2020 Michigan Winter Operations Conference

Day 3 – Thursday, October 15th
Best Practices for using Liquids in Winter Operations including Liquid Only Routes
TODAYS TOPICS

• WHY?
• BENEFITS OF LIQUIDS
• MAKING AND STORING LIQUIDS
• BLENDING OF LIQUIDS
• APPLYING LIQUIDS AND EQUIPMENT NEEDED
• LIQUID ONLY ROUTES CASE STUDIES – WHO IS ALREADY DOING THIS
• WRAP UP
Why and the Benefits of Liquids
You Are **Already** Using Liquids

Salt Doesn’t Melt Anything

Until It’s In Solution
Typical Liquid Products

• Natural Occurring Salts
  • Sodium Chloride – 23% solution
  • Calcium Chloride – 32% solution
  • Magnesium Chloride – 28% solution
  • Potassium Chloride

• Other Chemicals
  • Urea
  • Calcium Magnesium Acetate
  • Agricultural Products – Both by-products and engineered products
  • Various Additives
Why do we use liquids?

- Reduce salt usage
  - Prevent or break the bond
  - Reduce bounce and scatter
  - Activate salt quicker
  - Save money
  - Reduce environmental impacts
Terminology of Treatment Types

1. De-icing – traditional approach to snow and ice control
2. Anti-icing – sometimes referred to as pre-treating or direct liquid application (DLA)
   1. Typically with liquids
   2. Pre-wetted solids
3. Pre-wetting – applying liquids to solids before placement on surface or roadway
   1. In stock pile (pre-treated salt)
   2. At discharge
   3. On truck load (not recommended)
4. High Volume Output
   1. High amounts of liquids combined with some solids
   2. Direct Liquid Application for de-icing – high amounts of liquids
Making and Storing Liquids
Brine Making is Easy & Cost Effective
Brine Makers

Early

Modern
Continuous Brine Making Machine

Continuous brine making machine. Undissolved fines and solids are automatically and continuously removed during brine production. up to 6,000 GPH output or our Ultimate controls up to 10,000 GPH output.
Liquid Storage – Best Practices

- Above ground storage
- Proper containment system
- Double walled tanks
- Sufficient storage
- Blending liquids
Fort Collins, Colorado

- 10,000 Tons Salt capacity
- 230,000 Gallons
Material Management

- Truck Loading Island
- Quick Attach Setup
- 4 Loading Arms
- 2 Hand Style Hoses
- 160 GPM Loading
Blending Liquids
Chloride Cocktails

The Art Of Blending Liquid Deicers
Mixtures Can Be Purchased
Do Your Homework!

- Blending – How will the products work together?
- What am I trying to achieve?
- What am I applying to the environment?
- What is the cost/benefit ratio?
- Is this my best option?

How sugars help
Automated Blending System
THE OPERATOR CONNECTS THE HOSE,

ENTERS HIS TRUCK NUMBER,

ENTERS AN AMOUNT

AND IT FILLS IT PRECISELY ACCORDING TO THE PREDETERMINED FORMULA
APPLYING LIQUIDS AND EQUIPMENT NEEDED
Anti-Icing Equipment is it right for DLA?
Anti-icing

- Streamer nozzles
- 8” – 12” spacing (2-300 Mm)
- Anti-icing – 20 gal to 50 gal per Lane-mile - for DLA? How high does it go
- Better friction, established chemical layer and improved public perception
Anti-icing

- Proactive strategy accomplished by applying liquid directly to the road surface
- Generally used in advance of an event
- Focus on hills, bridges & major roads
- Benefits:
  - Better pavement conditions
  - Less chemical required
  - Applications can last for days
  - Lower costs resulting from less chemical
Trucks with 970 gallons of On-Board Liquid

These are not anti-icing units
Two flood nozzles

430 gallon tank installed inside the truck body
Anti-Icing Equipment

Source: City of Waconia
Anti-Icing Equipment
Anti-Icing Equipment

Source: Varitech Industries
Overseas equipment
Wisconsin modified unit – the L Bar

Concentrates the liquid at the middle of the road.

This is a direct liquid application modification

The taper of the road allows the liquid to work is way across the pavement
LIQUID ONLY ROUTES

CASE STUDIES – WHO IS ALREADY DOING THIS
• 09-02: Identifying the Parameters for Effective Implementation of Liquid-Only Plow Routes (2010)

This project identified the optimal circumstances and most effective methods for using liquid routes during winter storm events. The researcher produced a quick-reference guide for practitioners that outlined the safe and effective parameters at a glance. The final report also included recommendations on how to field test and verify the recommended practices.

http://clearroads.org/project/identifying-the-parameters-for-effective-implementation-of-liquid-only-plow-routes/
Liquid Only Routes - Where?
When?

**Warm Pavement Temperatures**
- Slushy roadways

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Most Favorable For DLA</th>
<th>Consider DLA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pavement Temperature</td>
<td>25°F or above</td>
<td>20°F or above</td>
</tr>
<tr>
<td>Storm Intensity (inches/hour)</td>
<td>0.5 inches/hour or below</td>
<td>1.0 inches/hour or below</td>
</tr>
<tr>
<td>Moisture Content</td>
<td>Ordinary</td>
<td>Dryer Snowfall (consider plow-only)</td>
</tr>
</tbody>
</table>

**CONDITIONS MUST BE CORRECT FOR USING LIQUIDS IN DEICING**
- Warm Pavement Temperatures
- Low or No Additional Snowfall Rates
- Short Route Cycle Times
- No Blowing Snow
User feedback in McHenry County

3 liquid only routes that start and terminate at the facility
Replaced existing tanks with (10) 15,000 gallon tanks

Four tanks holding Supermix, four tanks holding brine, one tank beet juice, last tank calcium chloride. They are running 3 liquid routes 80/20 - 80 %brine/20%beet juice. Chlorides only used in extreme temps.
Results

A 30% reduction in salt use over the routes using granular.

Route completion almost 3 hours sooner than routes using granular.
Ohio DOT

Liquid only routes are used throughout the winter and on all ramps to the expressways
British Columbia - Coquihalla Hwy
LIQUID ONLY ROUTES IN WISCONSIN

STATE DRIVEN BUT IMPLEMENTED BY THE COUNTIES
2017 Liquid Only Pilot

2017 Pilot Data

- All liquid applications for 14 storm events
- Cost decrease of 64% on material application
- Application issues with full lane liquid applications 9’ with add a lane feature
- Changed application system to twin 4’ centerline to quarter crown application with direct flow pencil nozzles 0.008”
New Setup for 2018-2019 Pilot
2018 Liquid Only Pilot
Methodology

Data Collection

Wood County Winter Maintenance Routes

Brown County Eau Claire County Jefferson County Wood County

Data Collection
- Routes, equipment, and storm data
- In preparation, routes and equipment data
## Results  Comparison Group Analysis

### Wood County

<table>
<thead>
<tr>
<th>Description</th>
<th>Study</th>
<th>Control</th>
<th>Comparison</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salt usage (lb/ln-mi)</td>
<td>155</td>
<td>298</td>
<td>-143</td>
<td>-48%</td>
</tr>
<tr>
<td>Cost w/ salt brine $0.08/gal ($/ln-mi)</td>
<td>$8.6</td>
<td>$16.5</td>
<td>-7.9</td>
<td>-48%</td>
</tr>
<tr>
<td>Cost w/ salt brine $0.14/gal ($/ln-mi)</td>
<td>$14.3</td>
<td>$16.6</td>
<td>-2.3</td>
<td>-14%</td>
</tr>
<tr>
<td>Time to Bare/Wet (hr)</td>
<td>9.8</td>
<td>12.5</td>
<td>-2.7</td>
<td>-22%</td>
</tr>
</tbody>
</table>

### Jefferson County (two control routes)

<table>
<thead>
<tr>
<th>Description</th>
<th>Study</th>
<th>Control</th>
<th>Comparison</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salt usage (lb/ln-mi)</td>
<td>965</td>
<td>$1,471</td>
<td>-622</td>
<td>-36%</td>
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<tr>
<td></td>
<td></td>
<td>$1,097</td>
<td>-180</td>
<td>-14%</td>
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<tr>
<td>Cost w/ salt brine $0.08/gal ($/ln-mi)</td>
<td>$42.0</td>
<td>$63.9</td>
<td>-22</td>
<td>-46%</td>
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<tr>
<td></td>
<td></td>
<td>$47.7</td>
<td>-6</td>
<td>-12%</td>
</tr>
<tr>
<td>Cost w/ salt brine $0.14/gal ($/ln-mi)</td>
<td>$47.9</td>
<td>$63.9</td>
<td>-16</td>
<td>-34%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$47.7</td>
<td>+0.2</td>
<td>+0.4%</td>
</tr>
<tr>
<td>Time to Bare/Wet (hr)</td>
<td>9.7</td>
<td>16.8</td>
<td>-7.1</td>
<td>-42%</td>
</tr>
</tbody>
</table>
Wrap Up
So, Liquids Are Always the Answer, Then?

- No, not always – there are times not to use them
- When a storm starts with rain...
- When the temperature is too low for the liquid to be effective – what is the temperature? Depends on the liquid...
- When wind speeds during the storm will be high enough to cause drifting (above 15-20 mph)
Sometimes nothing is the best option
So, If I can’t Use Liquids, What Then?

- First thing to note is that not every storm precludes the use of liquids
- But, if some of your storms do not allow liquids then you will not get all the benefits of using liquids
- It may still be advantageous to make use of them when conditions allow