

Report from: Municipal Works, Operations Planning

Report Date: January 31, 2020

Meeting Date: March 11, 2020

Report Number: MW-B007-2020

File: 68.81.3

Subject: Green Road Salt Alternatives

Recommendation

That report MW-B007-2020, regarding the feasibility of green alternatives to road salts being used during the City's winter program, be received for information.

Summary

Although alternate products have been developed to be more environmentally friendly, these products can only reduce the amount of salt entering the environment and not eliminate it completely. All products have effects on the environment that also need to be considered.

There are existing products where the prices are not feasible as well as some mixed products being used by other local municipalities that are more expensive than salt but worth considering. Dealing with these products will require additional time and effort when managing it, but can reduce the amount of salt entering the environment.

Background

At its meeting of [April 29, 2019](#), Council approved the following motion:

WHEREAS the City of St. Catharines is focused on green initiatives; and

WHEREAS the current road salt program has not been reviewed since 2011;

THEREFORE BE IT RESOLVED that the motion be referred to the Budget Standing Committee for review; and

BE IT FURTHER RESOLVED that staff be directed to review and report to Council on the feasibility of green alternatives to road salts to be used during the City's winter program.

Report

Every winter, Municipal Works manages the City's response to winter control and must balance three critical factors; the cost of the service, the impact to the environment and providing safe roadways and sidewalks to the residents of St. Catharines. As part of this program, Municipal Works uses on average 7,300 tonnes of salt per winter season.

Municipal Works uses two techniques when applying salt to the main roads; conventional spreading during a winter event and direct liquid application (DLA) prior to a winter event. Conventional spreading generally consists of the application of salt applied as a pre-wet mixture only to the city's main road network. DLA uses a liquid only application of salt brine which is a mixture of water and salt at a specific concentration which is made and stored at Lake Street Service Centre (LSSC). DLA is applied to priority locations before a snow event if time and environmental conditions permit. There are currently two trucks which typically complete DLA. The equipment used to create brine is currently ten years old and has a typical service life of 10-15 years.

Spreading uses sodium chloride (rock salt) which is pre-wet with salt brine just prior to spreading by trucks at a rate of 117kg per 2 lane km. Pre-wetting salt has four main advantages: it allows the salt to adhere better to the road; it enhances the melting ability of the salt by starting the melting process faster; it helps break the bond of ice and snow to the road making for a more efficient clean up to achieve bare pavement conditions on main roads; and it reduces the spreading rate allowing less salt to be applied to the road.

In 2008, Council adopted a Salt Management Plan which addressed concerns resulting from a report prepared under the Canadian Environmental Protection Act which concluded that high releases of road salts were having an adverse effect on the environment. Since that report, the City has completed several changes to our salt application, storage and snow disposal practices to reduce the amount of salt entering the environment.

Salt in the Environment

Several studies have been completed proving that road salt can raise the salinity in nearby soil and freshwater ecosystems. While damaging to both, the increase has a greater impact on local freshwater. In order to lower the amount of sodium chloride entering these ecosystems several de-icing and anti-icing alternatives are becoming popular.

De-Icing and Anti-Icing Materials

Several chemicals are available to be used for snow and ice control. Each has its pros and cons for using it as shown in the table below.

| | Material | Pros | Cons |
|-------------------------|---|---|---|
| Chloride Based De-Icer | Sodium Chloride (Rock Salt) | Availability | Damage to concrete, asphalt, grass, plants and ground water. |
| | Salt Brine | Availability Uses a smaller concentration of salt. | Damage to concrete, asphalt, grass, plants and ground water. |
| | Calcium Chloride | Works at much lower temp than sodium chloride. Less harmful to plants if not over applied. Effective as an additive to sodium chloride. | Damages carpets, tiles and corrodes metal. Absorbs moisture, handling concerns, environmental concerns when over applied. |
| | Magnesium Chloride | Minimally damaging to environment. | Over-application can damage plants. Less corrosive to concrete and more corrosive to metal. Draws moisture from air and can keep pavement wet. Can clog equipment earlier than calcium chloride. |
| | ProMelt Mag® (Calcium Magnesium Brine) | Less Corrosive to roads and metal. Can use a lower application rate. | Additional handling requirements for health and safety. |
| Acetate Based De-Icer | Potassium Chloride | Potassium based fertilizer which is better for plants. | Not easily available. Mostly used in a blend. |
| | ClearLane® (Mixed Product) | Adheres to pavement better than Sodium Chloride. | Pre-wet with Magnesium Chloride and corrosion inhibitor to reduce the corrosiveness. |
| | Urea | Minimal effect on plants and grass. Non-corrosive. | Nitrogen based which is harmful for water sources. |
| Agricultural By-Product | Beet Brine | Lowers melting point of water. Reduces the amount of sodium chloride entering the environment | Odour, stains, if not mixed correctly can freeze. Sugar from solution can reduce oxygen in water. Specific products can only be found in regions where they are created and not made available locally. |
| | Pickle Brine | | |
| | Cheese Brine | | |
| Abrasive | Sand | Availability | Abrasive material only. Not a de-icer. Requires clean up after winter season. Can clog drainage systems. Negative effect if too much enters water source. |

Modified Agricultural By-Products

There are several Modified Agricultural By-Product Anti-icing brine solutions used in North America that can reduce the amount of salt applied to the roads. Products used have been cheese brine, pickle brine, potato brine and beet brine. Cheese brine has been used in Wisconsin due to the availability from local cheese factories and New Jersey has used pickle brine. The only alternative brine solution available in this area is beet brine which is manufactured in Milton, Ontario.

The Region of Niagara has used beet brine for several years, but stopped using it 2018 due to increased equipment maintenance costs, additional time required to screen the product before loading, as well as stain and odor complaints from both business owners and employees.

However, beet brine is not without its own environmental consequences. According to a National Geographic report, "A commercially prepared beet juice solution, when mixed with salt, serves as a "goo" to which salt sticks, minimizing its tendency to run off into nearby streams. Molasses and other sugary substances, including the waste from beer making, provide the same benefit."

Further, when these sugar based brine products make their way into streams, the sugar can promote the growth of aerobic bacteria, which deoxygenates the water and negatively impacts fish habitats.

Salt Management

Although alternatives to salt are available, generally as an additive to salt, they can only reduce the amount of salt entering the environment and not eliminate it completely. In addition to the measures we have already taken with our Salt Management Plan.

Through the Salt Management Plan, Municipal Works completed the following:

- All salt stored indoors and on an impermeable surface
- All salt handling, loading and unloading completed indoors on an impermeable surface
- Purchase of brine making and storage system
- All dump trucks equipped with pre-wetting and / or DLA capability
- All dump trucks equipped with electronic spreader controls for more accurate salt application
- All dump trucks and Supervisor trucks equipped with road temperature sensors to monitor road conditions
- Introduction of dash cams to monitor winter control activities and road / weather conditions
- GPS system to monitor winter control activities
- 22% reduction in salt application rate from 153kg / lane km to 117 kg / lane km (pre-wet)
- Do not apply salt to roads in environmentally sensitive areas

There are additional methods that can be looked at to reduce the amount of salt used on the roads. These include: our Levels of Service, other salt based products, salt usage on private property and utilizing DLA more frequently before a winter event.

Levels of Service

The Municipal Works Levels of Service guidelines as well as the provincial Minimum Maintenance Standards outline how often and to what degree roads are cleared. The Levels of Service used by Municipal Works exceed those outlined in the provincial Minimum Maintenance Standards. There could be a possible reduction in salt usage by lowering the levels of service while still adhering to the minimum Maintenance Standard. The current levels of service would need to be reviewed and a cost and risk analysis completed to determine what the impacts would be on the possible reductions.

Clearlane®

Clearlane is a salt product containing a pre-wetting agent, coloring agent, and a corrosion inhibitor which allows the salt to adhere better to the pavement. Clearlane is currently being used by the City of Niagara Falls on all roads. Niagara Region has been experimenting with Clearlane at one of their yards and Niagara Parks uses Clearlane on some of their roads. Using Clearlane allowed Niagara Falls to reduce the application rate from 120kg per lane km to 100kg per lane km. The product is purchased through our current shared tender with the Region of Niagara.

Alterations to our current storage techniques would be required as Clearlane will harden and clump more rapidly than salt, especially in warmer temperatures. Any material remaining after the winter season may not be usable. Increased cost for maintenance would be required as the product is heavier and sticky. Niagara Falls and Niagara Parks have noted having troubles with their equipment for these reasons.

ProMelt Mag 22%

Niagara Falls also use a calcium magnesium product called ProMelt Mag 22% for DLA which contains no salt and is applied at a lower application rate than salt brine. Additional health and safety requirements are required to protect skin contact and cautions against inhaling mist or aerosols.

Private Property

Although Environment Canada has required municipalities to look at a salt management plan, it does not apply to private property. The run-off from private properties enters the City's storm sewer system which outlet to near by water courses. Since there is no control on spreading rates for private property they may use more salt than what may be necessary.

Increase Use of DLA

DLA is the proactive use of applying melting products to prevent the formation of bond between the road surface and snow or ice. DLA is applied to the road surface prior to a storm event (should environmental conditions allow) and is only effective with a prior application.

Municipal Works currently applies DLA to priority hills and bridges during patrol if temperatures and forecasted precipitation allow. Current application of DLA takes approximately five hours to complete with two trucks with a large capacity tanks. In order to apply DLA to all main routes it would take two trucks 24 hours to complete full application. By applying DLA to all main routes this could eliminate one frequency of salt application.

Regional Roads

There are several Regional Roads that are apart of our winter road maintenance requirements. Any changes made to products and application rates would need to be approved by the Region of Niagara.

Financial Implications

Below is a chart indicating the prices for each material. Although some products seem like a great solution the prices are not feasible.

| Material | Price | Units |
|--------------------------------------|-----------------------|--------|
| Sodium Chloride (Rock Salt) (2) | \$72.76 | /tonne |
| Salt Brine (2) | \$0.15 | /litre |
| Calcium Chloride (1) | \$440.39 | /tonne |
| Magnesium Chloride(1) | \$512.79 | /tonne |
| Potassium Chloride(4) | \$357.00 | /tonne |
| ClearLane® (Mixed Product) (6) | \$87.00 | /tonne |
| Calcium Magnesium Acetate (5) | \$1,260.00 | /tonne |
| ProMelt Mag® (Calcium Mag Brine) (6) | \$0.26 | /litre |
| Potassium Acetate (1) | \$1.93 | /litre |
| Urea (4) | \$344.00 | /tonne |
| Beet Juice (3) | \$0.66 | /litre |
| Pickle Brine | Not Available Locally | |
| Cheese Brine | Not Available Locally | |
| Sand (1) | \$22.21 | /tonne |

(1) 2020 prices from Chemical Solutions Inc. (does not include delivery, stockpiling etc.) converted to Canadian Dollars and tonnes

(2) City price inclusive of all charges (deliver, stockpiling, mixing etc.)

(3) Missouri Department of Transportation report converted to litres and Canadian Dollars

(4) indexmundi.com (commodity index)

(5) Price derived using the pricing ratios in the 2010 Cary Institute report multiplied by the base price (\$65.28) for City salt (Current bulk price not available)

(6) Niagara Falls price quote from 2019

Costs for Increased Anti-Icing

Since brine contains only 23% salt, if DLA is applied to all main routes prior to an event and one frequency of salt application is eliminated at the beginning of an event, it would

reduce the amount of salt applied to the roads. The cost to complete 1 frequency of DLA on all main routes is \$8,560.28. Whereas the cost to complete 1 frequency of pre-wet salt on all main routes is \$5,018.73.

Cost for using Clearlane® and ProMelt

| Product | Application Rate (kg/ L Km or L/ I Km) | Price (Tonne/Litre) | Price (/km) |
|---------------------------|---|--------------------------------|--------------------|
| Clearlane® | 99 | \$87.00 | \$8.61 |
| Salt (for Pre-Wet) | 117 | \$72.76 | \$8.51 |
| Brine (for Pre-Wet) | 38 | \$0.15 | \$11.40 |
| Salt | 130 | \$72.76 | \$9.46 |
| Brine (DLA) | 90 | \$0.15 | \$27.00 |
| ProMelt Mag 22% (DLA) | 60 | \$0.26 | \$31.20 |
| ProMelt Mag 22% (pre-wet) | 30 | \$0.26 | \$15.60 |

Although the cost of Clearlane and ProMelt is more; with the lower application rates the overall cost is reduced as is the overall amount of salt used on the roads. Since Clearlane is a pre-wet product it would be comparable to pre-wet salt. Clearlane is \$8.61 / km and pre-wet salt (including cost of brine) is \$19.91.

With using Clearlane, pre-wet equipment on the trucks would no longer be required. Future purchase of winter control tucks would be purchased without pre-wetting equipment saving approximately \$10,000 per truck.

Since the product is sticky and clumps together, it would require extra time spent by crews and technicians cleaning and repairing equipment and breaking up large clusters. Niagara Parks and Niagara Falls has run into issues with using the product in some of their equipment due to the stickiness and additional weight. Niagara Parks was not able to use Clearlane in some of their trucks.

Conclusion

All products used for winter control have associated environmental and budgetary impacts. These impacts must be balanced against the need to provide safe roadways and sidewalks within the City.

Notifications

Beacon Christian School

Prepared by

Sabrina Mills, C.E.T.,
Operations Technologist

Submitted by

Gary Janssen,
Manager of Operations Planning

Approved by
Darrell Smith, P. Eng.
Direction of Municipal Works