride, like other such chemicals, is corrosive. DOT is aware of the chemical's effect on vehicles, but says chloride salts are currently the most effective and economical material for maintaining safe winter roads, and that the benefits of a chloride-based snow and ice program for motorists' safety and the efficient flow of traffic far outweigh the increased risk of corrosion.

DOT began using liquid chemicals to pre-wet salt in 2006. It first used calcium chloride for this purpose, but switched to magnesium chloride because magnesium chloride was more readily available, less costly, and generally more effective.

It is possible to add a rust inhibitor to the liquid chemicals DOT uses for snow removal, and DOT has done so in the past. DOT estimates it would cost between 10 cents and 20 cents per gallon to add a rust inhibitor, or between $100,000 and $200,000 per million gallons (the amount DOT uses in a winter). However, cost is not the primary reason DOT does not currently use an inhibitor. DOT initially used an inhibitor to the calcium chloride solution, but discontinued its use in 2007 for a number of reasons, including the Department of Energy and Environmental

Protection's (DEEP) concern that the rust inhibitor was depleting oxygen levels in state streams, posing a threat to aquatic life.

DOT says it is constantly evaluating new products, and would probably add an inhibitor if DEEP approved it and its benefits outweigh its cost.

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### *Background*

DOT switched from a winter highway treatment program using a combination of sand and salt to one using liquid chemicals and salt in 2006. The changeover was largely prompted by a National Transportation Safety Board (NTSB) investigation of a January 2003 crash on I-95 that killed four people. The NTSB concluded that the state's inadequate roadway treatment contributed to the crash.

Under the liquid chemical and salt program, DOT trucks pre-wet salt with liquid chemicals, which helps keep the salt crystals from bouncing and scattering when hitting the pavement. The chemical also absorbs water from the air, dissolving the salt more quickly, and creating the brine that melts the snow and ice.

The department first used calcium chloride to pre-wet salt, but switched to magnesium chloride in 2009 because calcium chloride was in short supply. The department also found that the magnesium chloride (1) was more effective than the calcium chloride, especially in colder temperatures, and (2) cost less (75, rather than 99, cents per gallon).

The department says accidents and complaints about road conditions have decreased substantially since it began using the chemicals, and that other factors, such as the unusually large number of snow storms in recent years, have played a part in making vehicles more susceptible to rusting.

DOT recommends that motorists wash their cars after snow storms to remove accumulated salt and reduce the likelihood of rust.

## *Current Practice*

DOT currently uses a 30% solution of magnesium chloride (three parts magnesium chloride to seven parts water). It uses an average of about five gallons of magnesium chloride for each ton of salt. Since DOT spreads one ton of salt for every five miles of road, it uses about one gallon of magnesium chloride every mile.

DOT also says it does not use magnesium chloride when the temperature is above 25 degrees Fahrenheit because salt alone is effective at those temperatures.

DOT, which uses about 150,000 tons of salt annually, says it applies less salt per mile than do other New England states. For example, it says that Massachusetts, with about 10% more road miles than Connecticut, uses about 450,000 tons of salt a year. DOT says it expects to reduce the amount of chemicals it uses as its snowstorm maintenance program becomes more efficient and is continuing to study new developments in snow and ice removal.

## *DOT's Use and Discontinuance of Rust Inhibitors*

DOT does not currently add a rust inhibitor to the magnesium chloride solution. It says there are several reasons for this. The first is harm to aquatic life that rust inhibitors can cause.

Rust inhibitors, typically made from organic agricultural products, reduce corrosion by consuming some of the oxygen that that is necessary to cause rust. DOT initially included a rust inhibitor with the calcium chloride that it used to pre-wet salt. But the inhibitor's propensity to consume oxygen led DOT to discontinue its use in 2007 after wastewater treatment operators reported low levels of oxygen in adjacent waterways. DOT also found the rust inhibitor was hampering the deicing process by clogging the applicator nozzles through which the chemical was applied to the salt. Questions also were raised about how long the inhibitors lasted, and how effective they were.

DOT estimates that between 80 percent and 90 percent of municipalities in the state use magnesium chloride and salt in their snow removal programs. Unlike DOT, these municipalities use salt pre-treated with magnesium chloride (eliminating the need to pre-wet the salt) and containing a rust inhibitor. DOT says the pretreated salt costs up to $20 per ton more than the untreated salt it uses.

## MAGNESIUM CHLORIDE'S CORROSIVENESS

According to *Deicing Salt – Recognizing the Corrosion Threat*, salts such as calcium chloride and magnesium chloride absorb water and form a "corrosive concentrated chloride solution when critical humidity and temperature level combinations are reached. It is at approximately these humidity levels that corrosion is most severe…"

The report notes that the American Trucking Association Foundation "has reported a direct correlation between increased magnesium chloride use and a significant escalation in truck corrosion and electrical system damage."

A 2010 report by the University of Maine's Margaret Chase Smith Policy Center (http://www.umaine.edu/files/2010/02/Winter-Road-Maint-Final.pdf) similarly noted "abundant anecdotal evidence" that "vehicle corrosion on cars and trucks is more prevalent than a decade ago."

The Maine study, based on a year-long study of winter road maintenance in that state, found that while all chlorides cause corrosion, both calcium chloride and magnesium chloride are particularly corrosive because of their ability to retain moisture. The report said it could not rank these salts according to how much damage they do to vehicles, because real world conditions (weather, road conditions, amount of chemical and salt applied) vary widely.

### *Other Factors Affecting Vehicle Corrosion*

Although DOT recommends that motorists wash their cars, including their undercarriages, regularly in the winter to reduce the accumulation of salt, it notes that other factors besides the use of road salt can cause vehicles to rust. Car washes may recycle the water they use, so that salt washed off one vehicle may be sprayed onto others. DOT also says motor vehicle manufacturers in recent years have stopped coating their brake lines and electrical connectors with hexavalent chromium, a toxic chemical, leaving those components more susceptible to rust.

In addition, DOT notes, the state has experienced more snow storms than usual in five of the past six winters, exposing vehicles to more corrosion than usual.

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