Lake Simcoe Region conservation authority

Friction and Parking Lots

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Introduction

The issue of high levels of salt application has been gaining attention over the past few years. While decades of research has been conducted on the efficient use of salt on roads, parking lots represent unique challenges including the type of traffic, the mix of pedestrians and vehicles, varied surfaces (e.g. drive aisles, parking stalls, walkways, islands, etc.), and the requirement to store snow. However, research is now beginning to emerge which shows how salt use can also be optimized in parking lots.

Salt is typically applied at heavy rates in parking lots, for a number of reasons:

- A lack of clarity or understanding of what the "right" application rate is
- Rising insurance rates, and concerns around liability
- Pressure from parking lot users to apply heavy amounts under the perception that more salt = safer conditions

The environmental impacts of excessive salt use are well known, and include effects on fish and other aquatic organisms, impacts to surface and ground water, and damage to vegetation.

Best Practices for Parking Lots

Some best management practices (BMPs) have been developed specifically for winter maintenance in parking lots. Along with recommendations around the proper use and calibration of equipment, many of these practices relate to plowing the lot and walkways before applying salt, and applying the recommended amount of salt for the conditions. Several studies have been conducted, by industry and academia, to determine what the "right" amount is, and, while "proper" application can vary depending on temperature and conditions, 58 g/m² (or 13 lb/1000 ft²) has been suggested as being a reasonable rate to use for "moderate" winter events (Hossain, K. and Fu, L., 2015). In recent studies of commercial parking lots undertaken by the Lake Simcoe Region Conservation Authority (LSRCA), the typical real-world application rates tended to be closer to 90 g/m², and are often much higher.

There are, however, challenges related to the use of these best management practices.

- Not all contractors use calibrated equipment, which can make it difficult to ensure that the right amount of salt is being applied. Further, while there are some industry-recommended application rates, a one-size-fits-all approach may not work for all situations; rates will vary based on the layout of the parking lot, how it's used, and what the conditions are.

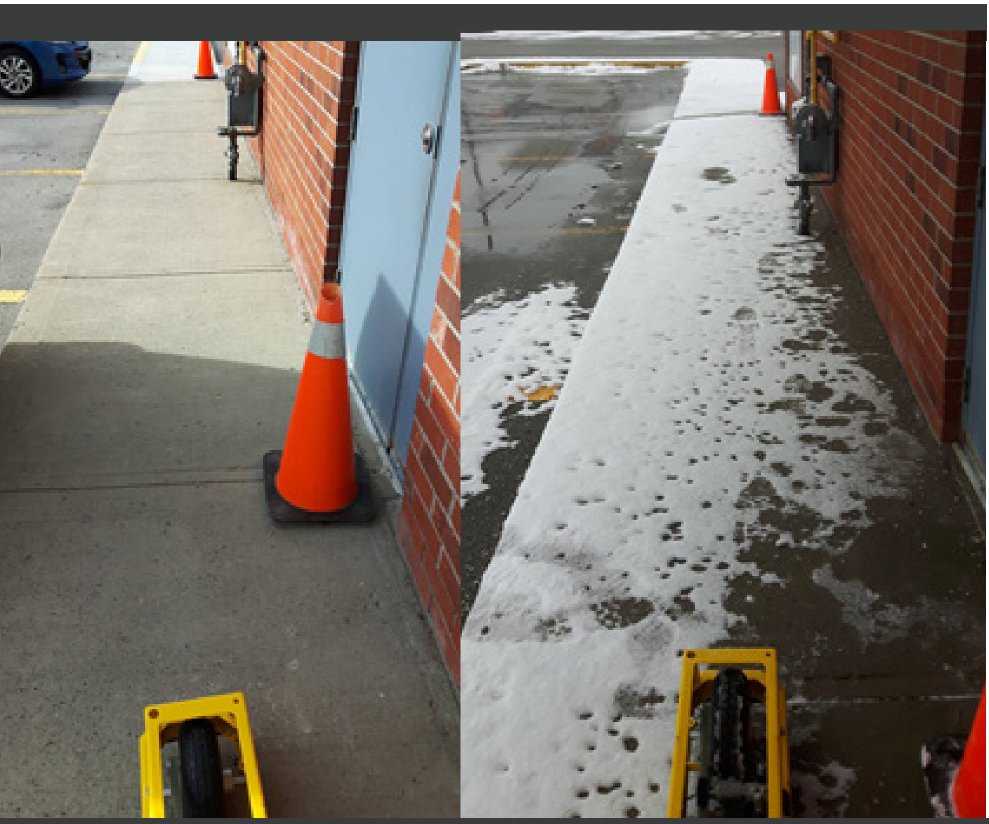
- The tables and other materials developed by industry experts and academics to determine optimal application rates are often not practical, as they can be difficult to interpret, with an extremely wide range of rates and conditions to assess.
- A property may have salt management plan in place, which is ideal, but these plans may be poorly communicated between property managers and the contractors on site doing the work, and the expectation of seeing residual salt by the property manager, tenants and patrons can still be an obstacle.
- Concerns around increasing insurance premiums and potential payments of deductibles for claims lead many to apply more salt than is needed in an effort to prevent these expenses.

In response to these challenges, the LSRCA and its partners have been conducting research to better understand best practices as they relate to parking lot maintenance, and the impacts of using various practices, to safety, to the environment, and to the bottom line.

Table 1: Friction values and related road surface conditions

Measured Friction Value (µ)	Road Surface Condition
0.80 - 1.00	Dry, New Asphalt
0.50 - 0.80	Wet Asphalt
0.30 - 0.50	Wet Sand on Ice
0.25 - 0.30	Dry Sand on Ice

Figure 1: Two extremes of LSRCA's friction testing: a perfectly clear and dry surface, with a µ value of 0.9 (left image) and the same surface covered in a light layer of snow, with a µ of only 0.11 (right image).



Parking Lot Friction Testing

Two of the main considerations contractors face in maintaining parking lots in winter are: what application rate should be used; and what is the level of service expected by the client, for which the bare pavement return time is a common measure. In order to better understand these questions; in 2017 the LSRCA obtained a friction tester, with a goal of quantifying the effectiveness of various practices and salt application rates. Here we present some of the findings of this study.

As can be seen in the inset table, the unit for measuring friction is 'µ', and the closer to 1.00 the µ value, the safer the surface, although a high µ is not the only measure of safety – many smooth indoor floors will have low µ values, in the range of 0.3 to 0.4, and they are generally not considered unsafe. Through this study, we measured the friction of a number of different surfaces, which received varying treatments.

High volumes of salt are often applied because contractors, the property managers hiring them, and/or the general public feels that the more salt there is, the safer the surface is. Figure 2, however, demonstrates empirically that a properly treated surface in the photo on the left, which is slightly wet with a small amount of salt residue (µ =0.63) is actually far safer than the photo on the right where the salt has been heavily applied (µ =0.26).

Figure 2: Friction values for a properly treated surface μ =0.63 (left image) and an oversalted surface μ =0.26 (right image)

Through this work, LSRCA staff were also able to demonstrate that while excessively high volumes of salt are no safer than many untreated surfaces, the μ value of a surface may still remain low if it has only been shoveled or plowed. Figure 3 displays a walkway where more than 10 times the generally recommended amount of salt was applied in the photo on the left, and only shoveling was done in the photo on the right, and both μ values were in the low 0.20s. This demonstrates that while shoveling is an important part of the winter maintenance process, practitioners need to consider the site and predicted conditions on the day to determine how to attain the safest surface. In many cases the sun or traffic may melt the residual snow on a shoveled or plowed surface without any further treatment being necessary; while in other cases, some salt, applied at an appropriate rate, may be necessary.

This work highlights the importance of considering all factors, including vehicle use, and current and anticipated weather, to ensure that the management of the parking lot does not contribute to collisions. Pavement treated with an appropriate amount of salt is almost as safe as bare pavement; this should remain the goal for winter maintenance contractors.

Figure 3: Similar μ values were measured for an oversalted walkway (left image), and the same walkway which has had the snow shoveled off (right image).

The bottom line - higher costs, little benefit

LSRCA's friction testing showed us that bare pavement is safest, as it has the highest friction value, and that the over-application of salt does not translate to safer conditions. The takeaway from this is that if you achieve bare pavement in a reasonable amount of time with little to no residual salt, you applied the right amount.

The question is now 'what is a reasonable amount of time?' Depending on the operating hours of the property being maintained, it may be possible to reduce the salt application rate without sacrificing the desired level of service. For example, many commercial properties keep hours between 9:00 am and 9:00 pm, which would mean that the lot doesn't need to be clear until shortly before 9:00 am. The table below demonstrates the time it would take to reach bare pavement at typical industry-recommended application rates, in a situation where the temperature is between -7 and -9 °C, with between 0.5 and 1.5 cm of snow on the ground. The rate may need to be increased or decreased slightly to achieve the desired level of service depending on traffic, sunlight, type of snow, or pavement type.

Table 2: Time to reach bare pavement under two different salt application scenarios

Time to bare pavement (hrs)	Application Rate (g/m^2)	Volume of salt used for each application (kg)*	Total salt applied per season** (tonnes)	Cost savings per season (assuming $100/tonne)
2	87	13,050	913	$30,400
3	58	8,700	609	

* Assuming lot size of 15 ha (the approximate size of an LSRCA study lot)

** Assuming 70 applications

Table 2 demonstrates that significant salt and cost savings could be seen in a typical big box store parking lot by simply reducing the application rate and extending the time to bare pavement by one hour; and this is only the material cost of the salt (which, notably, has been higher than $100/tonne in recent years). Over-application of salt has been noted to cause significant damage to parking lot infrastructure, including issues with concrete, corrosion of railings, damage to landscaping materials, and damage to flooring. Recent estimates put this infrastructure damage, as well as that to vehicles, roads, and bridges, at $1000-$5000/tonne of salt applied (Minnesota Pollution Control Agency, 2014). Reducing the application rate would decrease the rate at which this damage occurs, reducing the amount needed to repair or replace property each year, without sacrificing the safety of parking lot users. Using our study lot above as an example; this would mean over $900,000 in damage each year if the higher rate was applied, at the low end of the cost estimates, and only $600,000 if the lower rate was used.

Salt management plans are another important tool in reducing salt application in parking lots. Simple decisions like dividing the parking lots into zones based on use and traffic, or seasonal closures of certain sections can result in significant cost and material savings.

The implementation of all or a combination of these tools can go a long way toward achieving the goals of winter maintenance: maintaining public safety at a lower cost, while minimizing impacts to the environment. For more information, please go to https://sustainabletechnologies.ca/home/urban-runoff-green-infrastructure/pollution-prevention/road-salt-management/ https://www.lsrca.on.ca/watershed-health/salt.

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