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Maine Department of Transportation

Transportation Research Division

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Comparison Tests of De-icing Liquids on Snow Plow Routes in Northern Maine

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Magnesium chloride appeared to enhance the melting action of granular rock salt (pre-wet). Routes treated with a salt/magnesium chloride mix cleared off faster and dried quicker than comparable routes treated with either salt/calcium chloride, or salt/salt brine. Comments received from the traveling public were also favorable toward the product.

Introduction

The Maine Department of Transportation, like other state transportation agencies in the northern U.S., utilizes solid salt to maintain bare pavement conditions on its roads and bridges during winter. Like many other states, Maine is progressively adopting recommended Federal Highway Administration procedures aimed at improving winter road maintenance. One procedure in particular, involves mixing a liquid de-icing chemical with solid granular rock salt, and has proven to be effective at enhancing snow and ice melting. This procedure, called pre-wetting, creates a damp mixture of de-icing chemicals, that not only tends to reduce the scattering of salt, making it more effective on the pavement, but it also aides in the formation of a brine. The faster that brine forms on the road, the faster that the melting action occurs. Several liquids can be used for pre-wetting rock salt. The most popular liquids are salt brine, liquid calcium, magnesium chloride, and calcium magnesium acetate. Chemical effectiveness, expected temperatures, availability, and cost are considerations in the choice of de-icing chemicals. There is a significant cost difference between theses chemicals. Salt brine is the least expensive due to low cost of rock salt and ease of producing the brine on-site. Liquid calcium is among the most expensive, costing at least ten times more that salt brine.

Field Test

During 2003-2004, an experimental treatment involved three different maintenance garages. Each garage location was designated to use a different de-icing liquid in the saddle tanks on their plow trucks. The plow routes associated with these garages are adjacent; due to this proximity, any differences between the treatments could be observed. At the outset, it was not apparent to the researchers if any differences could be detected between alternate pre-wetting chemicals at the low concentrations used in pre-wetting (about 8 gallons of liquid per ton of dry salt).

For this experiment, one garage used a magnesium chloride product that included an organic by-product that enhances the melting action and is also non-corrosive. That product, called “Ice B’Gone”, is one of several in the corrosion inhibited category that could be used by state transportation agencies. It is a 50/50 mix of $MgCl_2$ with an organic byproduct. Another lot used a liquid calcium product called Corguard Gold, a 23% concentration of $CaCl_2$, which was tested as an alternative to Liquid Dow Armor, currently used by MaineDOT.

A third maintenance garage in the area already had installed salt brine equipment, and had a plow route located adjacent to one of the other test routes, creating a convenient three-way comparison.

Snowplow truck drivers recorded their observations on data collection forms during each plow or spreading run during a storm. In general, each driver has a specific plow route, although this sometimes changes due to staffing and also storm intensity. The data collection forms were based on the "TAPER logs" that have been used by many states during field evaluations of alternative treatment methods. TAPER is an acronym based on **T**emperature **A**pplication **P**roduct **E**vent **R**esult. An example of the data collection forms is in the Appendix. Crew supervisors were able to compare the different treatments during their route inspections. Post-season discussions with the crew supervisors in each of the maintenance lots supplemented and rounded out the analysis. The raw data is in the Appendix to this report.

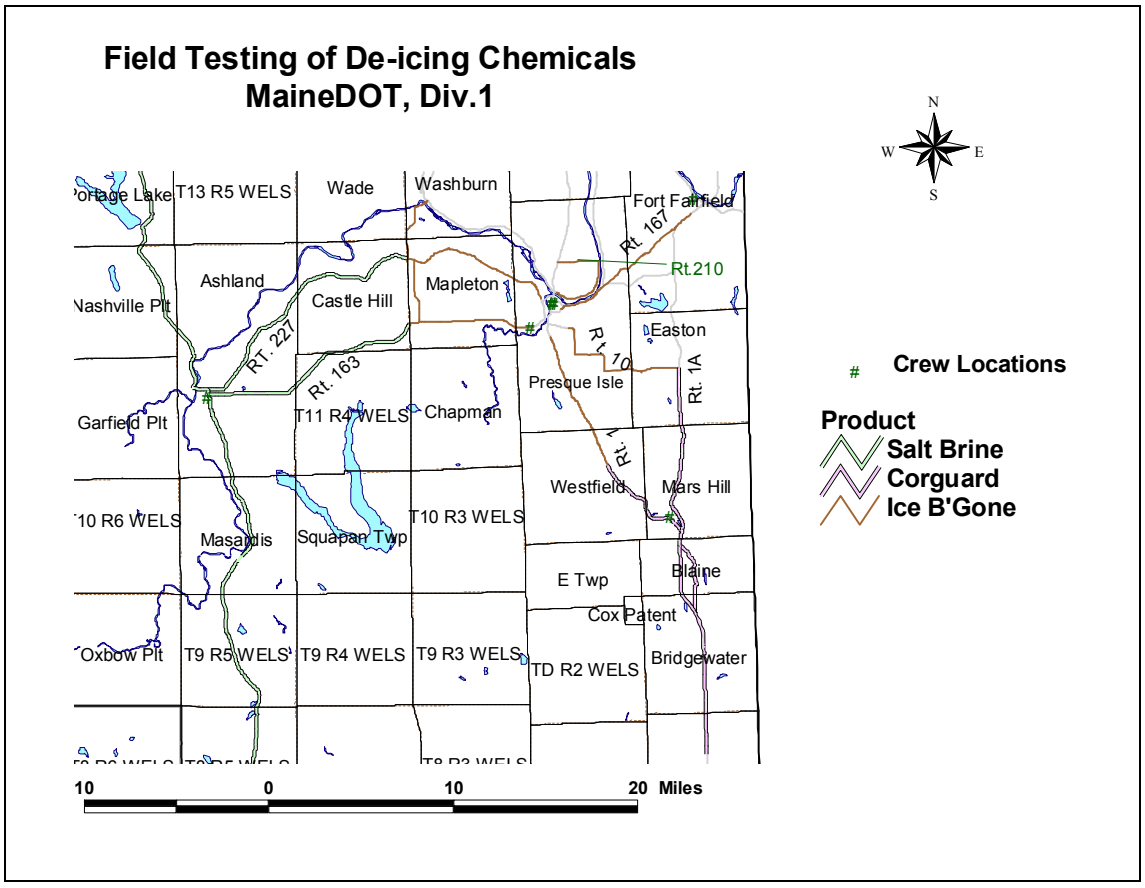

Figure 1. Location of Test Routes

Results

Due to mechanical problems, extremely cold temperatures, and problems with freezing equipment, no data was gathered at the salt brine locations in Ashland. At Presque Isle, and Mars Hill the testing continued throughout the winter. As well as noting the temperature, precipitation and action of the treatment, the drivers provided several comments on the products. The results were generally positive for $MgCl_2$. In particular, there were no

mechanical problems with $MgCl_2$, and no instances of plugged nozzles, though nozzles had been replaced before the tests, with nozzles having larger diameter openings. $MgCl_2$ seemed to work particularly well in areas where drifting and blowing snow is a problem. The drifted areas softened up as snow accumulated. This condition, described as "mealy" by the drivers, was noted as helping in storm cleanup. The $MgCl_2$ areas dried out well after the storm, and didn't seem to draw moisture from the air, which would tend to keep the road wet or slick (as sometimes happens with liquid calcium). It is not clear based on these limited trials how much of these observed effects are due to the organic portion or the magnesium chloride portion of the mix. Almost 50% of the comments received from the drivers were favorable towards the $MgCl_2$ product. An unexpected result was the favorable comments received from the general public. A few people remarked that they had observed the brownish-tinged material coming from the truck spreaders, and thought that whatever it was, it seemed to be working well.

Results were not as favorable on the routes using CorGuard. The crews on those routes reported having to use more of the liquid than the comparable liquid that they used in previous winters, up to three times more. Several times during the winter season, reapplication at higher rates were necessary to clear the highway. Crews reported that sometimes the accumulated snow would turn mealy then re-freeze, then they would have to do another application. No mechanical difficulties were encountered, however, such as plugged nozzles or freezing equipment. From that standpoint the product did not perform as well as the stock liquid calcium used in previous winters. Nevertheless, this limited field trial was not able to establish a side-by-side comparison between the two products due to the differences in snowplow routes.

Conclusions

Based on this limited field trial, magnesium chloride should be considered for further testing and evaluation, especially in northern Maine, where problems due to colder temperatures have occurred. In these locations liquid calcium or magnesium chloride would provide an alternative to the problem of flushing out the spray systems in anticipation of very cold temperatures expected during storm events, as is sometimes necessary when using salt brine. As far as liquid calcium is concerned, it is recommended that MaineDOT continue with the brand used in previous winters.

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