Lake Simcoe Region conservation authority

Sand versus Salt

Should sand be used for winter maintenance?

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Sand as an alternative to salt

Road and property managers are tasked with keeping surfaces including roads, parking lots, and sidewalks clear of snow and ice in the winter months to ensure public safety. This is most often accomplished through plowing and the use of either salt or sand, or some mixture of the two.

High levels of chloride, one of the main components of winter salt, however, have been identified as an issue across northeastern North America, and the Lake Simcoe watershed is no exception. The main source of this chloride is winter salt. Property managers often turn to sand as an alternative to salt, as it is thought to be a less harmful option.

This technical bulletin will explore the efficacy of the use of sand for winter maintenance, its associated environmental issues, and where its use is most appropriate.

Why is sand used?

Sand has been used, either on its own or mixed with salt, as a core part of many municipalities'/property managers' winter maintenance practices. It is used to increase friction between snowy or icy pavement and the vehicles passing over it.

Of those municipalities that use sand, rural ones with a higher proportion of gravel roads use almost exclusively sand (with a small percentage of salt mixed in to prevent freezing and caking), while other municipalities often use a sand-salt mix at various ratios.

The common thinking is that the salt in the mixture will melt the snow or ice, while the sand will provide traction. In addition, traditional rock salt is only effective at temperatures above -7°C, so sand is commonly used to provide traction and make roads safer at colder temperatures.

Plowed rural road with sand cover

The issues with using sand

Many jurisdictions have recently been evaluating their winter maintenance programs to ensure that they are achieving optimal results in terms of public safety, and that they are cost effective. Many have found that in terms of effectiveness in improving road safety, and particularly from a cost perspective, sand is not seen to be a viable option when it comes to winter maintenance. And while salt is seen to have more of an environmental impact, there are also environmental issues associated with the use of sand. A number of the findings from these evaluations are highlighted on the next page.

Limited effectiveness

Several studies and municipal evaluations have found sand to be relatively ineffective, with minimal improvement in friction, and only under certain conditions. One of the main issues is that much of the sand applied blows off the road within relatively few (e.g. 8-12) vehicle passes at speeds over 40 km/hr; rendering any improvement in friction temporary.

An Iowa study found that practices including pre-wetting of the sand at the spinner, can help the sand adhere to the road, but there is still no further improvement in friction, and it is not known how long the sand will stick to the road.

As a final note, studies have noted that the effectiveness of sand in creating traction is reduced due to the melting action of the salt (rather than becoming embedded in the snow, the sand becomes part of a slushy mixture), calling into question the utility of sand-salt mixes that many jurisdictions use because they think that they're getting benefits from both.

Sand accumulates on the side of the road

Additional costs

To achieve any improvement in friction, sand must be applied at a high rate (3-7 times the application rate of salt). This means only short routes can be treated before refilling is required, resulting in additional driver time spent on trips to the storage yard, increased fuel consumption, and extra wear and tear on vehicles.

These additional costs are over and above the relatively higher cost of sand compared with traditional salt . And the sand that has been applied either stays on the road, requiring clean up in the spring (discussed in the next section), or it ends up in stormwater infrastructure, watercourses, and wetlands. Municipalities must then incur the additional effort and cost of sweeping up this material at the end of the season to reduce the environmental impacts. While some are able to recycle some or all of the material that is swept up, many cannot. And in recent years, many jurisdictions have found that, due to contamination of the sand, disposal is becoming a more complicated, and hence costly, process.

Life cycle costs of sand

A recent LSRCA study (2013/14) looked at the full life cycle costs of including sand in a winter maintenance program above and beyond those associated with salt.

- Street sweeping and catch basin clean out costs $37/tonne = $1,511,820 annually
- Cost of removal from stormwater ponds at $150/m^3 = $3.5 million
- The application rate is typically >3x the rate of salt, resulting in fuel and labour cost increases

Environmental impacts

Once applied, sand makes its way into stormwater infrastructure, watercourses, and wetlands. This large annual influx of sand into stormwater infrastructure may mean more frequent catchbasin cleanouts, at significant cost to the municipalities. A recent LSRCA study showed that catch basins in sanded areas need to be cleaned out every two years at a minimum (annual cleanouts are often required).

Stormwater ponds may need additional cleanouts to ensure that they continue to function properly. In watercourses, the sand can impact water quality, and can also affect aquatic habitat by blanketing the substrates used by fish and aquatic insects to carry out their life processes.

Another consideration is that, depending on the amount of salt in the mix, the overall volume of salt applied may be higher when a sand-salt mix is used than it would be for straight salt, due to the high application rate.

Sand build up in the Tannery Creek (Newmarket, ON)

When is it appropriate to use sand?

Given the concerns highlighted above, a number of municipalities have moved to using only salt or treated salt, at least in their urban areas. Some have found that the amount of salt used has not increased substantially, both because of its effectiveness, and that they have adopted practices to maximize its effectiveness. There are, however, some situations where the continued use of sand is appropriate, and should be encouraged.

In areas where groundwater is vulnerable

Due to its highly soluble nature, salt can be transported quickly into a groundwater system, particularly if that system is in a vulnerable aquifer. This can be of particular concern where the aquifer is used as a drinking water source. In areas such as these, it is advisable to minimize salt use and implement practices that focus on using plowing and sanding to maintain safe conditions. Snow-packed surfaces, rather than bare pavement, are often the standard in less travelled (i.e. residential) areas that are vulnerable to high chloride concentrations; with friction being provided by sand. Salt may still be used, but it is used much more strategically – for example, only on curves and hills; or anti-icing is undertaken to prevent snow or ice from bonding to the pavement, reducing the amount of salt needed as the storm progresses.

In rural areas

Because salt is not appropriate for use on gravel roads, municipalities with a high proportion of gravel roads will often use sand for their winter maintenance. Typical conditions in these areas are snow-packed surfaces, with sand used for traction.

In extreme cold

In temperatures below the lowest effective temperature of salt, sand could be used as an option for providing traction.

For low-speed applications (sidewalks, parking lots)

The risk of sand being blown off of a sidewalk or parking lot is low due to the low speed or absence of vehicle traffic, which makes it a good option for providing traction following plowing.

What's happening in the Lake Simcoe watershed?

A number of municipalities are re-evaluating their winter maintenance programs, with several concluding that sand is not a viable part of their program, or that its role should be limited to specific conditions (e.g. when it is too cold to use salt, or in freezing rain) or applications (e.g. sidewalks).

Winter Maintenance Materials used by Lake Simcoe Watershed Municipalities

Materials	Sand	Sand & Salt	Straight Salt	Brine
Number of Municipalities+	5*	5	10	3

+ Municipalities are counted in more than one category if different materials are used in different areas/conditions

* Two of these only used sand when it is too cold for salt, or for freezing rain or heavy snow

In a survey recently conducted by the LSRCA, 13 Lake Simcoe watershed municipalities discussed their programs. Of these 13, nine are using salt or treated salt only, or have moved forward with this change in specific areas (e.g. salt in urban areas).

Many are experimenting with various ratios of sand, salt, and treated salt, and are finding that having sand in the mix reduces the effectiveness of the practices, and significantly adds to the cost of the program when the indirect costs discussed above are factored in.

As noted, a number of municipalities have made the switch from using sand or a sand-salt mix to straight salt or treated salt. Most have found that the materials put down are much more effective at removing snow and ice than the use of sand.

The Town of Aurora costed out the switch from sand to salt and estimated that the number of trips to the storage dome would be reduced by close to 50% with a switch to straight salt. With the switch to straight salt, the materials costs were anticipated to increase; this, however, would be more than offset by the savings in street sweeping costs, and the cost of materials disposal. Since making the switch they have seen an 80% reduction in street sweeping, and catch basins now only require cleanouts every four years at most, rather than every year. They are also observing a reduction in the amount of sediment in stormwater management ponds.

The Town of East Gwillimbury has found that by converting seven out of their nine routes from a sand/salt mix to Thawrox (the remaining two routes are rural, and a sand-salt mix is used), they have significantly reduced the amount of effort and materials required to treat their roads. They are hoping to achieve further reductions through the use of direct liquid application and by continuing to adjust their application rates. Further, their street sweeping costs have been reduced by approximately 50%.

The City of Mississauga also conducted an evaluation to their program, with a view to reducing the impact of salt and spring clean-up costs, and opted to omit sand – both due to its lack of effectiveness and the extraneous costs of using it. In making the switch, they found that the amount of salt used is generally less, or equal to what they were using before. This is, in part, because the sand/salt mix being used contained 15-20% salt, and required application rates that were four times the application rate for salt only. The switch to salt has therefore reduced the impact to the environment, and has resulted in significant savings in street sweeping and materials disposal.

Conclusions: What should be used?

Each winter management agency will have its own unique needs and limitations, and will need to review their programs in light of these. The aim of this bulletin is to provide some additional information to help agencies when they review their programs, to ensure that they are providing services that are effective in terms of maintaining safe surfaces, cost-effective, and conscious of their potential environmental impacts.

1. The Use of Abrasives in Winter Maintenance – Final Report of Project TR 434. Iowa Institute of Hydraulic Research, 2001

For further information or assistance please contact Lake Simcoe Region Conservation Authority at info@LSRCA.on.ca or 905-895-1281.

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Conservation ONTARIO Natural Champions

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