



07/01/2013

Feasibility of Using Cheese Brine  
as a Supplement to Rock Salt

## Report on Alternative Deicers

---

# Contents

EXECUTIVE SUMMARY .....	2
DEFINITIONS .....	3
SNOW OPERATIONS IN MILWAUKEE .....	3
Historical Snow Data.....	5
TYPES OF DEICING AGENTS.....	5
ALTERNATIVE DEICER EXPERIENCES.....	7
Salt Brine .....	7
Other Alternatives .....	8
DEICING WITH CHEESE BRINE .....	11
Polk County, WI .....	11
Other Communities .....	11
A CHEESE BRINE PILOT.....	12
SUMMARY .....	13
Appendix A .....	14
Appendix B.....	15

# 130661 – Report

## EXECUTIVE SUMMARY

This report evaluates the feasibility of using cheese brine as an alternative deicing agent and supplement to rock salt. The historical and current use of deicing agents including cost, availability and effectiveness will be reviewed to determine if cheese brine is a feasible deicing option for the City of Milwaukee's Department of Public Works (DPW).

Milwaukee residents have high expectations when it comes to snow and ice control on City streets and sidewalks. It is extremely rare for schools and businesses to close due to snow and ice covered roads. At the heart of keeping City streets open and in good winter driving condition is the timely and effective use of various deicing agents.

The primary deicer used by DPW crews is sodium chloride (NaCl) or rock salt. Rock salt is plentiful, inexpensive and very effective. However, there have been concerns raised with its long term impact on infrastructure and the environment. Hence, alternatives are continuously being researched and tested across the country.

This report reviews several alternative deicing agents, including a newly discovered use of cheese brine, to determine if these products should be incorporated into the City of Milwaukee's existing snow and ice control plan.

Although there is no single product that is effective in all snow and ice events, the City is committed to deploying the deicing agents that are most effective and least costly.

## DEFINITIONS

To provide clarity to some of the information shared in this report, a few terms must first be defined. **Anti-icing** is a proactive approach to winter road maintenance. It forms a bond-breaker between the pavement surface and the snow and ice layer which melts snow more quickly and reduces the chance that ice will form and bond to the surface. It reduces the amount of time required to restore the roads to a clear, dry state.

(Transportation)<sup>1</sup>

**De-icing** is the removal of snow, ice or frost from a surface. It can be accomplished by mechanical methods (scraping, pushing); through the application of heat; by use of dry or liquid chemicals designed to lower the freezing point of water (various salt or brines, alcohols, glycols); or by a combination of these different techniques. (WikiPedia)

**Cheese brine** is a liquid waste product from the cheese making process that is usually sent to treatment plants for disposal.

## SNOW OPERATIONS IN MILWAUKEE

The Department of Public Works (DPW) is responsible for snow & ice control on 1,418 miles of paved streets in the City of Milwaukee. Public safety is the number one priority. Each snow and ice operation is unique based on the forecast temperature, dew point, intensity and accumulation of snowfall, wind speed/direction and timing of the event.

---

<sup>1</sup> North Dakota Department of Transportation

These variables factor into DPW’s response to ensure safe winter driving conditions on City streets. A snow operation can range from 3 trucks treating bridge decks to over 300 trucks plowing and salting City streets following a significant snowfall.

Type	# of trucks	Application
Brine run	3 trucks	brine bridge decks
Bridge run	18 salt trucks	salt bridges and hills
General ice control	90 salt trucks	salt City streets
Partial plowing	90+salt/plow trucks	plow some/salt all City streets
General plowing	300+plow trucks	plow and salt all City streets

TABLE 1

A general ice control (GIC) operation is the most common response initiated where rock salt (pre-wet with liquid calcium chloride when conditions warrant) is applied to prevent snow and ice from bonding to the roadway. Streets are treated in a predefined order (Appendix A) that focuses on keeping major arterials open first and then collectors and other streets as the snow operation progresses.

A general plowing operation is normally initiated for snowfalls that exceed 5– 6 inches. Since refuse packers are used to plow residential streets, garbage and recycling collection is suspended during general plowing operations. Drivers are enlisted from across the Department of Public Works to augment Sanitation, Fleet and Forestry operators so trucks can remain on the road 24/7 to maintain public safety.

## Historical Snow Data

Milwaukee averages around 50 inches of accumulating snow each winter (NOAA). DPW managers and drivers are on call around the clock from mid-October through mid-April to respond quickly to any winter weather event. The chart below shows the budgeted and actual snow expenditures, operations, salt usage, snow fall and cost per inch for the last five years.

Snow and Ice Budget and Expenditures										
Year	Funding		# Operations				Tons of Salt		Inches of snow	Avg cost per Inch
			Plowing		Ice Control					
	Budget	Expend	Budget	Actual	Budget	Actual	Budget	Actual		
2008	4,918,942	14,607,812	3	9	24	63	43,000	99,389	106.6	\$ 137,034
2009	4,965,204	6,590,901	3	3	24	37	43,000	46,099	49.8	\$ 132,347
2010	6,500,000	6,408,375	3	3	24	31	43,000	35,666	34.5	\$ 185,750
2011	6,500,000	10,451,235	3	5	24	23	43,000	53,604	53.6	\$ 194,986
2012	7,900,000	6,437,187	3	3	24	21	44,000	44,339	28.4	\$ 226,662

TABLE 2

## TYPES OF DEICING AGENTS

Mounting fiscal constraints paired with environmental sustainability concerns have led municipalities across the country to seek alternatives to rock salt for winter road maintenance needs. There are several different types of deicing agents that vary widely in effectiveness and cost.

A comparison of some of most common deicing agents is shown in the table below. The cost and effectiveness varies widely based on each products effective and eutectic temperature.

The effective temperature is the practical lowest temperature where melting occurs within 15 minutes. The eutectic temperature is the lowest possible melting temperature<sup>2</sup>. (Also see Appendix B)

Highway Deicers	effective temp	eutectic temp	cost comparison
Sodium chloride (rock salt)	20°F	-6°F	\$50 per ton
Salt brine	20°F	-6°F	\$0.12 gallon
Magnesium chloride	0°F	-28°F	\$0.70 gallon
Calcium chloride	-20°F	-60°F	\$0.70 gallon
Calcium magnesium acetate	25°F	-18°F	\$1.50 gallon
GEOMELT/ ICE BAN/CALIBER		-5°F	\$1.75 gallon

Source: Managing Snow and Ice Control Operations (UW-Madison Course #J376 – Oct 2007)

TABLE 3

One of the most cost effective anti-icing agents is salt brine. Salt brine is a solution of water and salt mixed to a 23.3% concentration that provides several benefits<sup>3</sup>:

- Pre-storm application can help prevent ice from bonding to the pavement.
- Helps keep roadway wet longer, possibly throughout the storm.
- Quicker cleanup returns roads to normal driving conditions more rapidly.
- Reduces labor hours.
- Reduces wear on ice blades and underbody plows.

Many communities have purchased or built brine mixing systems that create a “hot blend” of salt brine, calcium chloride and other agricultural products. The brine can be used as

<sup>2</sup> Chemistry Dictionary.com

<sup>3</sup> Iowa Department of Transportation

a direct anti-icing agent or as a pre-wet to rock salt that is spread on roadways. Pre-wetting has been shown to reduce the amount of salt required to maintain safe winter driving conditions.

## ALTERNATIVE DEICER EXPERIENCES

### Salt Brine

The City of Milwaukee purchased a brine maker and two 7,000 gallon holding tanks and has used brine as an anti-icing agent primarily on bridge decks since 2005. Crews spread roughly 14,000 gallons of salt brine on 4-6 applications on average per winter season. A few seasons with bitter cold and heavy snow in early December were not conducive to direct anti-icing efforts.



City of Milwaukee DPW salt brine maker and holding tanks



The City currently has only three trucks outfitted to spray salt brine directly on the roadway. Brine is sprayed on bridge decks prior to heavy frost or light snow to prevent precipitation from freezing and bonding to the pavement.

Anti-icing with brine is effective only under certain conditions: dry roads, pavements above 20 degrees, no rain or blowing snow forecast for 24 hours and a dew point at least two degrees lower than the temperature.



**DPW truck applying brine to the pavement over a viaduct**

## Other Alternatives

Many communities have incorporated the use of alternative deicers into their winter road maintenance program. According to Chris Walsh, Operations Manager for the City of Beloit, WI, they use a “hot” mixture of 10% liquid calcium chloride, 10% GEOMELT® and

80% salt brine for anti-icing roads. St Croix County uses rock salt pre-treated with GEOMELT®.

The City of Milwaukee has tested various alternative deicers over the years. A molasses type product was tested from 1999 – 2001 but was shelved after residents complained that the product stunk and was tracking into their houses from the bottom of shoe soles.

A pilot test of GEOMELT® (beet juice) was conducted beginning in December 2009. The product claimed to lower the freeze point of salt brine down to -30F and leave a residual on the pavement longer which would equate to less salt use and cost savings.



City staff spraying GEOMELT® onto rock salt

The City of Milwaukee purchased 9,000 gallons of GEOMELT55® at roughly \$1.70 per gallon and stored it in tanks at 30<sup>th</sup> & Ruby. Staff sprayed 3,000 tons of rock salt with the liquid, which turned the rock salt a light brown color and had a slightly sweet odor.

Four routes on the north side of the City tested the product. The salt was too wet initially and caused tunneling problems in the truck's hopper. Several other attempts failed as the salt turned to a sticky, oatmeal like consistency in the truck. Trucks had to be emptied, washed out and refilled with dry rock salt during an ongoing general ice control operation.



GEOMELT55® treated salt in the hopper of a salt truck

Subsequent tests showed that the treated salt did melt the snow faster at up to one inch and held the pavements wet a little longer, but there was no noticeable difference once snow depths surpassed the one inch mark. The testing ended in March 2011 with mixed results.

The remainder of the GEOMELT55® treated salt was used by Forestry on sidewalk snow code enforcement actions since the brown salt showed up better in photos taken after snow was mechanically cleared from non-compliant properties.

## DEICING WITH CHEESE BRINE

### Polk County, WI

A surprise discovery in the search for alternative deicers is cheese brine. Moe Norby, Technical Support Manager for Polk County, WI (population 44,000) has been using cheese brine since 2009.

Polk County saved around \$40,000 the first year by using cheese brine as a pre-wet agent to salt or salt/sand instead of expensive magnesium chloride. Since dry salt bounces when spread, by pre-wetting the salt with brine they were able to use around 30% less salt and still get the same deicing effect. (USA TODAY)<sup>4</sup>

Jeff Tews, Fleet Services Manager with the City of Milwaukee spoke with Norby and gathered the following points from Polk County's experience with cheese brine:

1. Polk County had to first obtain a conditional grant of low hazard exemption permit from the WI DNR to use cheese brine on the highways. (Emil Norby, 2010)<sup>5</sup>
2. The DNR approved using 8 gallons of cheese brine per ton of salt as a pre-wet agent only. Cheese brine cannot be applied directly to roads like salt brine.
3. Depending on the source, the cheese brine may need to be diluted or infused with more salt to achieve the 23.3% required salinity. The cheese brine Polk County receives varies from 24% - 25.5% and must be diluted with water and filtered.
4. Although Polk County gets the cheese brine for free from F & A Dairy Products in Dresser, WI, they pay between .08 and .12 per gallon to have the brine shipped 17 miles from the cheese factory to storage tanks at its facility in Balsam Lake, WI.
5. Cheese brine has a distinctive odor.
6. They have not experienced mold growing in the brine over summer storage.

### Other Communities

---

<sup>4</sup> Larry Copeland, USA Today, Feb 26, 2013

<sup>5</sup> Crossroads Periodical Article, Fall 2010

An internet search turned up only one other municipality in the U.S. currently using cheese brine. The Department of Transportation in Chehalis, WA uses a mixture of cheese brine, a molasses product and liquid calcium chloride.<sup>6</sup>

In Wisconsin, the only other communities found to be considering using cheese brine as an alternative deicer are Burnett and St Croix Counties, which abut Polk County in Northwest WI.

Wanda Booker spoke with Tim Ramberg, Highway Commissioner for St Croix County and they were waiting for the State of Wisconsin to pass an exemption from special permitting for the use of cheese brine on roadways. Currently, F&A Dairy in Dresser, WI holds the exemption permit for using cheese brine on roadways.

## A CHEESE BRINE PILOT

To allow for testing of cheese brine as an alternative deicer in Milwaukee, certain elements would need to be in place prior to the 2013–2014 snow season:

- Locate a mozzarella or provolone cheese brine supplier in the Milwaukee area. The closest cheese plants are located in Richfield, West Bend and Bristol, WI.
- Procure transportation of the brine from the factory to a holding tank in Milwaukee. Estimated cost from Fusion Renewables is around \$0.24 per gallon.
- Purchase a holding tank, hoses and dispenser where brine could be infused with more salt or diluted with water to attain required 23.3% salinity.
- Retrofit filter screens on salt trucks so brine can flow freely from on-board tanks.
- Identify a pilot area to test the effectiveness of cheese brine treated salt.
- Draft testing procedures to be followed on each ice control operation, including observation photos and documentation of existing weather conditions.

---

<sup>6</sup> Tom Paulson, [www.seattlepi.com](http://www.seattlepi.com)



The estimated cost of piloting a test of cheese brine this winter would be approximately \$6,500, including transport and storage of 4,500 gallons of brine, retrofitting designated salt trucks and tracking and measuring the test results during the snow season.

Subsequently, a cost-benefit analysis would be done to determine if using the cheese brine is a cost-effective solution over traditional anti-icing and deicing agents. These findings would be shared with the Common Council to determine if cheese brine should be added to Milwaukee's snow fighting toolbox.

## SUMMARY

The Department of Public Works appreciates the Council's interest in alternative deicers and welcomes the opportunity to explore ways to improve the cost effectiveness of our snow and ice control operations.

There are benefits of anti-icing and using liquid activators to make rock salt work better. DPW is prepared to advance its snow operations by incorporating the use of salt brine as a pre-wet agent to reduce the amount of salt that bounces off the road.

In the future, additional brine tanks are envisioned at north and south salting locations so brine can be readily available for use as a pre-wet agent during all general ice control operations. This could ultimately reduce the amount of salt usage by up to 30%.<sup>7</sup>

In closing, Russ Alger, Director of the Institute of Snow Research at Michigan Technological University states<sup>8</sup>, "When you look at all the options, a lot of time road salt turns out to be pretty good. So we keep coming back to road salt. Cost-wise, efficiency-wise, availability-wise, it's just the best answer. I don't see it getting replaced for a long, long time, if ever."

---

<sup>7</sup> (Salt Institute, Ontario Research)

<sup>8</sup> Article from USA TODAY, Communities seek substitute for road salt, Feb 20, 2013

## Appendix A

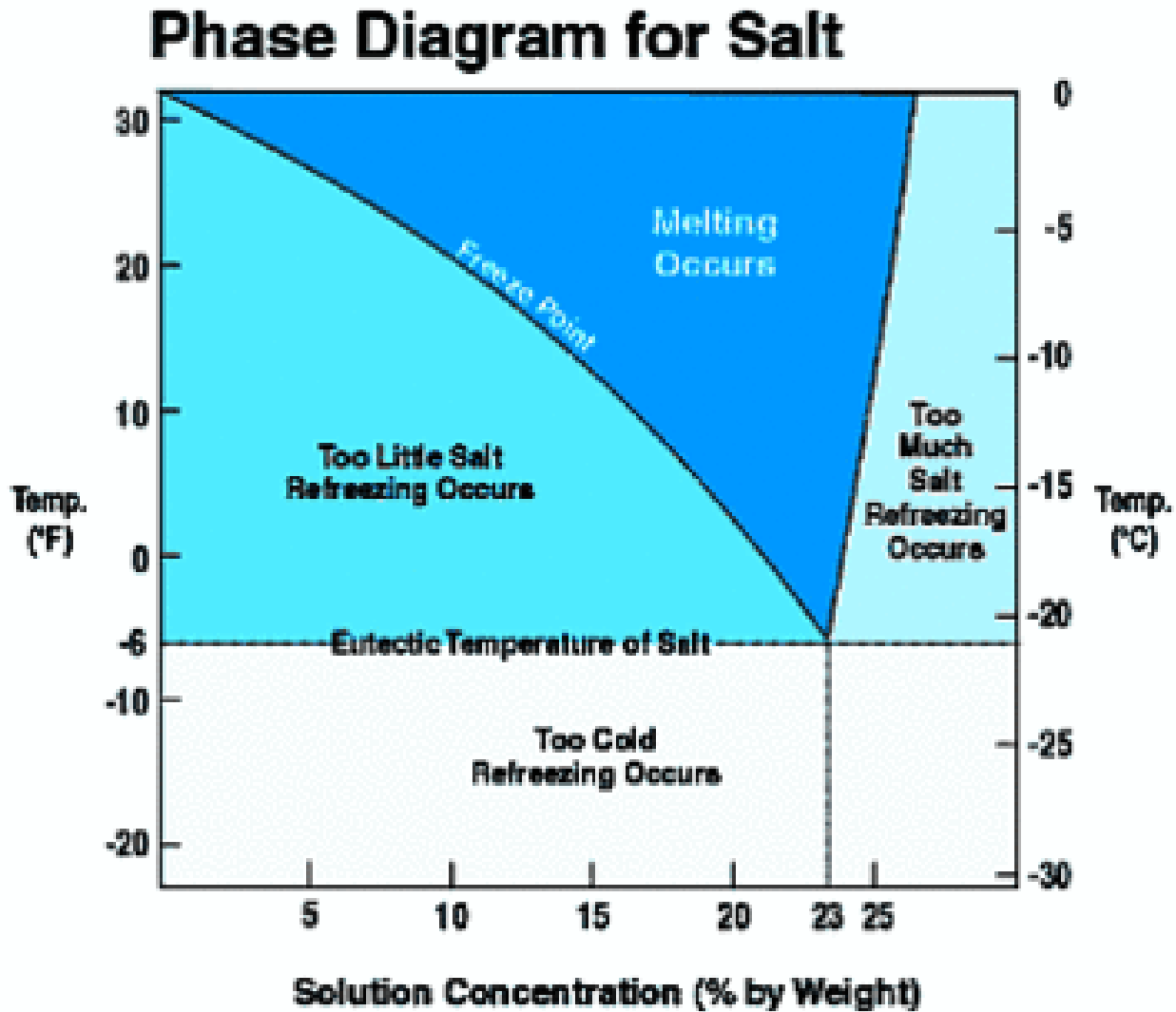
## Current Goals by Street Type

Priority	Street Type	Condition Goal	Salting Time Goal	Plowing Time Goal
1	Open mass transit routes (Includes non tow-away routes).	Bare pavement, curb-to-curb	3-4 hours from start of operation	6-12 hours from end of snowfall or before next rush hour
2	Open main streets, arterials and fire lanes to through traffic.	Bare pavement, curb-to-curb	3-4 hours from start of operation	6-12 hours from end of snowfall or before next rush hour
3	Open residential streets to through traffic (Includes the clearing of dead-ends, cul-de-sacs and boulevard openings).	Safe and passable, not bare pavement. (Curb-to-curb in low density areas only)	6-8 hours from start of operation One pass down center of road.	18-24 hours from end of snowfall (Center lane only in parking congested districts)
4	Alternate side plowing and cleanup.	Safe and passable, not bare pavement	-	24 – 48 hours from end of snowfall
5	Plowing of sidewalks, crosswalks and alley openings.	Safe and passable, not bare pavement	-	3 - 5 days from end of snowfall
6	Clearing of bus stops.	Safe and passable, not bare pavement	-	50% of bus stops cleared within 72 hours after plowing
7	Snow removal – street and/or intersection widening.	Safe and passable, not bare pavement	-	Several days after end of snowfall

*Policy updated Oct 2009*

## Appendix B

This chart demonstrates the importance of maintaining the salt concentration level of 23.3% when using brine by itself for anti-icing.



The roadway temperature is critical in choosing a deicer with temperatures below 15 degrees Fahrenheit generally requiring addition of other "hotter" deicers to salt (e.g. magnesium chloride, calcium chloride). The phase diagram illustrates the required concentration of salt to keep the brine liquid at various temperatures

Eutectic temperature is the minimum melting temperature that occurs at a specific mixture concentration.

(Source: The Salt Institute)