A – Z LIQUIDS

Why Do We Use Liquids?

Todays topics

- Why Liquids
- Terminology
- Where do we start?
- Brine and brine making
- Treated materials
- Pre-wetting
- Anti-icing
- De-icing
- Costs
- Sustainability
- Organics
- Enhanced performance
- Liquid only routes

Why do we use liquids?

- Reduce salt usage
  - ✓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

Anti-icing vs. De-icing

- Anti-icing is a *proactive* operation:
  - Spreading materials before or during the early stage of the storm – ***prevents*** frost formation and snow and ice from bonding to the road
- Deicing is a *reactive* operation:
  - Spreading material after storm starts and snow accumulates – ***allows*** bonding of snow and ice to road surface causing use of more salt and more time to ***break*** the bond and achieve melting

Using liquids is about moving from a reactive to a proactive position

Anti-Icing & De-Icing

- Anti-Icing
  - Prevents snow from freezing & bonding to a surface
  - Frost prevention
- De-Icing
  - Breaks the bond of snow that has already froze to the surface

Brine Making is Cost Effective

- ✓Can be done manually for small batches
- ✓Consider regional partnerships to get started

You Can Start Small

- ✓Nome, Alaska
- ✓Started at 1,000 gallon capacity. Expanded to 23,000 gallons

What is the cost of brine?

- Material
  - Water – Variable – 0.01/gallon
  - Salt – Variable – $0.10/gallon
- Equipment
- Labor
- Typical purchase cost: $0.25-0.50

Brine Making Equipment

Cargill

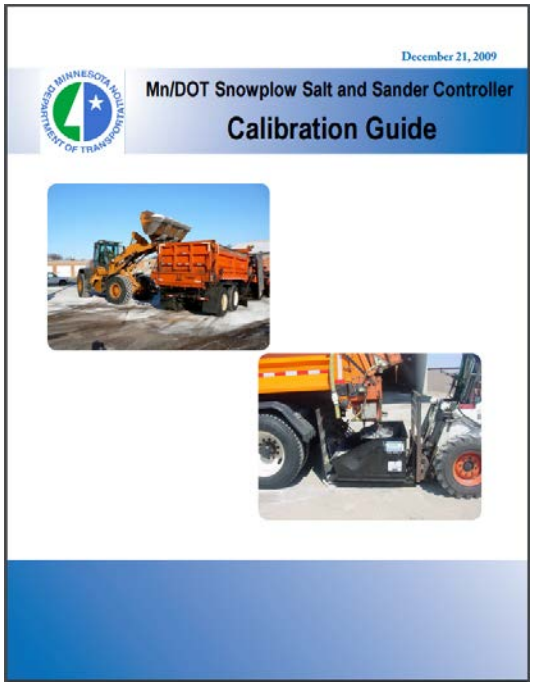
VARITECH INDUSTRIES
LIQUID MANAGEMENT

Liquid Storage – Best Practices

- Above ground storage
- Proper containment system
- Double walled tanks
- Sufficient storage
- Blending liquids

Calibrate Equipment

- Improves spreader accuracy
- Reduces salt usage
  - Variable – 20%-50%



Pre-Treat

- Apply liquid to stock pile
- Typically w/ Mag, Calcium, or Ag product
- Helps w/ bounce and scatter
- 5 - 10 Gal/Ton

Source: Village of Downers Grove, IL

Treating the Stockpile

Pre-Treated Salt

Thawrox TREATED SALT

CLEARLANE® enhanced deicer

Compass Minerals

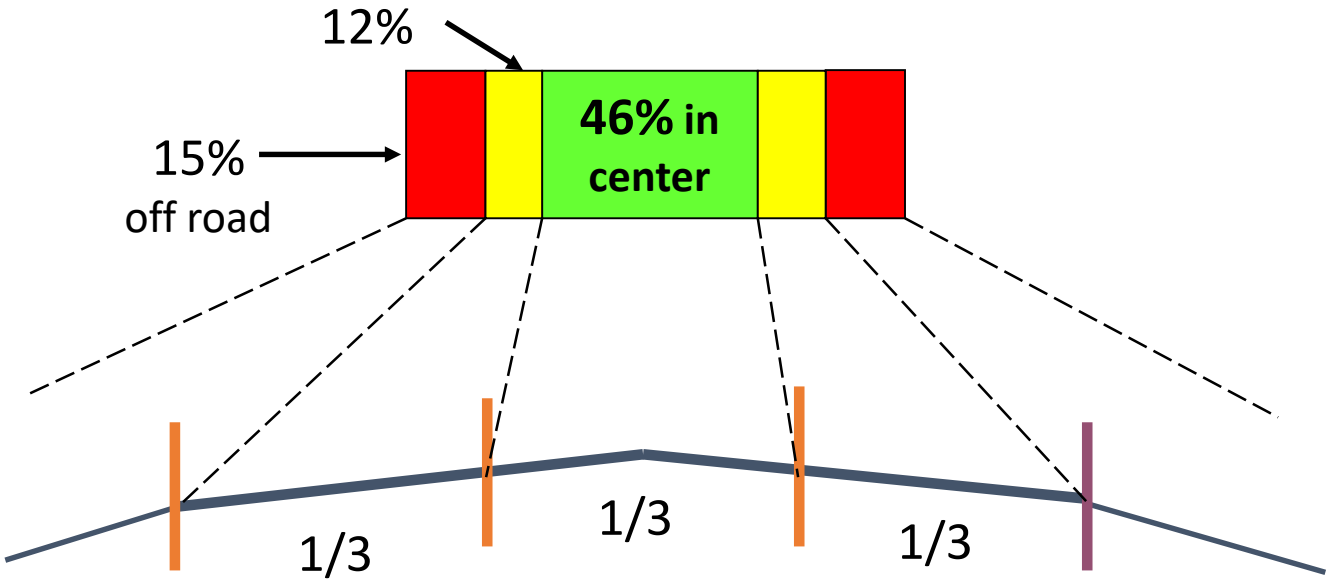
Cargill

Source: Village of Downers Grove, IL

Pre-Wet

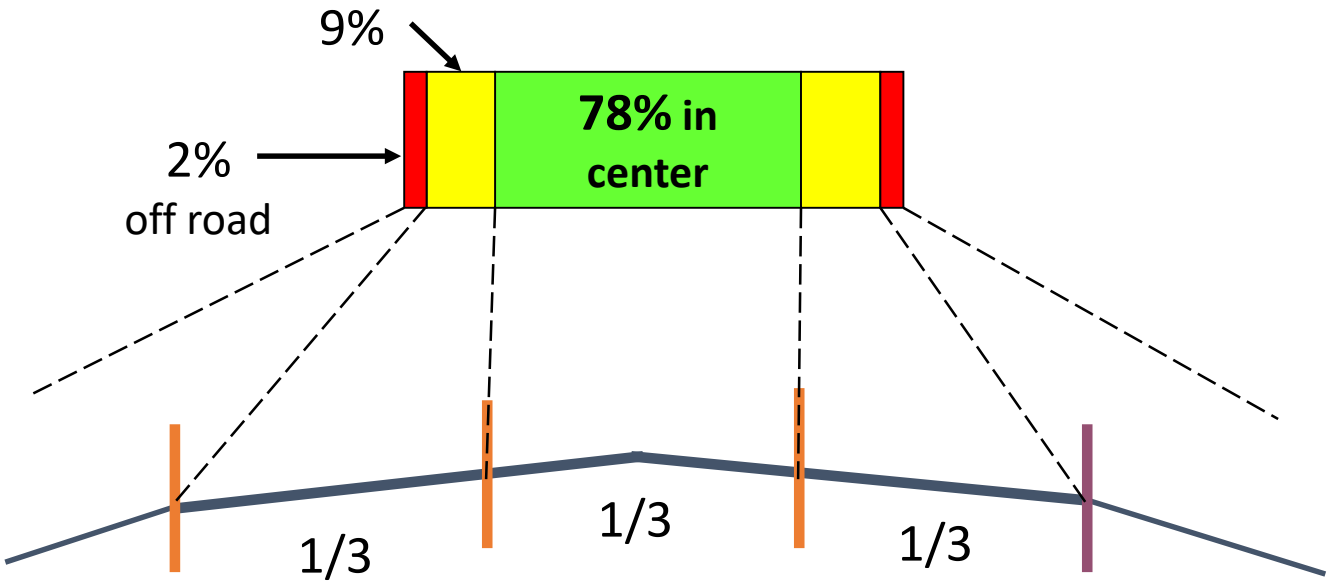
- Minimizes bounce and scatter
  - Keeps 20%-30% more Material on Road
- Activates salt quicker
- Reduces working temperature
- Reduces usage
- Reduces environmental impacts
- Saves money

Typical Scatter Pattern of Dry Road Salt



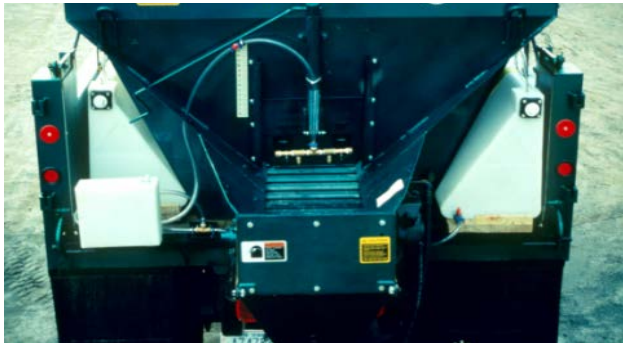
Source: Michigan DOT

Typical Scatter Pattern of Pre-Wet Road Salt



Source: Michigan DOT

Pre-Wetting Equipment



- Salt brine sprayed on salt at exit either at the conveyor or at the spinner

Pre-Wet Equipment

Pre-wet application rates vary.

8-15 gal/ton

Higher rates have proved effective but may require higher output pumps

Anti-Icing

- Proactive use of melting agent to prevent formation of bond between snow/ice and road surface
- Includes application of liquids (direct liquid application/DLA), pre-wetted or pre-treated salt
- Usually applied prior to start of event but can also be reapplied during

- Benefits - Snow is easier removed by plow, as snow/ice is prevented from bonding to road surface
- Creates safer road conditions quicker with less chemicals used than de-icing *(reactive)*
- Especially effective in frost/black ice conditions including bridges

Anti-icing Guidelines

- When to Anti-Ice?
  - As close to the start of the event as possible – such as within 12hrs of event and overnight where possible.
  - Any time you anticipate having to use salt and the conditions are favorable for anti-icing

- **Do Not** use when pavement temp is below -9°C (15 F) or when expected to fall below -9°C (15F) within 12 hrs
- **Do Not** use when there is a chance of blowing snow at open areas
- **Do Not** use if raining/freezing rain or event is to start as rain/freezing rain

This Flow Chart Is for Salt Brine or Enhanced Salt Brine Only!!

Anti-icing

- Streamer nozzles
- 8” – 12” spacing (2-300 Mm)
- “Less is best” – 20 gal to 50 gal per Lane-mile
- Better friction, established chemical layer and improved public perception

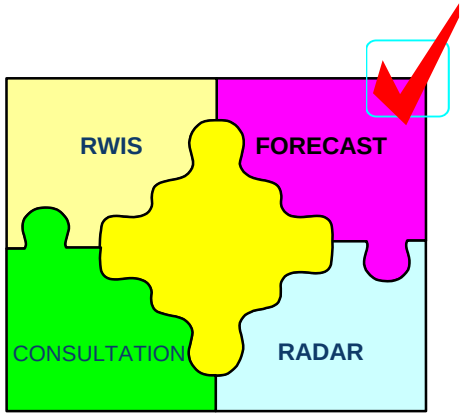
Anti-Icing (Direct Liquid Application) Equipment

Anti-icing

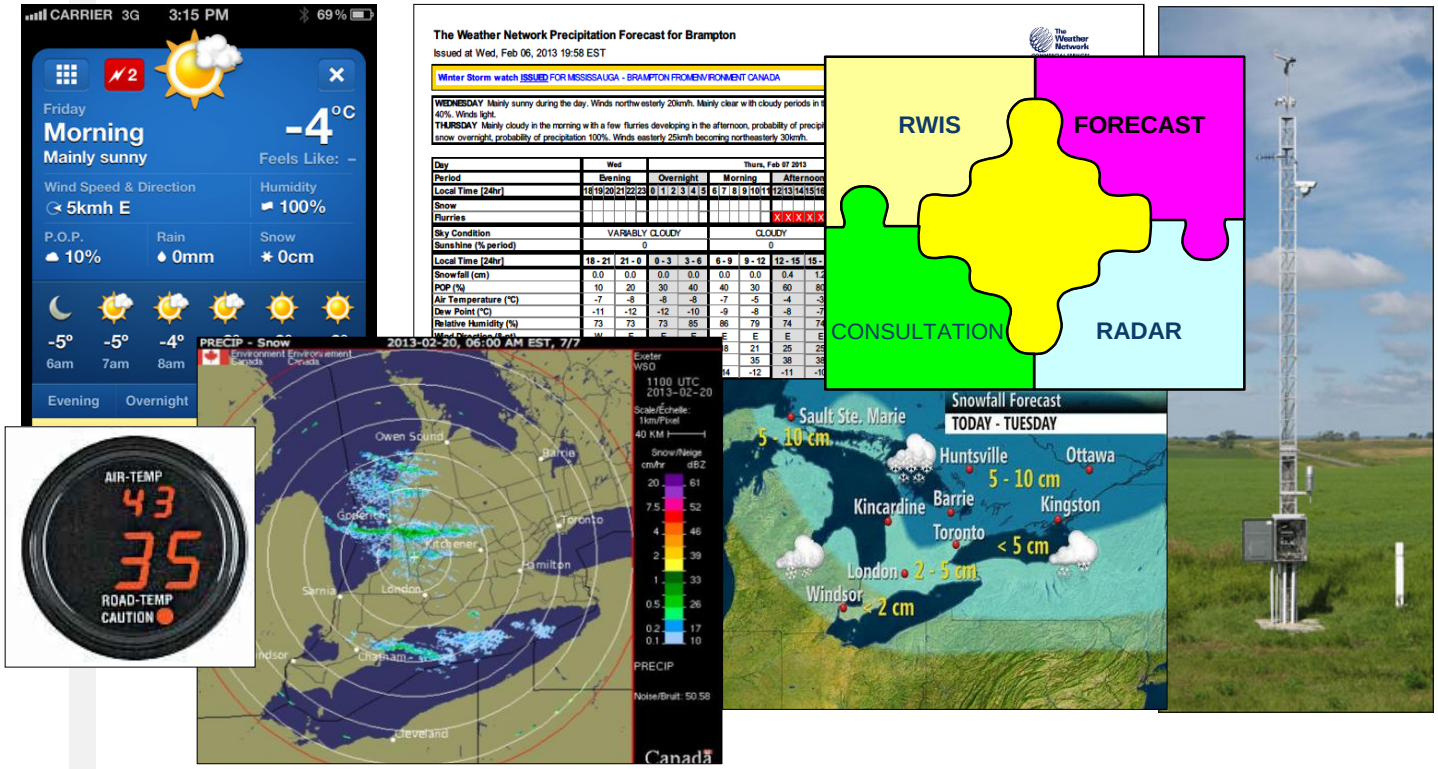
- Proactive strategy accomplished by applying liquid directly to the road surface
- Generally used in advance of an event
- Focus on hills, bridges & major roads
- Benefits;
  - Better pavement conditions
  - Less chemical required
  - Applications can last for days
  - Lower costs resulting from less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

Helpful Tools for Anti-Icing

- Because decisions are made based on pavement temperature
  - Freeze point depressant chosen (i.e. liquid applications or pre-wetting amount)
  - Advance monitoring systems (RWIS)
  - Value Added Meteorological Services (VAMS)
  - Communication consultation



Monitoring Tools



Implementation Difficulties - Equipment

- Complexity of equipment; controllers, liquid tanks, spray nozzles, manufacturing salt brine
- Limited local knowledge on how to buy or use equipment
- Equipment suppliers adjusting to meet our needs

Implementation Difficulties - Materials

- Understanding when to use liquids
- Understanding how to make brine properly
- Salt brine not effective below – 9 C or 15 F
- Some alternative liquid de-icers do not work as expected

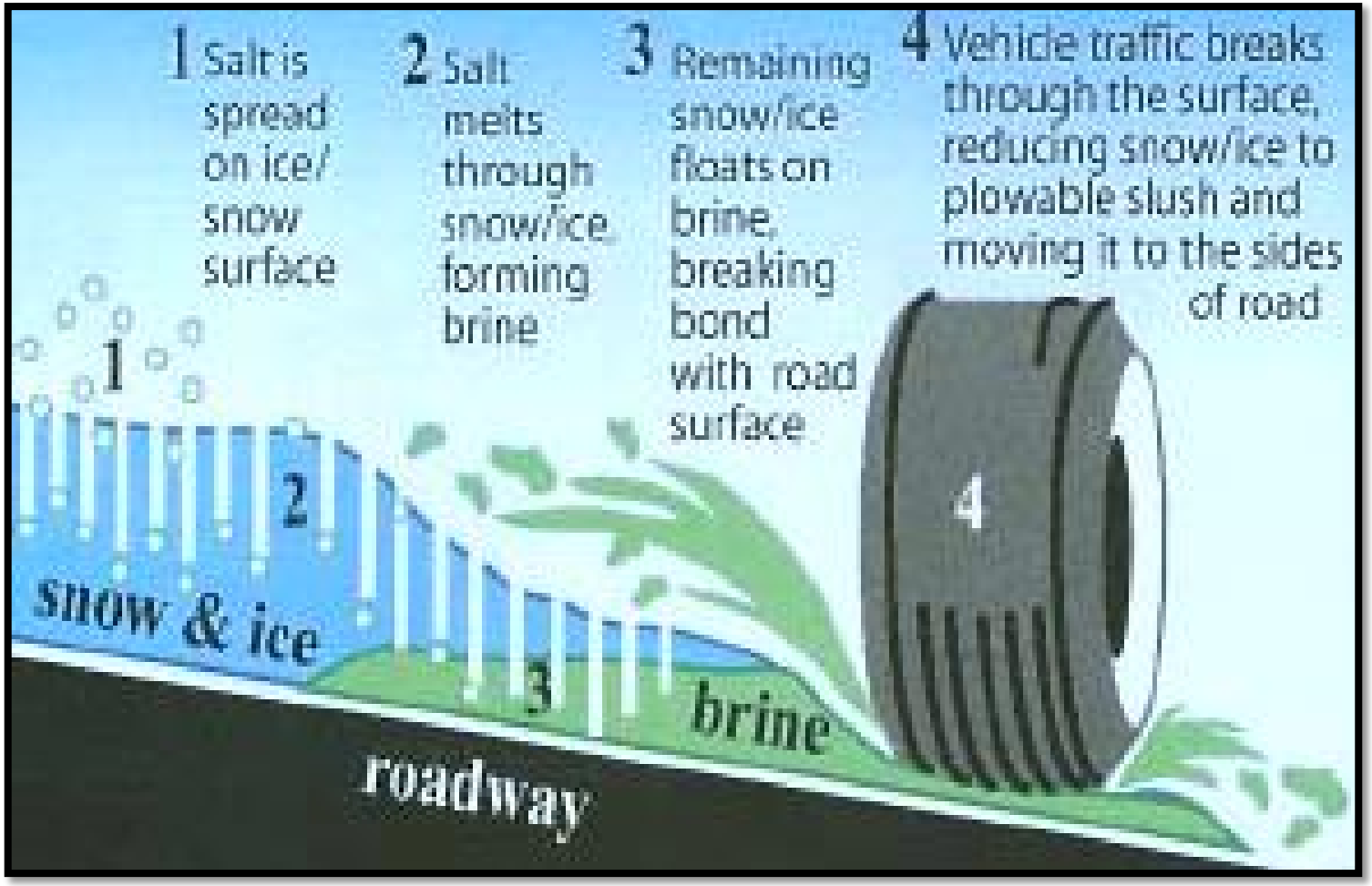
Implementation Difficulties - Training

- Lack of suitable training programs
- Lack of experienced trainers
- Training is ongoing
  - Multi-session
  - Multi-year
- Reluctance to allocate time for training
- Reluctance to change

De-Icing

- Reactive use of melting agent, which is applied after bond is formed between snow/ice and road surface
- Chemical must work its way through snow/ice to road surface where bond can be broken and snow/ice plowed off
- Includes pre-wetted, pre-treated or dry salt
- Usually deployed in combination with plowing, as de-icing by itself has limitations due to
  - Snow accumulation
  - Road surface temperature
  - Traffic

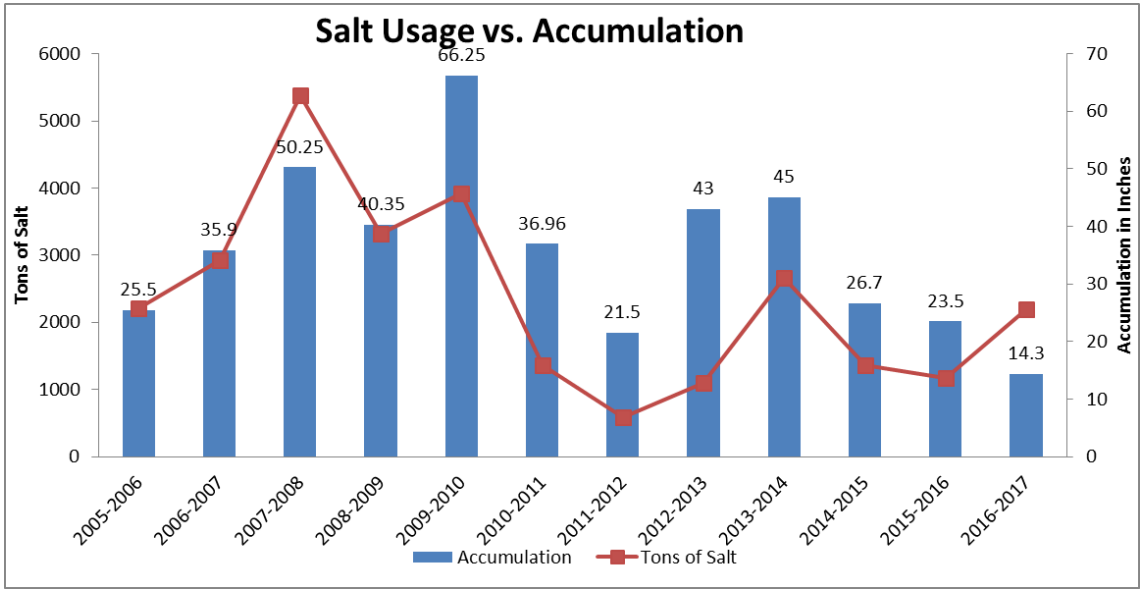
De-Icing


1 Salt is spread on ice/ snow surface
2 Salt melts through snow/ice forming brine
3 Remaining snow/ice floats on brine, breaking bond with road surface
4 Vehicle traffic breaks through the surface, reducing snow/ice to plowable slush and moving it to the sides of road
1
2
snow & ice
3
brine
4
roadway

The Past - Deicing

1998-1999 Salt Brine Test Area

City of West Des Moines



So, Liquids Are Always the Answer, Then?

- No, not always – here 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)

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 (e.g. Fairbanks, Alaska) then you will not get all the benefits of using liquids
- It may still be advantageous to make use of them when conditions allow, but
- The cost/benefit calculations are more complex

You Mentioned Costs…

- Yes, and they are very important
- First, we have to consider both capital and operating costs
- Then we have to make sure we have covered all the possible costs even if some of them do not apply in our case – like if you have your own well, water may not "cost" you anything, but if you have to buy the water from somewhere…

Capital Costs

- Anything that will be with you for a while
- For example, your brine maker
- Also your liquid storage facility
- The equipment that transfers liquid onto your trucks
- The stuff on the trucks that stores the liquid on the trucks and applies the liquid to the pavement
- Sensors that measure what you are doing with the liquid at each step of the process
- To analyze you need to have an idea of the lifetime of each capital item – your brine maker might last eight years, and your tanks could last twelve, for example

Operational Costs

- Anything that gets used each time you make brine
- For example, the salt that goes into the brine maker
- And the water…
- The time that your personnel spend managing the brine manufacturing process
- The power that is used to run the brine maker, the pumps, and loading equipment and so fo
- The time and costs associated with applying the materials
- And anything else!
- Not all of these apply everywhere, but be careful of excuses…

'Sustainable' Solutions Include More Than Just the Environment

- NOT JUST environmental awareness!
- Again a balancing trick
  - Social
  - Economic
  - Environmental
- No one sustainable solution
- One size ***emphatically*** does not fit all
- But, sustainability does impact all aspects

SUSTAINABILITY BALANCING ACT

Are we focusing on the right objectives?

1	2	3	4
Salt and chemical management plan.	Use the right amount and type of chemical…	In the right place…	At the right time…

What is the end objective or service level goal?

Bare pavement/bare parking lot?
Bare Pavement in wheel paths?
Passable condition ?
Do you have different levels of service for different road classifications or parking areas ?
In what time period will you accomplish your goal?

Pretreated lot

Untreated lot

Treated vs. Untreated

Chloride Cocktails

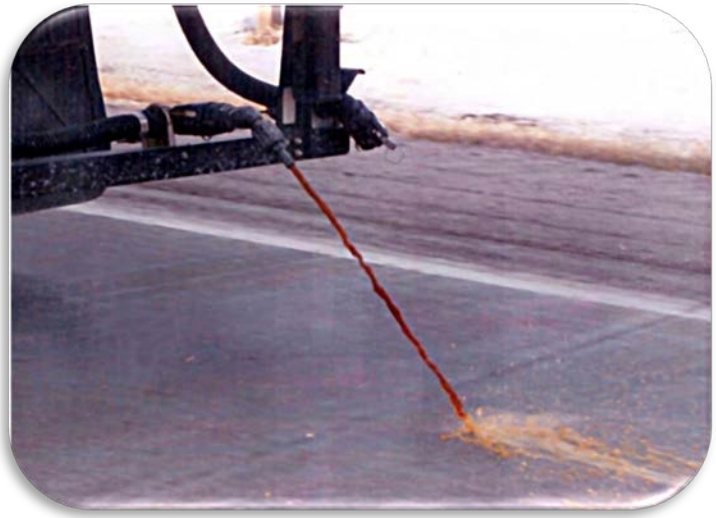
The Art Of Blending Liquid Deicers

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

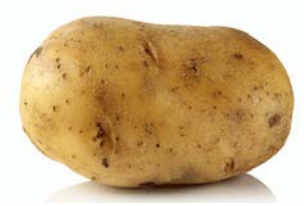
Do Your Homework!

- 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?



What do we mean by Organics?





- Co-product or by-products from an existing process

Why would I add something "Organic" to my deicer/anti-icer?

- Enhanced performance
- Residual effectiveness on the pavement
- Corrosion protection

http://pixdaus.com/sheep-riding/items/tag/sheep+riding/

Hold on we are going to jump straight into some science.

Enhanced performance

- Liquid agro-based products blended with 23.3% salt brine **Significantly lowered** the freezing point of water compared to NaCl
- When ag-based products were blended with 23% salt brine they did not melt more ice than salt brine alone….
- **Something about ag-based products depresses ice nucleation (the temperature where ice crystals begin to form).**

Enhanced performance

- Ag-based products tend to be more viscous and stickier than salt brine, mag, etc.
- Agro-based products with higher viscosity than salt brine may have slower **grain boundary penetration** than the salt brine with lower viscosity.
- Ag-based product show much lower corrosion rates to carbon steel

Enhanced Performance

- *Products with higher viscosity may have more product remain on the pavement surface resulting in reduction in bond strength between ice and pavement surface.*

How does this impact my WMO?

- **Black Ice treatment**
- **Serve as pretreatment**
- **Reduce amount of next application**

What can we take from this…

1. Science is messy and rarely are things absolute!
2. Ag-based products can help to enhance deicer performance and winter maintenance operations.
3. Ag-based products require care…
   - Store in a cool, dry place.
   - Mix them if they have been sitting around.
   - They have a shelf life, write it on the tote.

Where to find new products

- Talk to Distributors
- Talk to other agencies
- Clear Roads – Qualified Products List (QPL)
- Transportation Research Board (TRB)
- SICOP (part of AASHTO)

CLEAR ROADS
research for winter highway maintenance

U.S. Department of Transportation
Federal Highway Administration

APWA AMERICAN PUBLIC WORKS ASSOCIATION

Questions to ask Distributors

- Is the liquid ready to use?
- Is the product a corrosion inhibitor?
- What are safe blending ratios?
- What is the freeze point?
- What conditions are best for use?
- Is the product used for Anti-icing, De-icing or pre-wetting?

Liquid Only Routes

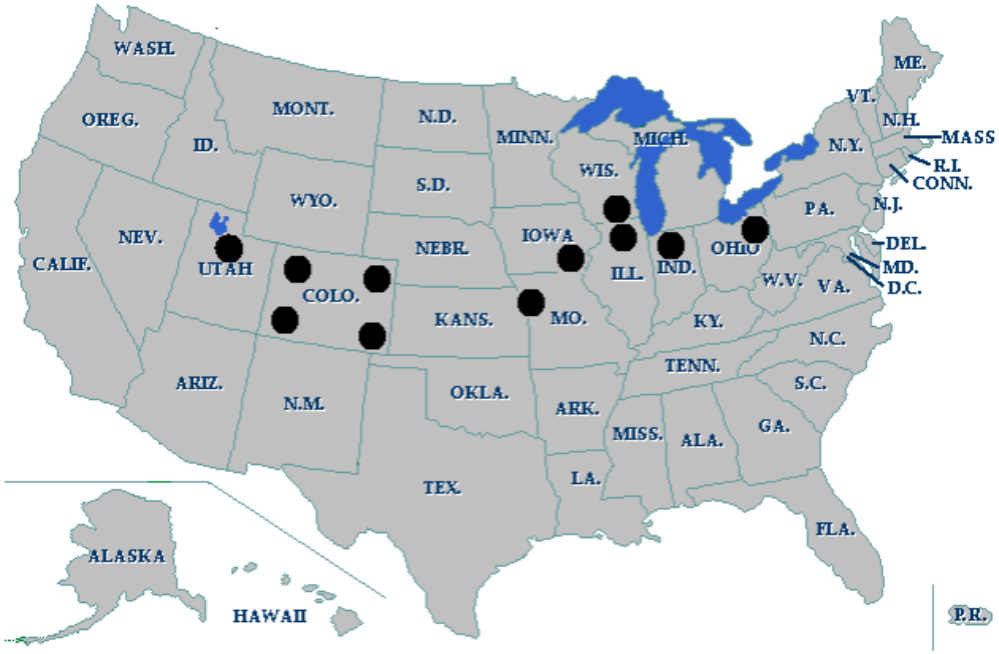
CLEAR ROADS
research for winter highway maintenance

- **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

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

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

QUESTIONS?

THANK YOU!

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