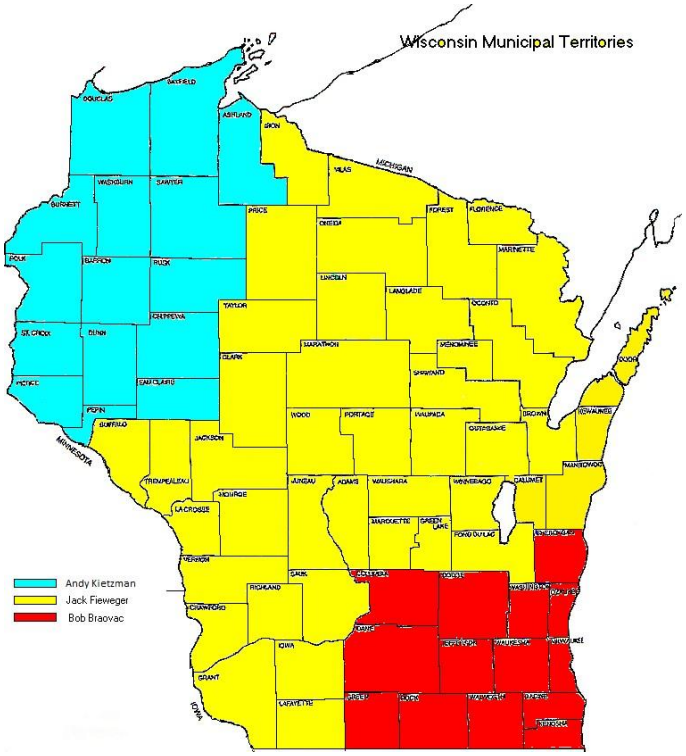
Liquid Application

Prewetting, Anti-icing, and De-Icing



Presented by: Jack Fieweger
Territory Manager
FORCE America

DEFINITIONS

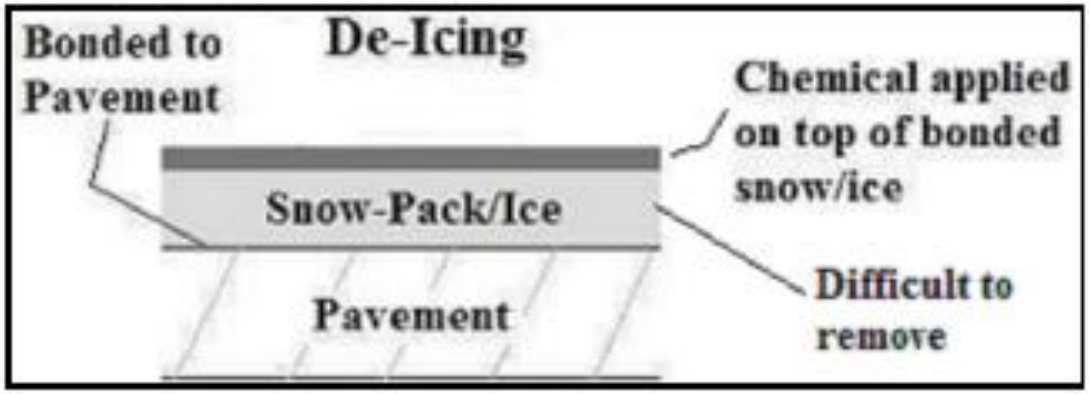
- <u>What is De-icing?</u>
  - Applying material to the road **after** snow/ice has fallen
  - Goal is to melt snow/ice off the roadway
  - Reactive
  - What has been done for years
- <u>What is Abrasive Application</u>
  - Applying sand, chips, etc to the road **after** snow/ice has fallen.
  - May contain some salt, primarily to prevent pile freezing.
  - Provides traction but not melting.

DEFINITIONS

- <u>What is Prewetting?</u>
  - Pre-Wets the granular material before it hits the roadway.
  - Part of De-icing operation
  - Spinner or Auger Application
  - Usually with salt, but sometimes with abrasives
  - Slurry = High rate prewetting

- <u>What is Anti-Icing?</u>
  - Also called direct application.
  - Chemical is applied directly to roadway.
  - Applied **before** the event.
  - Prevents bond of snow/ice to pavement.
  - Proactive, not reactive.
  - Critical areas or whole roads
  - Goal is to plow before refreeze

De-icing vs. Anti-icing



Trends in Snow/Ice Treatment since 1994

Increasing:

- Prewetting
- Salt Brine usage
- Anti-icing
- Simultaneous direct spray and prewetted granular salt
- Liquid only de-icing
- Prewet gal/ton application rates
- On board liquid capacity

Decreasing:

- Salt application rates
- Dry salt application

Stable:

- Level of Service Expectation

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Road Salt

- 20-30 million tons used annually in US
- Over 100 lbs. per person
- A powerful tool to maintain safe winter roads

- HOWEVER….

Growing concerns about salt use

- Infrastructure damage
- Municipal and private well contamination
  - No cleansing of chlorides in waste water treatment plants
  - Chlorides long-term stay (40-70 years)
- Chlorides in our environment have more than doubled in last two decades and in some places reaching dangerous levels.
- Cost
  - 1994: $25/ton
  - Current: $100/ton+

Salt Effectiveness

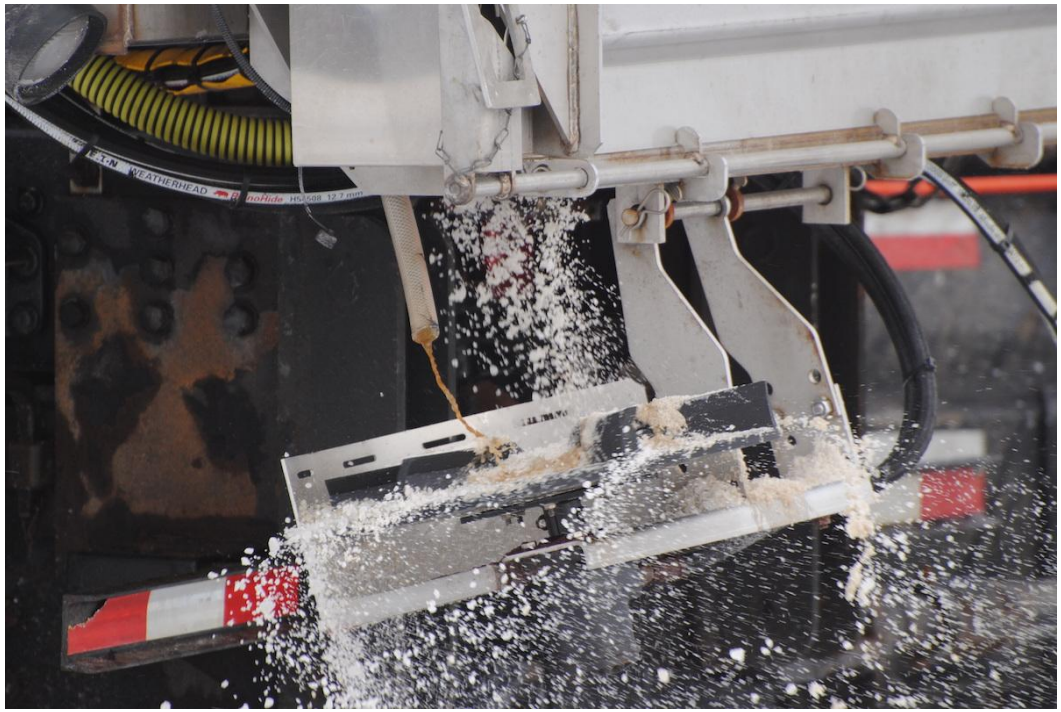
Pounds of Ice Melted Per Pound of Salt

Pavement Temp. °F	One Pound of Salt (NaCl) melts	Melt Times
30	46.3 lbs of ice	5 min.
25	14.4 lbs of ice	10 min.
20	8.6 lbs of ice	20 min.
15	6.3 lbs of ice	1 hour
10	4.9 lbs of ice	Dry salt is ineffective and will blow away before it melts anything.
5	4.1 lbs of ice	
0	3.7 lbs of ice	
-6	3.2 lbs of ice	

At temps below 15 degrees, it may be more cost-effective to use a chemical other than NaCl.

Chemical
*NaCl (Sodium Chloride)—Delivered as solid rock salt; also can be made into a brine. The basis of most deicing materials. Very corrosive. Inexpensive.
*$MgCl_2$ (Magnesium Chloride)—Delivered as flakes, pellets, or liquid. Often used to wet NaCl crystals to increase adherence to road and reduce melting points. Corrosive. Higher cost.
*$CaCl_2$ (Calcium Chloride)—Delivered as flakes, pellets, or liquid. Powerful deicer but extremely corrosive. Sometimes used incorrectly to open storm drains. Higher cost.
CMA (Calcium Magnesium Acetate)—Delivered as a powder, crystals, pellets, or liquid. Liquid CMA is used mainly on automated bridge deicing systems. Non-corrosive, biodegradable. Sometimes added to sodium chloride as a corrosion inhibitor. Alternative for areas where chloride use must be limited. Higher cost.
KAc (Potassium Acetate)—Delivered as a liquid. Used on automated bridge deicing systems. Use for anti-icing, deicing, and prewetting. Non-corrosive, biodegradable. Alternative for areas where chloride use must be limited. Higher cost.
Winter Sand/Abrasives—Winter sand is sand treated with brine or another blend. It is often used as an abrasive for low-temperature conditions when chemicals are not effective. Sand provides temporary traction and only works when it is on top of the ice.

Pre-wetting



- Wets salt before it hits the pavement.
- Results in better “stick”.
- Activates material
- Saves material.
- Better road conditions
- Now mostly done with salt brine

Prewetting is the “Low Hanging Fruit” of liquid application

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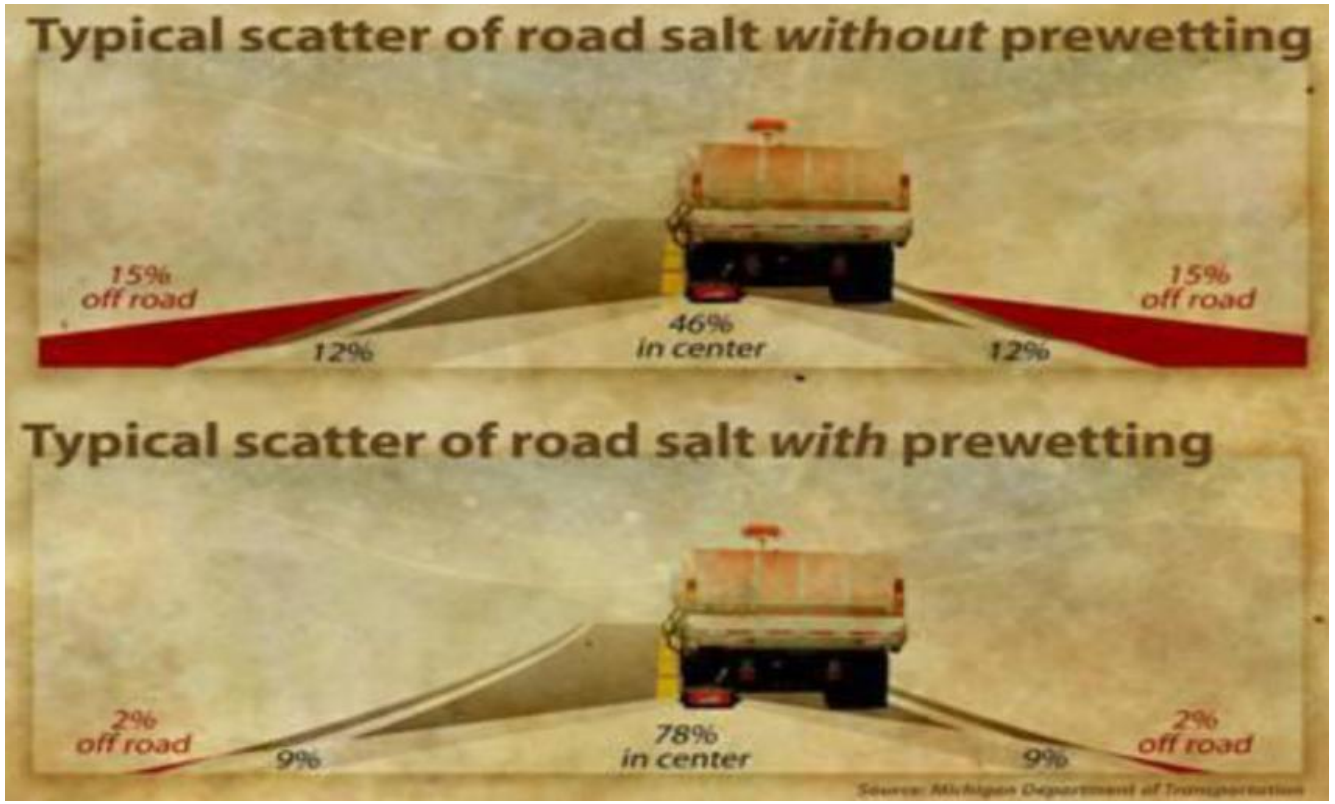
Prewet Benefits



At 200 lb/mile, 30% is about 60 pounds (a 5 gallon bucket full)
Less than 150 pounds is still on the road.

Prewet Benefits

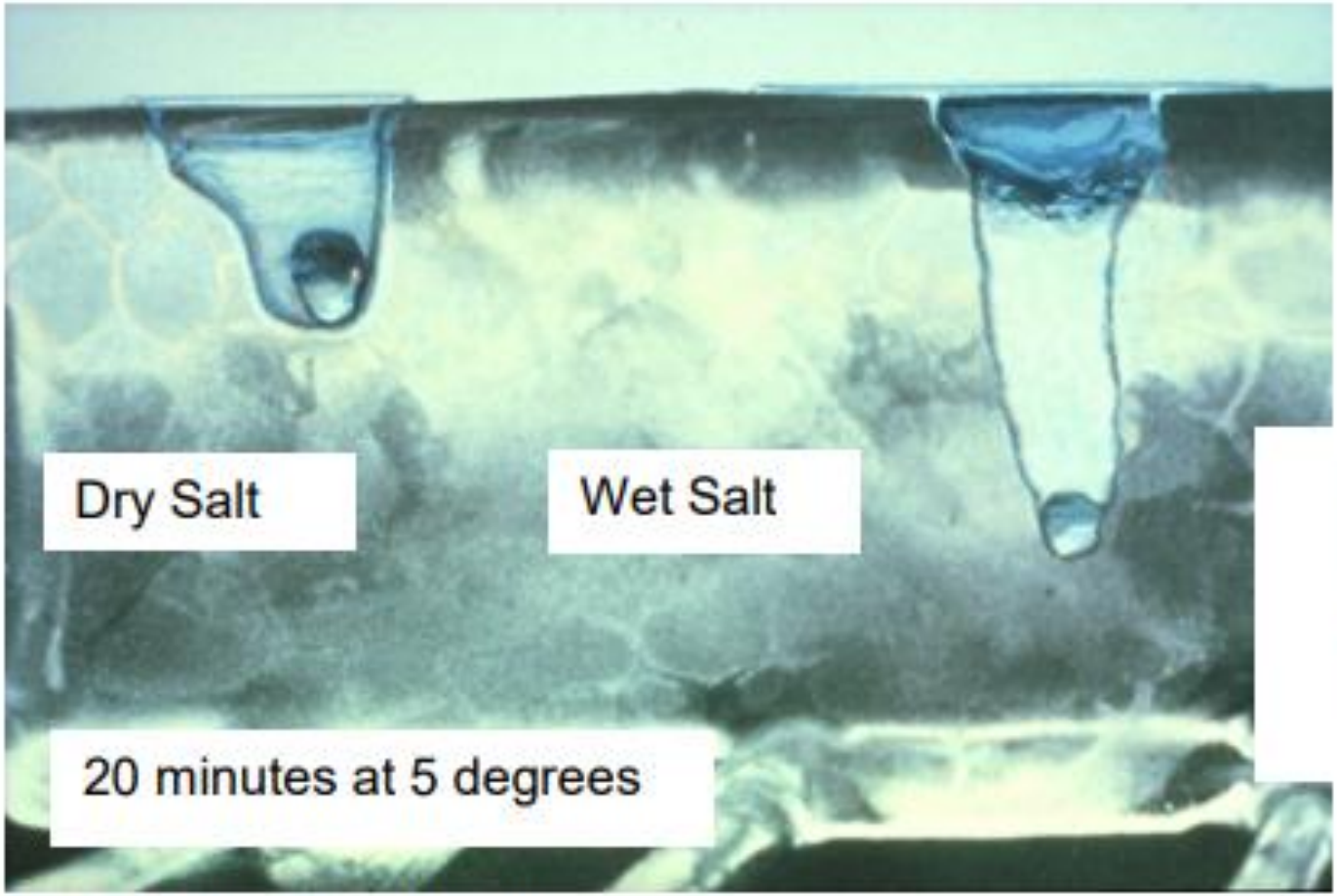
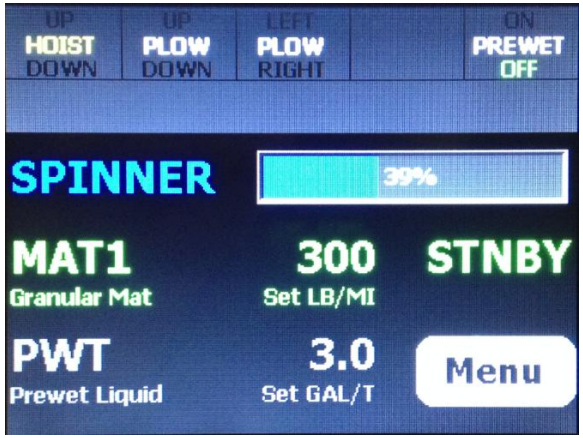


Figure 19: Dry salt vs. wet salt

Photo courtesy of Wisconsin DOT transportation bulletin #22

Pre-wetting



Liquid is applied in Gallons per Ton of salt

(sometimes gravity applied)

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Prewetting Application Rates

-Typical prewet application rate is 5-14 gal/ton.

-Some slurry rates near 30 gallons per ton

- On board liquid capacity limits maximum rate

- **Reduce granular application rate!**

			Lbs/ two-lane mile			
Pavement Temp. (°F) and Trend (↑↓)	Weather Condition	Maintenance Actions	Salt Prewetted/ Pretreated With Salt Brine	Salt Prewetted/ Pretreated With Other Blends	Dry Salt*	Winter Sand (abrasives)
>30° ↑	Snow	Plow, treat intersections only	80	70	100*	Not recommended
	Frz. rain	Apply chemical	80 – 160	70 – 140	100 – 200*	Not recommended
30° ↓	Snow	Plow & apply chemical	80 – 160	70 – 140	100 – 200*	Not recommended
	Frz. rain	Apply chemical	150 – 200	130 – 180	180 – 240*	Not recommended

*Dry salt is not recommended. It is likely to blow off the road before it melts ice.

Prewet Cost Savings:

So, how much can I save?

Let's look at a 100 tons of salt used:

- 100 tons of salt @ $100/ton = $10,000.00
- 20 ton (20%) x $100/ton = $2000.00
- 30 ton (30%) x $100/ton = $3000.00
- Prewet at 100 tons at 10 gal/ton @ $0.15/gallon: $150

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Prewet Equipment

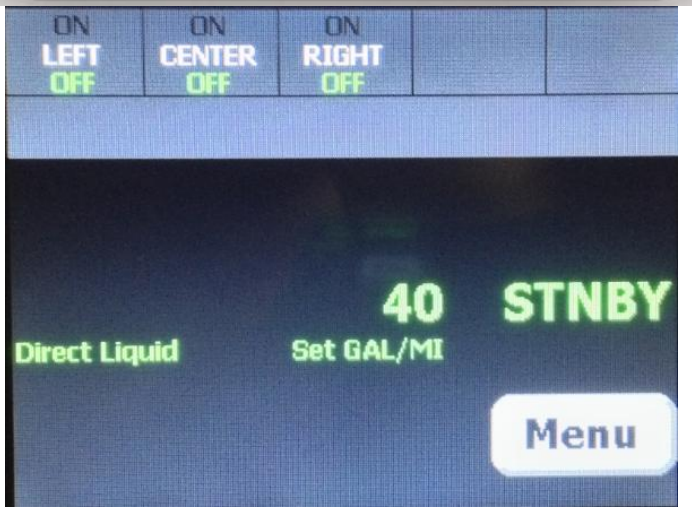
100 Gallon Tailgate System

Radius Body Tank System

Anti-Icing Application

- Liquid only.
- Application prior to event.
- Prevents bonding <u>until diluted</u>.
- Very effective for frost events.

Anti-Icing Application



Liquid is applied in Gallons per Mile

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Anti-ice Application Rates

-Typical application rate is 20-60 gallons per lane mile.

- 60 gal/mile ≈ 130 lb of salt

-Condition and chemical dependent. One application rate does not fit all storms!

-Keep an eye on dilution.

Anti-icing Application Rate Guidelines

These guidelines are a starting point. Reduce or increase rates incrementally based on your experience.

Condition	Gallons/Lane Mile		Other Products
	$MgCl_2$	Salt Brine	
1. Regularly scheduled applications	15 – 25	20 – 40	Follow manufacturers' recommendations.
2. Prior to frost or black ice event	15 – 25	20 – 40	
3. Prior to light or moderate snow	15 – 25	20 – 50	

Anti-Icing Application

-Apply chemicals 2-3 days ahead of time.

-Stream nozzles increase residual and traffic impact.

Residual Effect

-Treated roadway after 24 hrs.

-Can remain for up to five days (traffic and weather permissive).

Residual Effect

-Drifting may be an issue.

Anti-Icing Benefits

-Reduced material usage.

-Lower environmental impact.

-Less hardpack = reduced cleanup/plow time.

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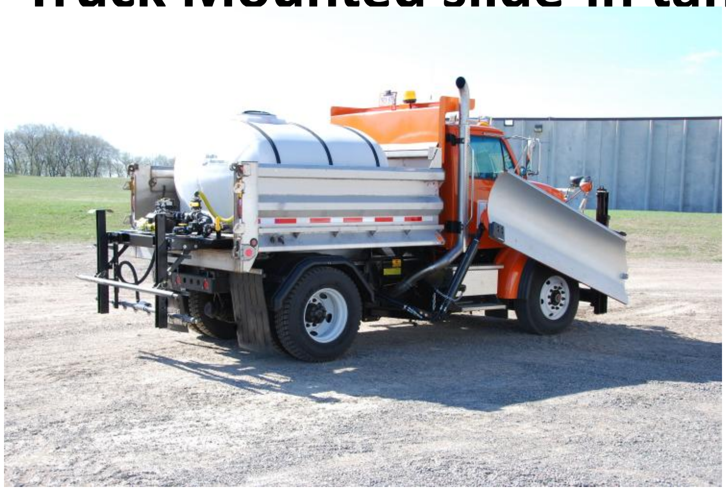
Anti-Icing Equipment

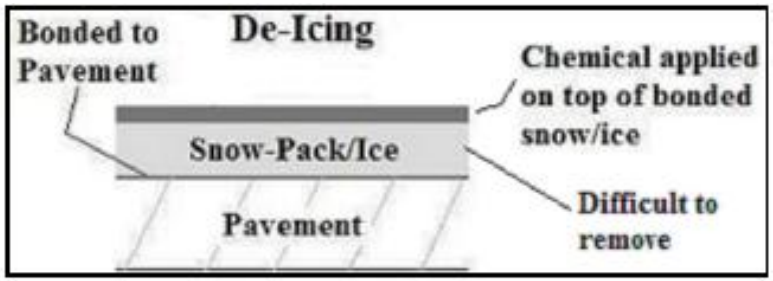
Truck Mounted slide-in tank



V-Box spreader

Wedge/Ramp tanks

De-icing with Liquids
“Liquid Only”



- Some customers are experimenting with liquid application for de-icing
- Seems to work in some conditions, not in others.

New Equipment = New controls?

SSC-6100	5100eX
Fully featured for auger, spinner, prewet, direct, simultaneous prewet/direct, tow plow, etc.	Auger/Spinner/Prewet control OR 3-lane direct spray control

Switching from Granular/Prewet to Direct

- Slide in Direct System:
  - Can accomplish with 5100eX or 6100 w/ correct cabling and hwconfig
  - 15 gpm auger valve is good for direct pump

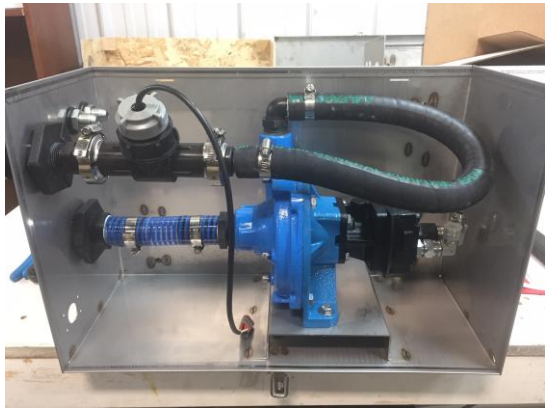
Switching from Granular/Prewet to Direct

- "3 in 1" Granular/Prewet/Direct System:
  - Auger/Conveyor and spinner with separate pumps for prewet and anti-ice mounted on truck
  - Can accomplish with 6100 w/ correct cabling and hwconfig
  - Cannot accomplish with 5100eX without changing feedback and/or hydraulic connections.

Simultaneous Granular/Prewet and Direct

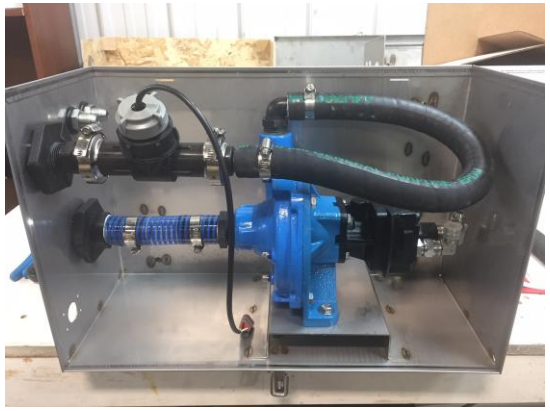
- Can accomplish with 6100 with proper cabling and hwconfig file
- Cannot accomplish with 5100eX
  - 5100eX uses same feedback for auger and direct

“Slurry” pump



- Single pump/motor/flowmeter for prewet (gal/ton) and anti-ice (gal/mile)
- “Bridges the gap” between prewet pumps that don’t flow enough for direct spray, and high flow direct pumps/flowmeters that don’t control well a very low prewet flows

“Slurry” pump



- Can run Prewet or Direct, but not both at the same time.
- Can add lane valves for alternate coverage zones, but is *not a multi-lane direct pump*
- Requires 6100 with appropriate configuration. Cannot accomplish with 5100eX

Salt Brine

- Benefits of using Salt Brine over different chemicals:
  - Cost
    - At 15 cents per gallon salt brine is a fraction of the cost of other deicing chemicals
    - No off season cost associated with liquid recirculation
  - Availability
    - Usually have salt on hand to make more salt brine vs. waiting for delivery on more chemicals when everyone in the state depletes their supply

Salt Brine

Freezing Point of Salt Brine by Percent of Weight			
% of NaCl By Weight	Spec. Grov. 15°C - 59° F	Freeze Point °C	Freeze Point °F
0	1.000	0.00	32.0
1	1.007	-0.58	31.0
2	1.014	-1.13	30.0
3	1.021	-1.72	28.90
4	1.028	-2.35	27.80
5	1.035	-2.97	26.7
6	1.043	-3.63	25.5
7	1.051	-4.32	24.2
8	1.069	-5.03	22.9
9	1.027	-5.77	21.6
10	1.074	-6.54	20.2
11	1.082	-7.34	18.8
12	1.089	-8.17	17.3
13	1.097	-9.03	15.7
14	1.104	-9.94	14.1
15	1.112	-10.88	12.4
16	1.119	-11.90	10.6
17	1.127	-12.93	8.7
18	1.135	-14.03	6.7
19	1.143	-15.21	4.6
20	1.152	-16.46	2.4
21	1.159	-17.78	0.0
22	1.168	-19.19	-2.5
23	1.176	-20.69	-5.2
23.3 (E)	1.179	-21.13	-6.0
24	1.184	-17.00	-1.4
25	1.193	-10.40	13.3
26	1.201	-2.30	27.9
26.3 (S)	1.203	-0.00	32.00

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Salt Brine Production

- Manual or automatic control, varying capacity, some on board storage
- Used equipment is often available
- Most Counties and many cities make brine and sell it other local entities.

Salt Brine: "Your spray is eating my car!"

Remember: Salt Brine = Rock Salt + Water

Properly used, liquids should result in LESS salt applied per mile of road.

Many DPW employees have given up trying to persuade people about this

Blending

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Chemicals

Benefits of Each Product

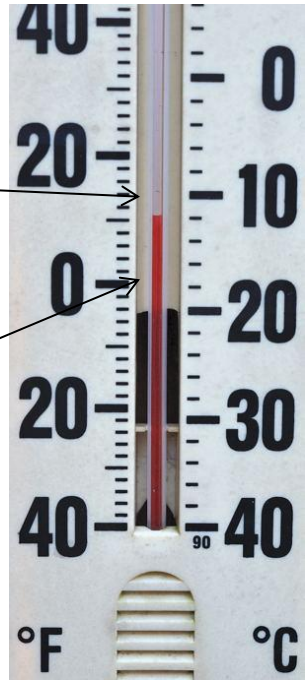
- SALT BRINE –Very low cost, dries quickly. Very effective, readily available or made.
- CALCIUM OR MAGNESIUM CHLORIDE – Effective at low(er) temperatures.
- ORGANICS – Increased residual effect, corrosion inhibitor.

Temperatures

Using a blended liquid for anti-icing will normally give you the ability to apply at lower temperatures

23.3% Salt Brine Solution
* 15 degree pavement

80% Salt Brine/20% Additive
* 0 degree pavement



Batch or On-demand blending

Batch Blending: Premixed in storage tank

On-demand blending: Blending during truck fill
Allows customized blends for each event or application type.

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Resources

Available from LTAP at:

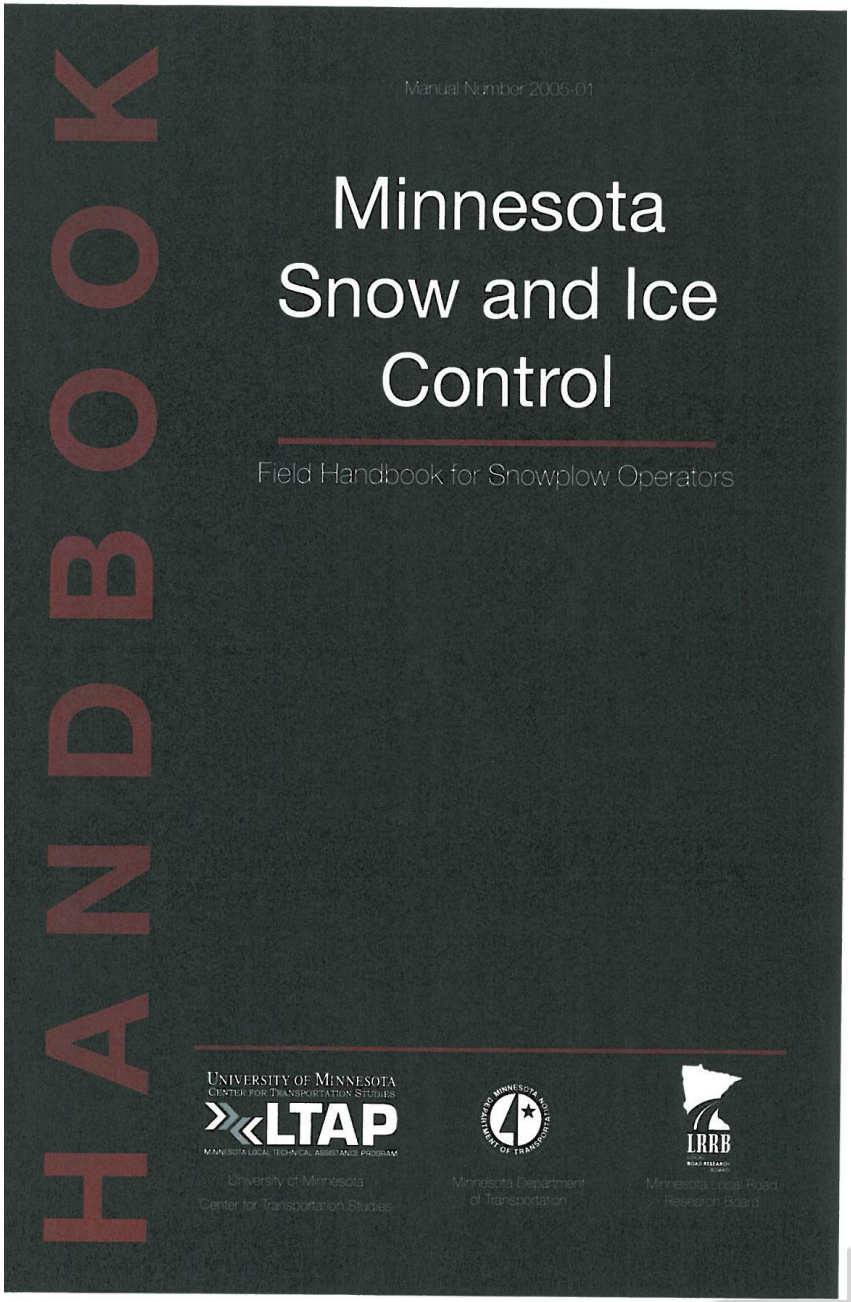
www.mnltap.umn.edu

Additional information:

www.lrrb.org

www.iowadot.gov/maintenance

Among many, many others.



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Thank You!