

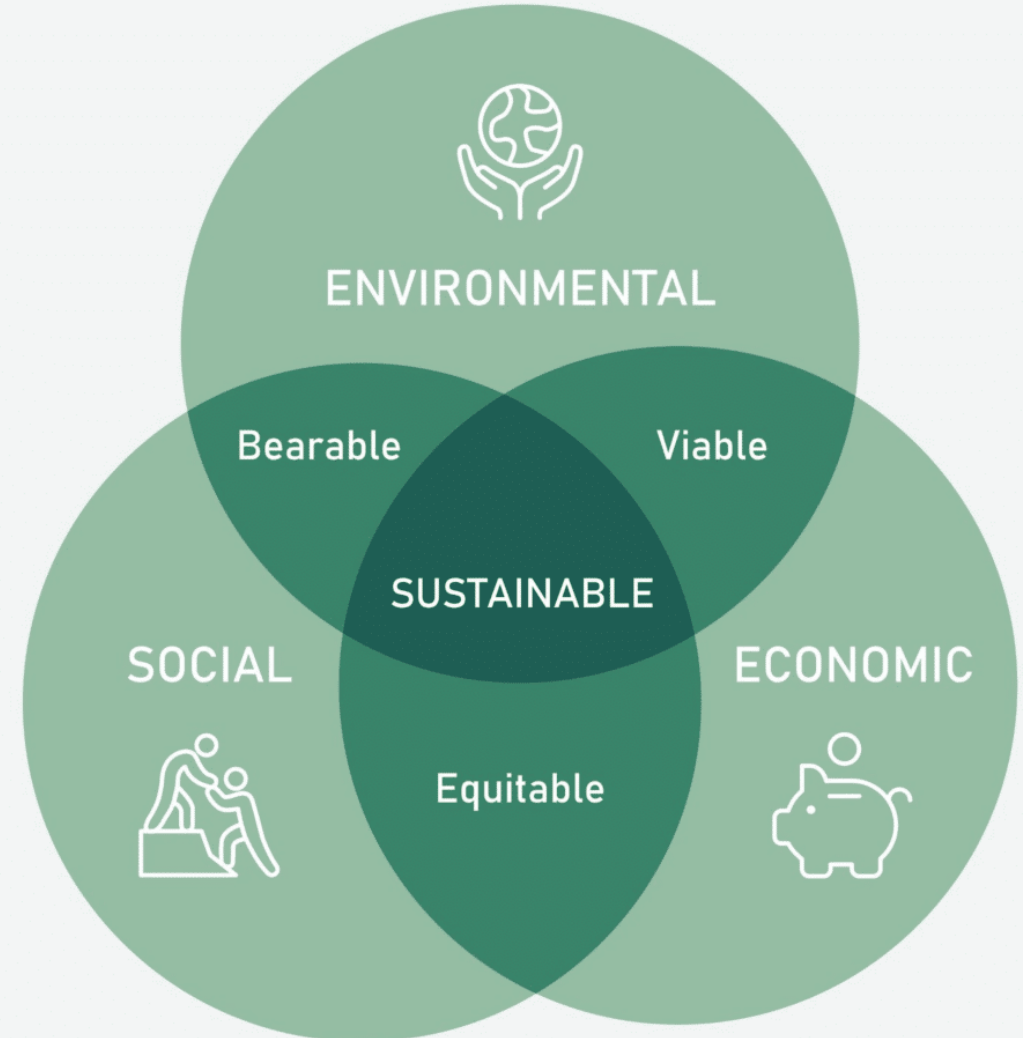
Environmental Considerations in WMO



Michigan DOT Maintenance Meeting
October 2024

Your job is to keep roads safe and passible roads.

- But creating a sustainable WMO program will benefit everyone!



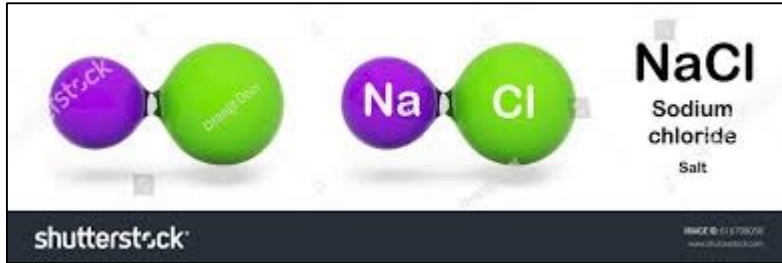
State and Federal Regulations you are dealing with....

“EGLE” Michigan Department of Environment, Great Lakes, and Energy

- Chloride and Sulphate Water Quality Values Implementation Plan
10/20/20, Revised Feb 2021
- MS4 permits – require reduction in discharge of pollutants associated with **cold weather operations**
 - Salt applications, salt storage, and strategic street sweeping to remove excess salt.

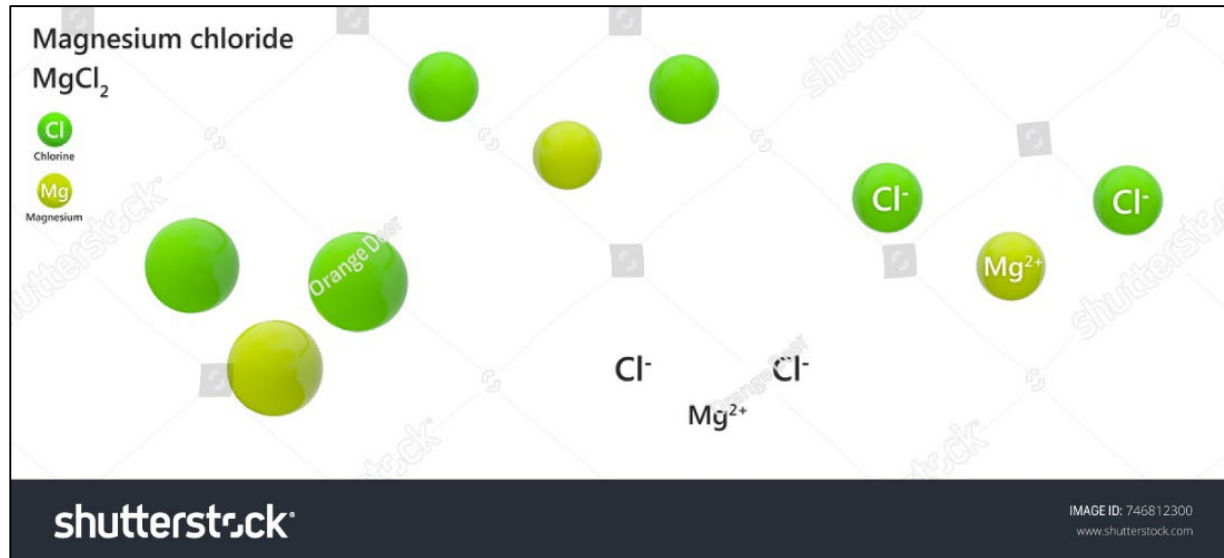
A little chemistry

NaCl

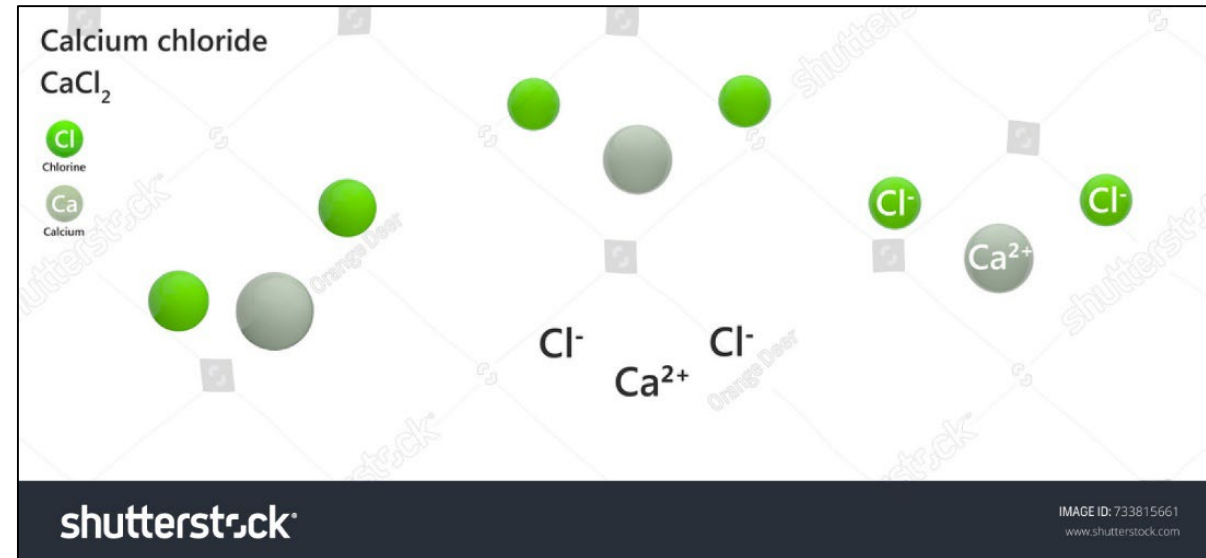


[100 g of NaCl = 39.34 g Na + 60.66 g Cl.]

MgCl₂

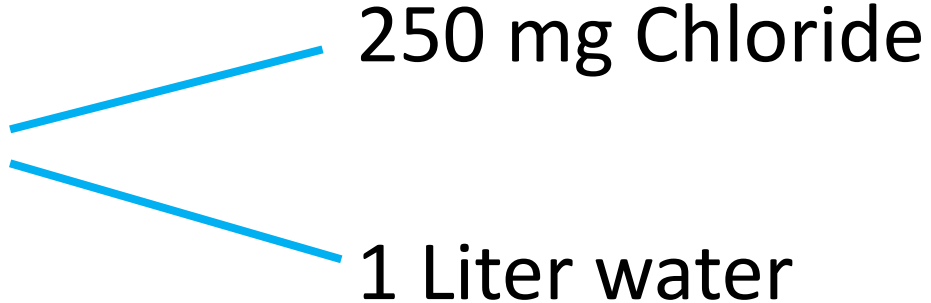


CaCl₂



Let's talk salt

- EPA water quality standard (*secondary drinking water standard)

250 mg/L =  250 mg Chloride
1 Liter water

*Maximum contaminant level, causes undesirable taste or odor, undesirable effects to the body, damage to equipment....

Where do these numbers come from?

- Federal - The Environmental Protection Agency (EPA)
 - <https://www.epa.gov/wqc/national-recommended-water-quality-criteria-aquatic-life-criteria-table>
 - <https://www.epa.gov/wqc/national-recommended-water-quality-criteria-human-health-criteria-table>
- Chloride (drinking water standard):
 - 250 mg/L
- Chloride (aquatic life standards):
 - 230 mg/L Chronic (longer term exposure)
 - 860 mg/L Acute (1 time exposure)
- Your State
 - <https://www.michigan.gov/egle/about/organization/water-resources/glwarm/water-quality-standards>
- Chloride
 - Final Chronic Value: 150 mg/L
 - Aquatic Max Value: 320 mg/L
 - Final Acute Value: 640 mg/L

This is what 250 mg/L of salt looks like!

2500 mg
NaCl

HOW MUCH IS TOO MUCH?

1000mg of sodium is about 3g of common salt. There are just over 5.3g of salt in one teaspoon. Here are the recommended upper daily limits according to AWASH (Australian Division of World Action on Salt & Health).

1 – 3 years

2.5g salt
(832mg sodium)



4 – 8 years

3.5g salt
(1166mg sodium)



9 – 13 years

5g salt
(1665mg sodium)



14+ years and adults

5.75g salt
(1915mg sodium)



What chloride values are in Michigan?

Source	Specific Conductance (ms/ cm)	~mg/ L
LOWER RIVER ROUGE AT DEARBORN, MI	10	21.2
PRESQUE ISLE RIVER NEAR CONNORVILLE, MI	176	80
FALLS RIVER NEAR L'ANSE, MI	222	100
RIFLE RIVER NEAR STERLING, MI	442	200
SAGINAW RIVER AT HOLLAND AVENUE AT SAGINAW, MI	766	400
CLINTON RIVER AT STERLING HEIGHTS, MI	1090	500
CLINTON RIVER AT MORAVIAN DRIVE AT MT. CLEMENS, MI (downstream)	1140	600
RIVER ROUGE AT DETROIT, MI	1390	700

Chloride numbers from the field

- USGS (Corsi et al., 2014)
 - 29% of the sites exceeded the EPA (230 mg/L)
 - by an average of more than 100 days per year from 2006 - 2011, almost double the amount of days from 1990 -1994.
 - The lowest chloride concentrations were in watersheds that had little urban land use or cities without much snowfall.
 - Chloride levels increased more rapidly than development of urban land near the study sites.
 - Rising chloride concentrations over time
 - Chloride infiltrating the groundwater system during the winter, then slowly released to the streams throughout the year.
- Kelting, Laxson, & Yerger (2012)
 - Higher stream salinity is correlate with proximity to roads.
 - Higher stream salinity is correlated with great road density.

<https://www.usgs.gov/news/urban-stream-contamination-increasing-rapidly-due-road-salt>

Kelting, D. L., Laxson, C. L., & Yerger, E. C. (2012). Regional analysis of the effect of paved roads on sodium and chloride in lakes. *Water Research*, 46(8), 2749-2758.

Stuart Findlay and Vicky Kelly (Cary Institute, 2018)

- Background < 10 mg/L
- Environmental effects (sub lethal) ~ 100 mg/L
- Lethal > 1000 mg/L

- Surface water [Cl⁻] = 10 – 300 mg/L
 - Dutchess County, New York

- Sources of chloride
 - 80% from deicing (DOT, local, private)
 - 5-10% from water softeners

Clear Roads Qualified Product List

- www.clearroads.org/qualified-product-list/

Category 1 - Corrosion Inhibited Liquid Magnesium Chloride

Product Name	Manufacturer	Corrosion Rate % Effectiveness	Concentration	Date Approved	Expiration
Iceban 200*	Earth Friendly Chem.	8	26%	8/15/2002	12/31/2024
Caliber M1000 AP	Envirotech Services, LLC	21	28%	8/2/2004	12/31/2029
Hydro-Melt Green	Cargill	24	28%	8/1/2005	12/31/2029
FreezGard CI Plus	Compass Minerals	12	30%	8/28/2006	12/31/2029
Ice B'Gone II HF	Sears Ecological Appl.	29	25%	8/9/2007	12/31/2024
FreezGard LITE CI Plus	Compass Minerals	12	27%	6/13/2011	12/31/2029
HydroMelt Liquid Deicer	Cargill	28	29%	8/15/2011	12/31/2029
FreezGard CI Plus Sub Zero	Compass Minerals	14	28%	10/11/2011	12/31/2029
Torch IB	GMCO Corporation	25	27%	1/10/2013	12/31/2024
Torch CI	GMCO Corporation	21	30%	1/10/2013	12/31/2024
Meltdown Apex	Envirotech Services, LLC	22	30%	4/16/2014	12/31/2029
Meltdown Inhibited	Envirotech Services, LLC	24	30%	4/29/2014	12/31/2029
ProMelt MAG 30 INH	Innovative Surface Solutions	25	30%	7/31/2015	12/31/2029
ProMelt Ultra 1000 INH	Innovative Surface Solutions	28	27%	7/31/2015	12/31/2029
Torch LT	GMCO Corporation	25	30%	12/17/2015	12/31/2024
NexGen Liquid De-Icer	Paradigm Group	25	30%	5/12/2017	12/31/2024

Note-Iceban 200 was formerly Iceban Performance Plus M;
 Torch IB was formerly Ice Ban 305; Torch CI was FreezGard 0 CCI; Torch LT was NextGen Torch
 Those products marked with an asterisk (*) indicates that the stratification can be seen and agitation is required.

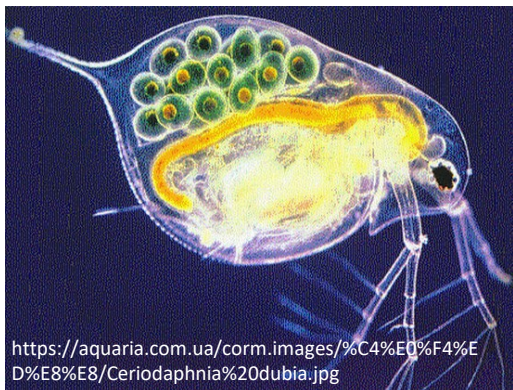
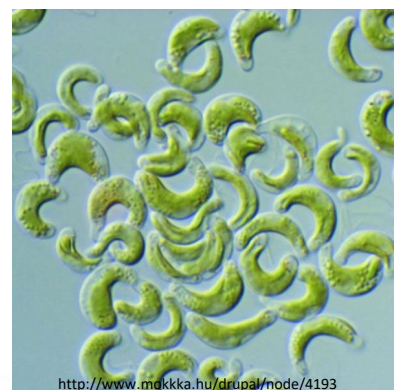
What does it take to be on QPL?

- Elemental Analysis

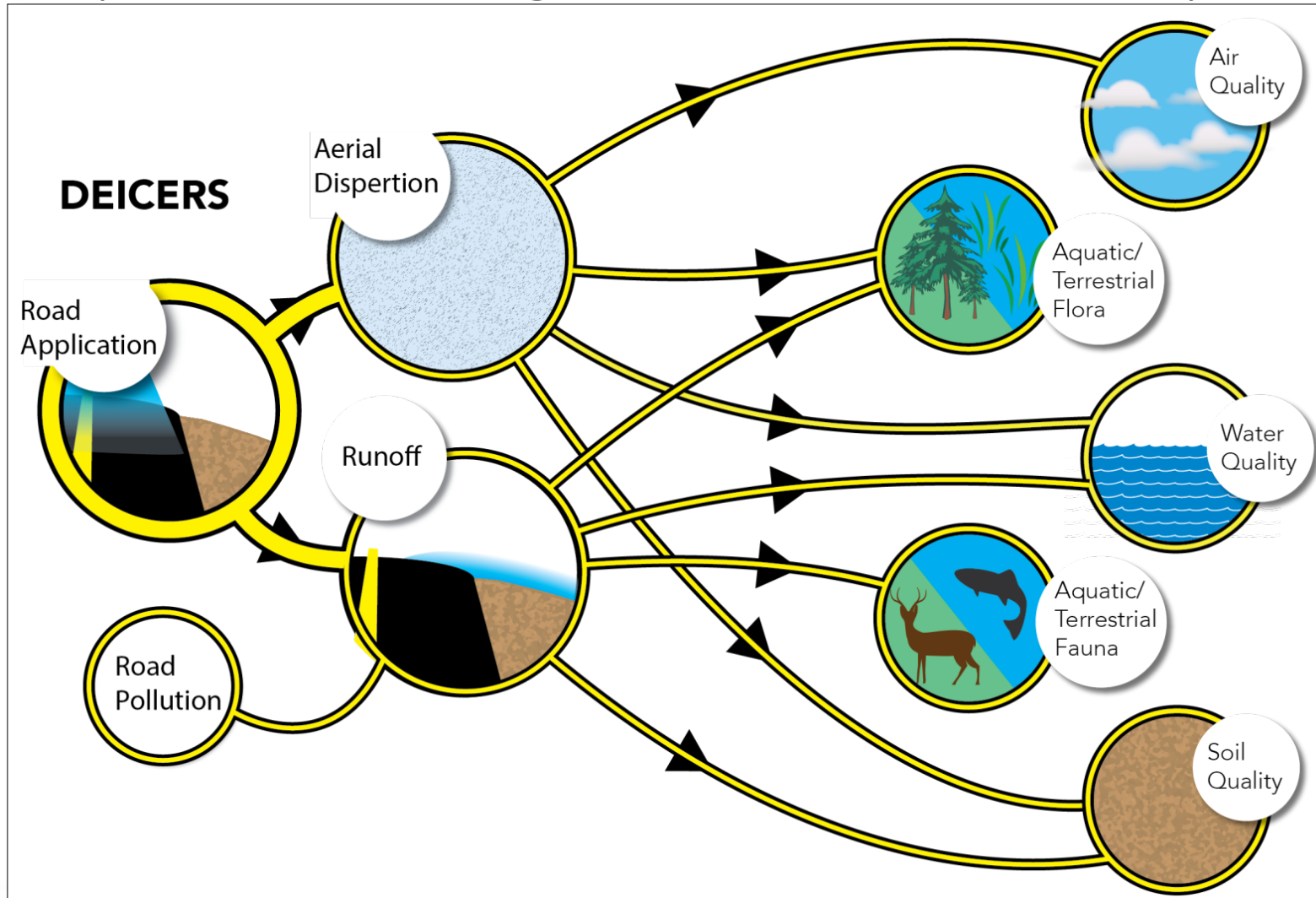
Arsenic	5.0
Barium	100.0
Cadmium	0.20
Chromium	1.0
Copper	1.0
Lead	1.0
Mercury	0.05
Selenium	5.0
Zinc	10.00
Phosphorus	2500.
Cyanide	0.20

- Other Testing Required

- Ammonia - Nitrogen
- Total Kjeldahl Nitrogen
- Nitrate and Nitrite - Nitrogen
- Biological Oxygen Demand
- Chemical Oxygen Demand
- Frictional Analysis
- Toxicity Testing
 - Rainbow Trout or Fathead Minnow Toxicity Test
 - Ceriodaphnia Dubia Reproductive and Survival Bioassay
 - Selenastrum Capricornutum Algal Growth



Pathways of Deicer Migration off the Roadway



Michigan Winter Operations Conference

Center for
Technology & Training

MICHIGAN
Winter
Operations Conference

Michigan's
Local Technical
Assistance Program



Sand and Abrasives



The science shows...

- Deicers can cause...
 - Mobilizations of heavy metals
 - Impacts to or death of aquatic & terrestrial species
 - Loss of native species => increase in invasive species (aquatic & terrestrial)
 - Wildlife-vehicle collisions

BOD

(Biological/Biochemical Oxygen Demand)

- “The amount of dissolved oxygen needed by aerobic biological organisms to break down material in water at a specific temperature or a specific time.”

https://en.wikipedia.org/wiki/Biochemical_oxygen_demand

BOD Level in mg/liter	Water Quality
1 - 2	Very Good: There will not be much organic matter present in the water supply.
3 - 5	Fair: Moderately Clean
6 - 9	Poor: Somewhat Polluted - Usually indicates that organic matter present and microorganisms are decomposing that waste.
100 or more	Very Poor: Very Polluted - Contains organic matter.

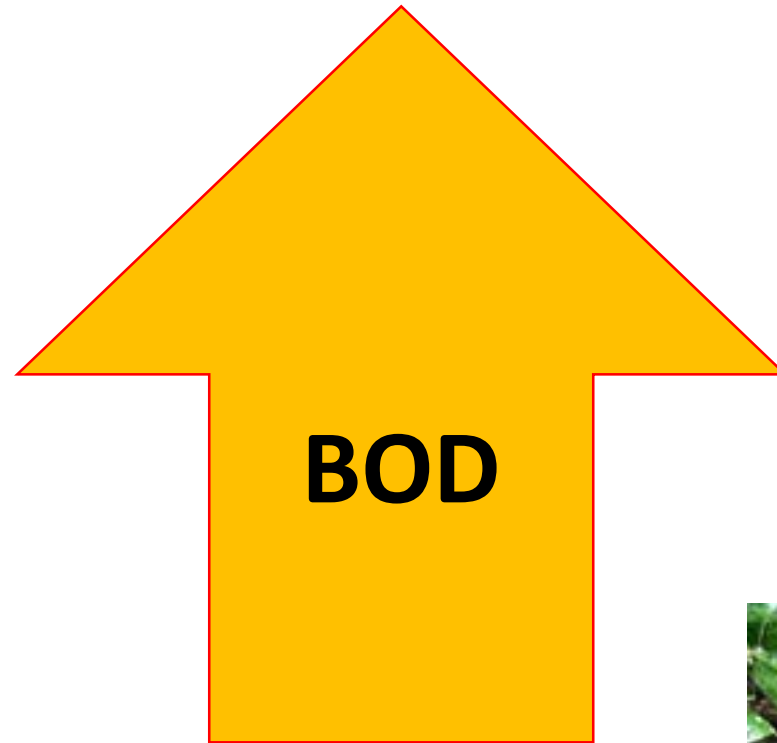
Ag-based, Acetate, Formates & Glycols

Benefits

- Break down in the environ.
- Less corrosive than chlorides

Not so good

- Higher costs
- Exert a higher BOD

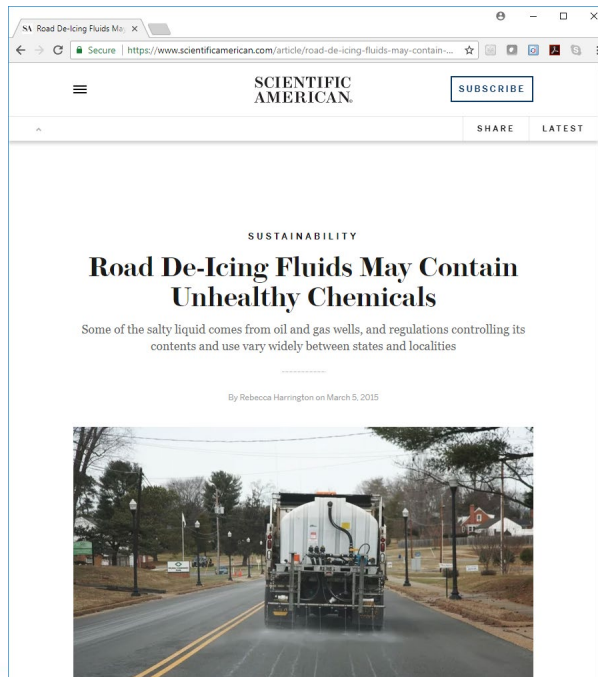


Reduces available oxygen for organism in the soil and aquatic environments.



Natural/Waste Brines

- Where is it from?
- Did they do toxicity testing?
- Show me the data!



TALK TO YOUR RETAILER
OR CLICK HERE TO

LEARN MORE

Everest 3.0



Environmental groups oppose brine 'deicing' bill

Vote had been expected on Wednesday, but apparently was postponed till later



By Conor Morris May 23, 2018 6



The Ohio House is set to consider a bill that its promoters hope will encourage the use of brine from oil and gas wells as a road deicer treatment.

https://www.athensnews.com/news/local/environmental-groups-oppose-brine-deicing-bill/article_b176e6dc-5ead-11e8-8cf8-4741614e418a.html

Removing Chlorides

- Reverse osmosis
 - It works, but its expensive.
 - \$1,500  \$18,000  \$30,000
 - cost increases as you scale up.

Ok, so much doom and gloom

- What next, what do we do?
 1. Not all chlorides are from state and local transportation agencies
 - Water softeners, agriculture, private landowner winter operations (parking lots), natural sources
 2. Find the areas where you can reduce salt use while not reducing LOS!

Product Application Rates

- **Sand** – 100 to 1000 lbs/l-m (32°F and colder)
- **Salt/sand** – 400 to 1000 lbs/l-m (32 to 0°F)
- **NaCl** (32 to 15°F)
 - Solid – 100 to 800 lbs/l-m
 - Liquid – 10 to 40 gal/l-m
 - Pre-wet – 8 to 20 gal/l-m
- **MgCl₂** (32 to -5°F) and **CaCl₂** (32 to -15°F)
 - Solid – 100 to 500 lbs/l-m
 - Liquid – 10 to 40 gal/l-m
 - Pre-wet – 8 to 20 gal/l-m
- **Ag-based by products** – typically an additive

Equipment Calibration

- Is a must
- Why: to realize savings gained from investment in new technology
- Train how to calibrate & keep records
- When to calibrate:
 - When first acquired, points throughout a season, whenever a new material is used, after repairs, if there appears to be discrepancy in material usage

Equipment Calibration

Savings of \$75,000 from calibrating in the first year.

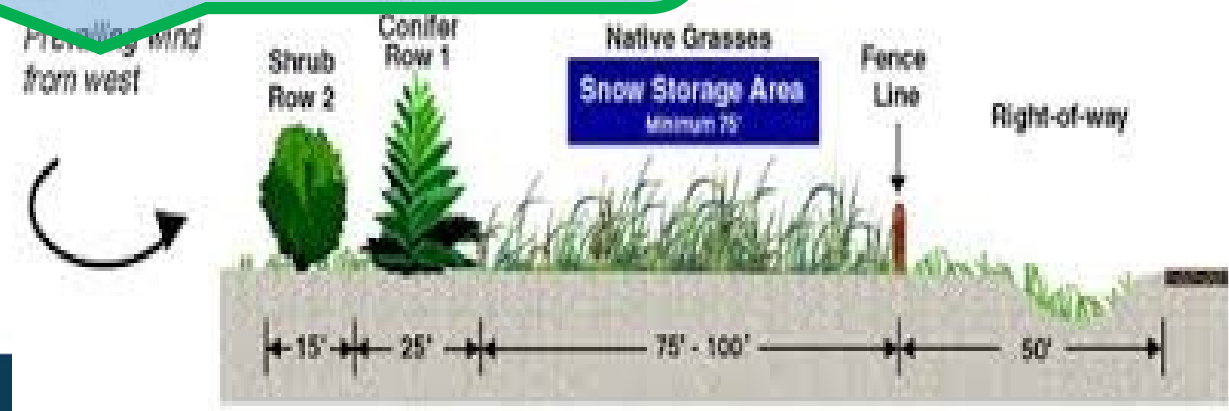
1. Ask the driver where they set the knob (500-1200lbs/l-m)
2. Recommend an application rate (e.g., 250 lbs/l-m), test use once calibrated.

Changing the culture of the operators.

Drift Control and Snow Fences

- Reduce blowing and drifting snow
- Low cost snow storage
- Increased safety
- Reduce need for snow & ice control product
- 25 year lifespan at \$1.40 per ft²

Wildlife habitat, control erosion, improve water quality, reduce spring-time flooding, sequester carbon.



Facility Management

- The design and operation of maintenance facilities can have a direct influence on potential contamination issues and loss of materials.
- “Good housekeeping” – clean, organized, and well maintained.



Facility Management – Material Storage

- Snow and ice control product storage facilities have the **greatest potential to impact the environment**, because they are a single source that can release high concentration runoff into the environment.
- Solids – Covered, impermeable surface.
- Liquids – Secondary containment, impermeable surface.

Training.....

- Benefits of improved or target training of winter maintenance personnel:
 - Reduction in the amount of snow and ice control products used while maintaining or increase LOS provided through:
 - Calibration training
 - Salt Smart Principles
 - Application rate
 - Impacts of over applications



What can we do

- Identified No Salt Zones



Where does this leave us...

- BMPs
- Invent a better deicer
- Invest in a different deicing system
 - heated pavement
 - ??



Necessity is the Mother of invention!
-Plato made of Play-doh

EVALUATION OF ALTERNATIVE ANTI-ICING AND DEICING COMPOUNDS USING SODIUM CHLORIDE AND MAGNESIUM CHLORIDE AS BASELINE DEICERS (Report)

http://www.westerntransportationinstitute.org/documents/reports/4w1095_final_report.pdf

Manual of Environmental Best Practices for Snow and Ice Control (Manual and webinar)

<http://clearroads.org/project/snow-and-ice-control-environmental-best-management-practices-manual/>

Strategies to Mitigate the Impacts of Chloride Roadway Deicers on the Natural Environment (Report)

<http://www.trb.org/Publications/Blurbs/169520.aspx>

Manual of Best Management Practices for Roads Salt in Winter Maintenance (Manual and webinar)

http://clearroads.org/wp-content/uploads/dlm_uploads/0537_2015-Clear-Roads-Best-Practice-Guide-WEB.pdf

Understanding the Effectiveness of Non-Chloride Liquid Agricultural By-Products and Solid Complex Chloride/Mineral Products Used in Snow and Ice Control Operations

<http://clearroads.org/project/13-02/>

Resources/References

The screenshot shows a web browser window displaying the Clear Roads website. The browser's address bar shows the URL clearroads.org. The website header features the "CLEAR ROADS" logo with the tagline "research for winter highway maintenance" and a "Member Login" link. A navigation menu includes "Home", "About Clear Roads", "Research Projects", "Partnership Projects", "Resources/Links", and "Contact Us". The main content area features a large image of a snow-covered road with a text box that reads: "The Clear Roads research program brings together transportation professionals and researchers from around the country to drive innovation in the field of winter maintenance. By evaluating materials, equipment and methods in real-world conditions, the program identifies the most effective techniques and technologies to save agencies money, improve safety and increase efficiency." Below this are three sections: "News & Events", "Recent Research Results", and "New Resources", each with a representative image. The Windows taskbar at the bottom shows the time as 9:23 PM on 9/6/2017.

Completed Research | Clear Roads

clearroads.org/completed-research/

Member Login

CLEAR ROADS

research for winter highway maintenance

- Home
- About Clear Roads
- Research Projects
 - Requests for Proposals
 - Research in Progress
 - Completed Research**
 - Synthesis Projects
 - All Proposed Projects
- Partnership Projects
- Resources/Links
- Contact Us

Completed Research

- 15-03: North American Study on Corrosion Response (February 2017)
- 14-04: Plug-and-Play Initiative: Phase 1 Synthesis Projects
- 14-07: Identifying Best Practices for Roadway Salting Operations (January 2017)
- 14-01: Synthesis on GPS/AVL Equipment Used for Winter Maintenance (September 2016)
- 13-02: Understanding the Effectiveness of Non-Chloride Liquid Agricultural By-Products and Solid Complex Chloride/Mineral Products Used in Snow and Ice Control Operations (May 2016)
- 14-10: Roadway Salt Best Management Practices (November 2015)
- 14-06: Use Of Equipment Lighting During Snowplow Operations (September 2015)
- 13-03: Cost-Benefit of Various Winter Maintenance Strategies (September 2015)
- 13-01: Snow and Ice Control Environmental Best Management Practices Manual (July 2015)
- 13-04: Best Practices for the Prevention of Corrosion to DOT Equipment: A User's Manual (May 2015)
- 14-08: Weather Severity Mapping Enhancement (March 2015)
- 14-05: Snow Removal Performance Metrics (May 2017)
- 12-02: Establishing Effective Salt and Anti-icing Application Rates (February 2015)

clearroads.org/completed-research/ | Distribution Systems (December 2014)

Type here to search

9:28 PM 9/6/2017

THANKS, SNOW MUCH

QUESTIONS ?

Mark DeVries - Business Application Manager

Vaisala Inc

Mark.devries@Vaisala.com

Cell 720.299.6380

Bret Hodne

Bret Hodne Inc.....

515-657-3487

Laura Fay

Senior Research Scientist

Program Manager – Cold Climate Operations

& Systems

laura.fay1@montana.edu

406-600-5777

<https://westerntransportationinstitute.org/>