A Survey of Current State of Practice for Winter Maintenance of Parking Lots and Sidewalks

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ABSTRACT:

This paper describes results from an online survey conducted to investigate and document the current state of practice concerning various aspects of winter maintenance of parking lots and sidewalks within the province of Ontario, Canada. In particular, the use of different materials, maintenance strategies, latest equipment and hurdles to sustainability were explored. The online survey included a total of 30 questions specifically addressing application rates, materials, types of equipment and preferences towards various maintenance strategies.

The information obtained from this research represents a unique compilation of the current standard of practice as described by actual field practitioners in the form of answers to carefully designed questions. From a research perspective, the results from the survey are very useful in explaining material usage patterns and exploring potential areas for improvement. Practitioners in the field can compare their practices to those presented in the survey while equipment and material manufacturers can use the results to improve their products and better serve the need of the industry.

INTRODUCTION

Considerable past efforts have been devoted to the development and advancement of snow and ice control methods, products, and technologies for improved transportation safety and mobility. However, most of the past efforts have focused on roadway maintenance with little research towards parking lots and sidewalks although the latter represents an important component of the overall transportation system and takes a significant share of resources consumed. There are few defendable and uniform guidelines on what snow and ice control methods, materials, and application rates should be adopted for these facilities. The few available guidelines are either short of recommending application rates (Environment Canada, 2004) or derived rates straight from those for roads which often have drastically different functional requirements and environmental conditions. To fill this need, a multi-year research study (Fu, 2012) aimed at development of guidelines for snow and ice control of parking lots and sidewalks is currently underway at the University of Waterloo (Ontario, Canada).

As part of this research project, a survey was conducted to investigate and document the current state of practice in regards to winter maintenance of parking lots and sidewalks with the eventual goal of using this information to develop guidelines that are easy to adopt and address common issues faced by field practitioners. The survey answers various important questions such as how much salt goes down per application and the various factors that govern the application rate. Moreover, the survey provides insight into the general trends in adoption of new technologies (e.g. salters with ground speed compensation) as well as materials (e.g. organic materials) and strategies (e.g. use of liquids, pre-wetting of salt). Furthermore, the survey covers various aspects of sustainability and the different reasons that lead to over application of material.

The online survey consists of a combination of 30 open and close ended questions. There are five questions related to the company information of the respondent and will not be discussed to preserve anonymity. Throughout the survey, care was taken to include all common metric and imperial units (where applicable) to reduce potential unit conversion errors by the respondents. The survey was sent out via email by Landscape Ontario (an Ontario based association representing over 2000 horticultural professionals such as landscape, maintenance and snow management contractors, and landscape designers) to more than 600 member practitioners. Overall, the survey was well answered in terms of response rate and quality of responses. More than 100 complete responses were received. On average, a respondent took fifteen minutes to answer the survey indicating that questions and answer choices were carefully read before responding. The high quality of responses is further validated by the fact that many respondents frequently used the open ended option at end of question to further comment on their response. In terms of timing, the survey was sent to the contractors at the start of April 2012 which is the tail end of winter in Ontario. After analysing the responses it was seen that many of the issues and experiences were still fresh in the mind of the respondents and thus were able to elaborate on them in details.

DESCRIPTION OF RESULTS

The following sections describe the results from the survey. Open-ended answers have been manually processed and categorized according to the nature of the question with irrelevant responses filtered out.

Respondent Characteristics

Responses were received from maintenance contractors based in different regions of Ontario (

Figure **1**). This section describes the nature of respondents to show that the surveyed sample was unbiased with good representation from the different types of contractors that are present within the industry.

Approximately 85% of the received responses came from the Central and Western Regions where winters are typically mild where as 15% of the responses came from the Eastern and Southern Regions with colder winters.

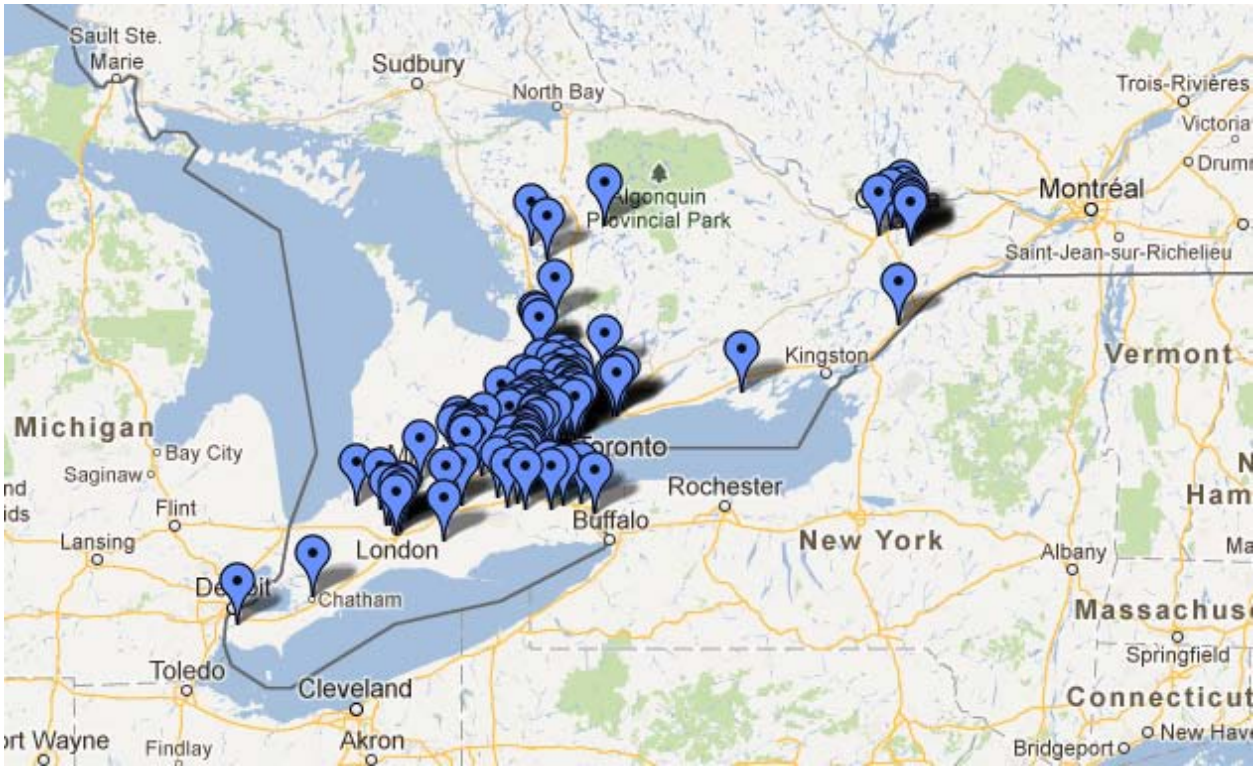

Figure 1: Geographical location of Respondents

To assess the respondent's size of business, the survey asked about the overall salt usage, the number of properties serviced and the total number of equipment (for snow and ice control) in the winter of 2011-2012. As depicted in Figure 2, the survey covers a large spectrum of business sizes ranging from smaller contractors (using less than 100 tonnes of salt) to larger ones (using more than 500 tonnes).

To further assess the type of clientele served by each of the respondents, the survey also asked to select what category described majority of their clientele. As shown in

Figure **3**, the respondents cater to a broad range of clientele with significant representation from large commercial clients, smaller commercial clients and residential clients.

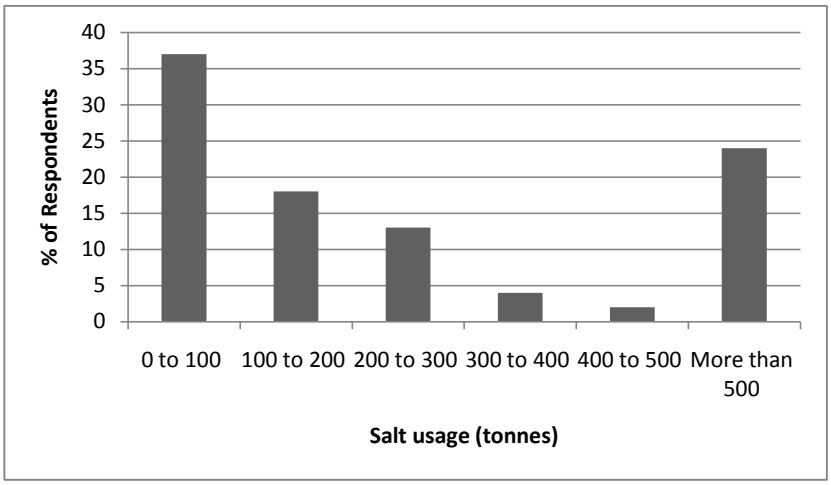

Figure 2: Distribution of Contractors by Salt usage

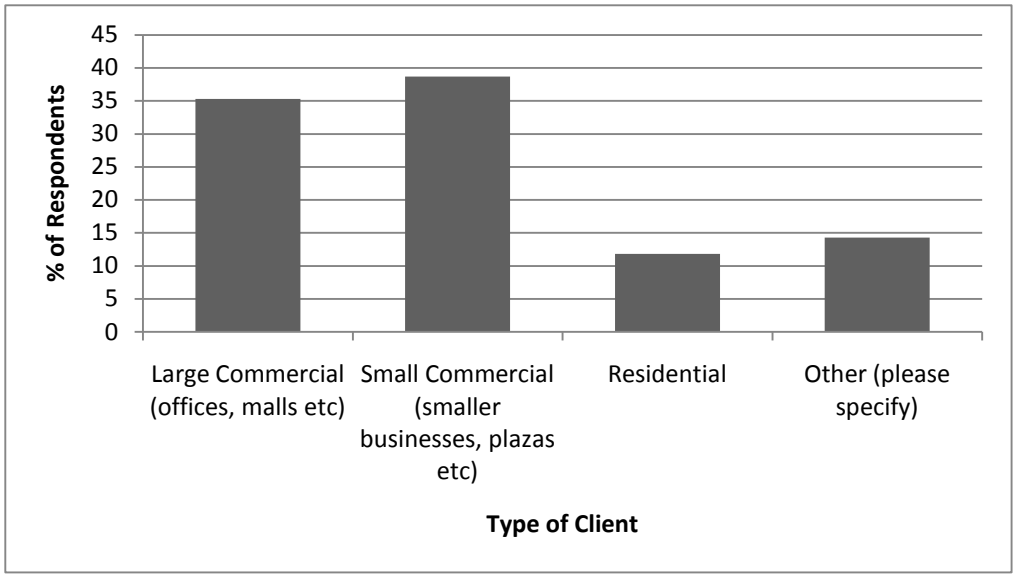

Figure 3: Distribution of Contractors by Client type

Contract Preferences

For winter maintenance of properties, there are three popular contract types, namely 'Salt Inclusive' (salt is included in contract regardless of the amount used), 'Salt Extra' (salt used is charged to client) and 'Mix' (a defined amount of salt is included whereas any salt on top is charged to client). The survey asked respondents to choose what types of contracts they would generally prefer with the three choices to choose from. Salt extra contracts were most popular (61%), followed by Salt Inclusive (24%), and lastly Mix contracts (15%). Individual responses were combined with the type of clientele served by each contractor (a previous question). The results are presented in Figure 4, where it can be seen that preference for the three types of contracts remains similar across the different types of clients.

In a similar question, respondents were asked about the proportion of their contracts that were 'Salt Extra' and 'Salt Inclusive'. Responses show that 51% of current contracts are Salt Extra, where as 45% are salt inclusive.

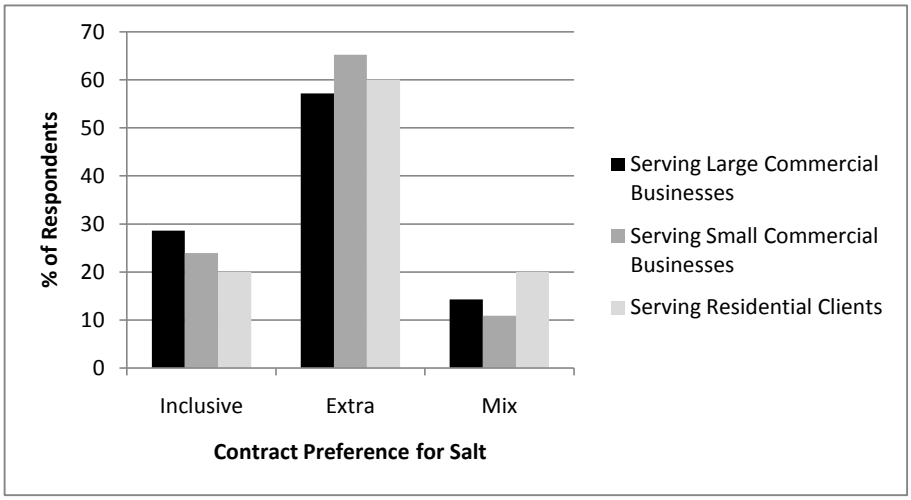

Figure 4: Contract preference for contractors serving different type of clinets

Level of service requirements

The amount of resources needed to maintain properties during the winter largely depends on the LOS (Level of Service) to be met. LOS ranges from the highest, being bare 24/7, to the lowest, being service on demand. The respondents were asked about the LOS required by large commercial, smaller commercial and residential clients. As expected, the highest LOS (bare 24/7) was most popular with large commercial clients (35%), whereas the lowest LOS (service on demand) was most common amongst residential clients (45%). Overall, bare-pavement before the start of the day was the most popular LOS.

In a similar question, respondents were asked how they ensure that the required level of service is being met. Majority (80%) relied on regular patrolling of sites as their primary source of information whereas some contractors (25%) also indicated relying on feedback from property

owners. A large proportion (40%) of respondents also indicated on-site video cameras to be a very useful tool for monitoring site conditions; however high cost of the systems was expressed as a major concern.

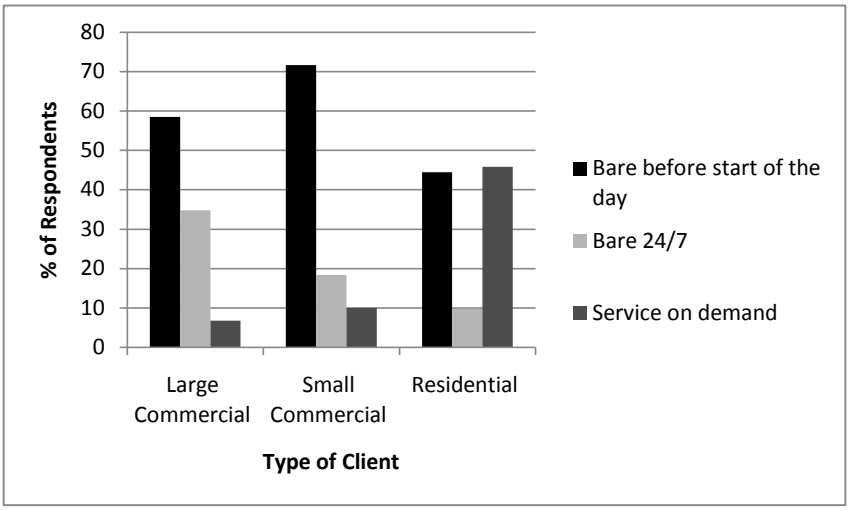

Figure 5: LOS requirements by different type of clients

Maintenance methods

Respondents were asked about the maintenance methods that had been applied to their business (

Figure **6**). As expected, majority of the contractors used a combination of plowing (97%) and regular dry salt (85%). However, interestingly,31% of the contractors indicated that they had used salt-sand mix (commonly referred to as pickled mix). Individual responses that indicated using salt-sand mix were analyzed for correlation between the use of this material and their geographical regions (experiencing colder temperatures where regular salt ceases to work); however, it was found that the salt-sand mix was equally popular in all regions.

Moreover, only 25% of the contractors indicated the use of pre-wetted salt as one of their maintenance materials where as only 15% indicated using DLA (Direct Liquid Application). This trend was further validated in another question where the respondents were asked about the number of trucks that are capable of DLA and pre-wetting of salt. Results are shown in Figure 7, which indicates that nearly 70% of the contractors do not own any equipment capable of pre-wetting or DLA.

Materials

In another question, respondents were asked about the types of snow and ice control materials being used by their company. As shown in Figure 8, nearly 45% of the contractors use treated salt which is salt combined with other additives. Treated salt usually comes pre-packaged under different commercial names, of which the exact constituents of the material are often not known.

Magnesium Chloride was another popular choice with 25% of the contractors having used this product.

Only a small number of respondents reported the use of organic (corn syrup or beet juice based) materials. This trend is further validated by responses to another question where the respondents were asked if alternative materials (corn syrup/beet juice based products) can be used to reduce maintenance cost (Figure 9). Only 15% of the respondents believed that the use of alternative materials could reduce maintenance cost while 26% replied 'No' and another 46% were not sure. The open ended option 'Others' was also available where the respondents manually entered the materials that they used. 14% of the respondents used this option to provide their comments in words. Amongst the open ended responses, a majority complained that few research results were available on the relative performance of these products.

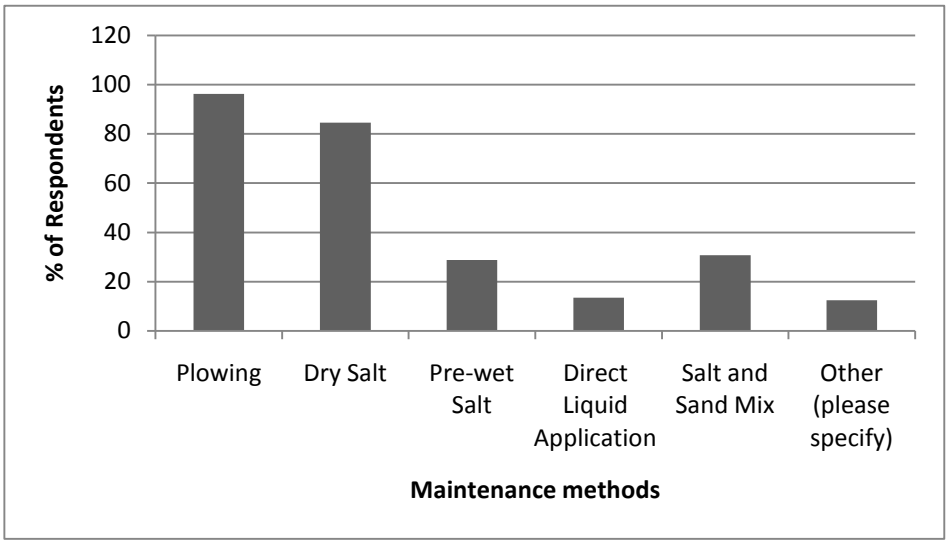

Figure 6: Maintenance methods selected by contractors

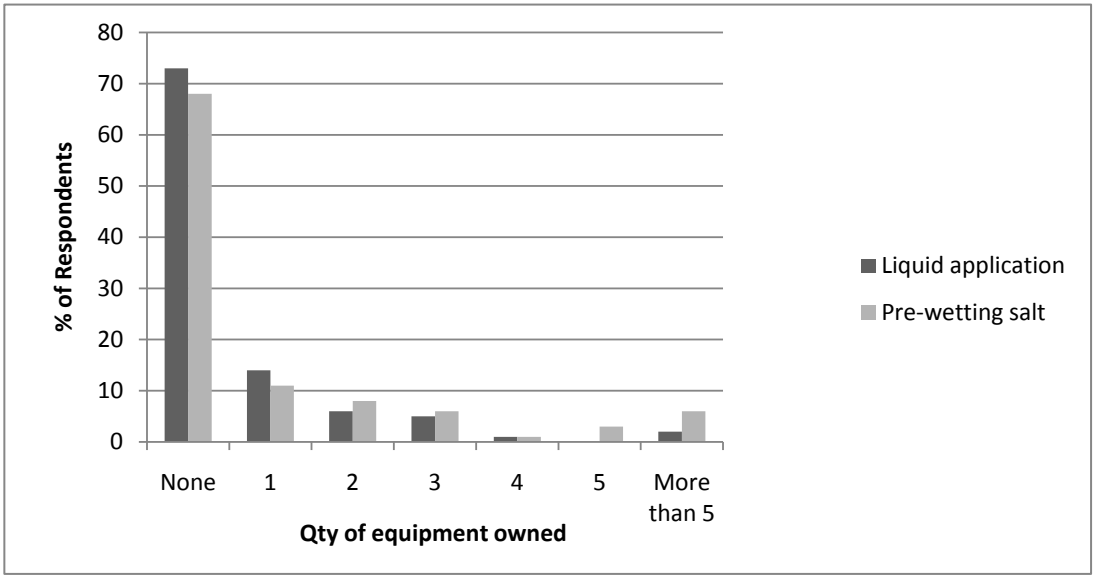

Figure 7: Contractors with pre-wet and DLA capable equipment

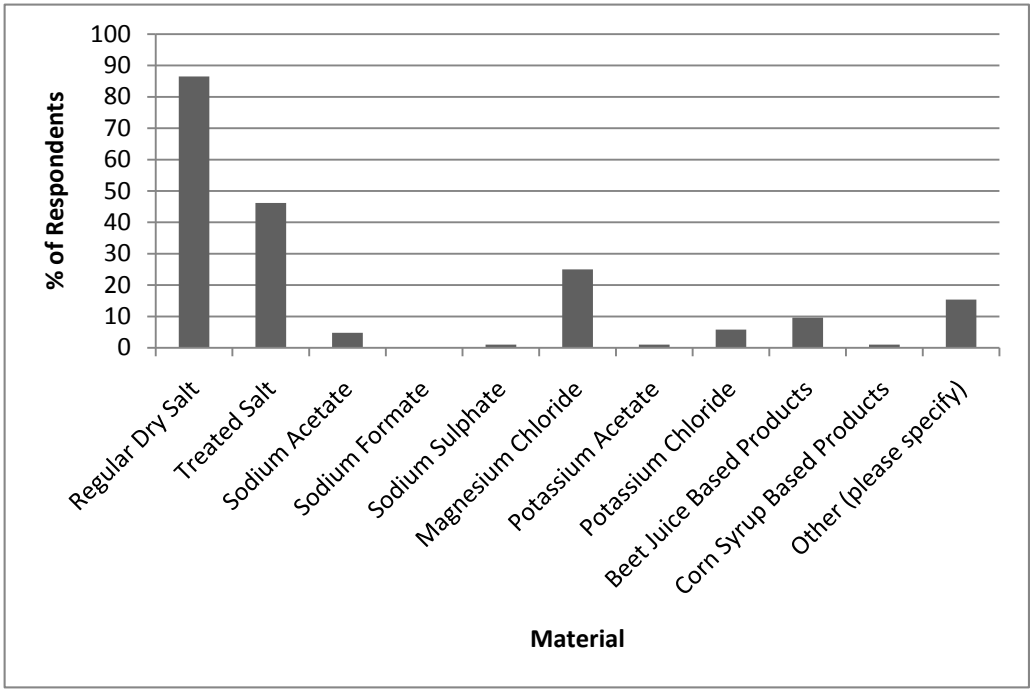

Figure 8: Use of snow and ice control Materials

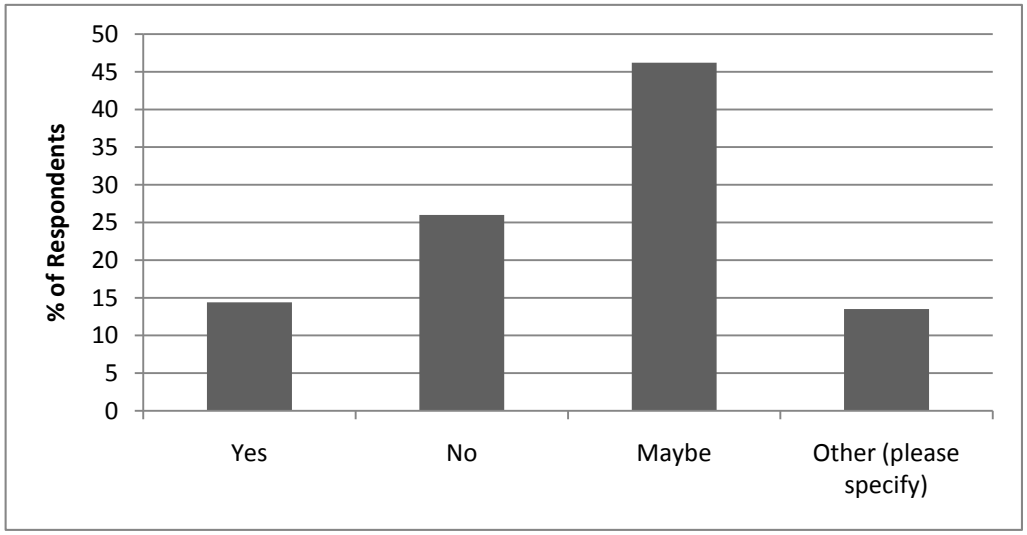

Figure 9: If alternative Materials can be useful

Application rates

In another set of questions, respondents were asked the typical values for low, medium and high application rates for salt that would normally be applied. Unlike most other questions on the survey, these questions were only answered by 75% of the respondents indicating that a number of respondents were unsure of the amount of material that were put down in every application. In order to ease the selection process and eliminate errors that could occur due to unit conversion, the rate ranges were provided in eight different commonly used units. Out of all the units, tonnes/acre and lbs/1000 feet^2 were more popular, which were used by nearly 70% of the respondents. The application rates are summarized in Figure 10 and Table 1.

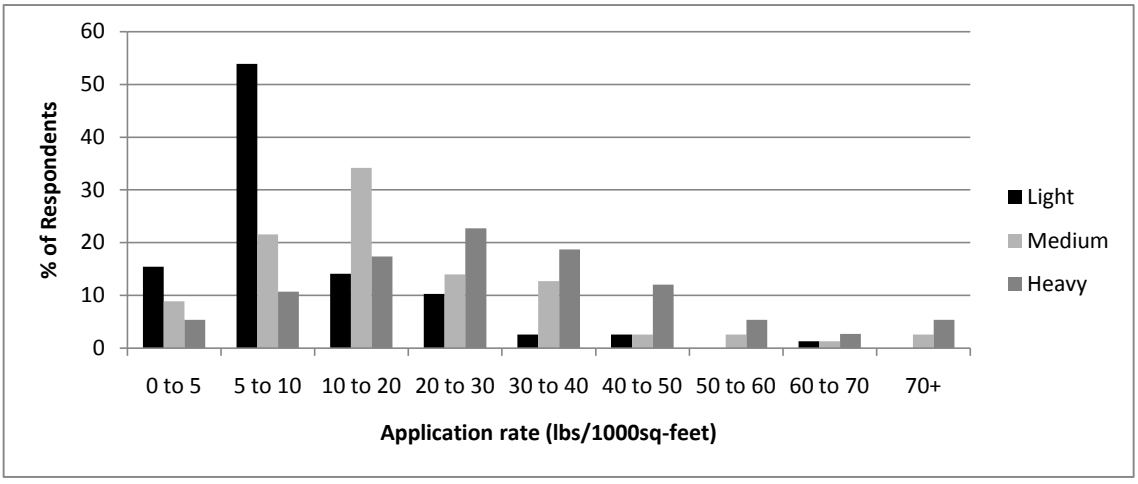

Figure 10: Application rates (lbs/1000sq-feet)

Table 1: Summary of statistics for application rates

	Mean	Mode	Standard Deviation
	lbs/1000sq-feet		
Low	11.9	5 to 10	10.5
Medium	20.0	10 to 20	15.5
Heavy	29.6	20 to 30	18.2

In a following question, respondents were asked how they calculate the application rates. From the results shown in Figure 11, it is evident that majority of the contractors only estimate their application rates either based on truck or hopper loads or using the amount of salt purchased during the season whereas only 25% of the contractors use scales or automated rate controllers to measure the amount of salt being put down at specific sites. In a similar question, respondents were asked about how they calculate site areas. More than 50% of the responses indicated that they either do not calculate site areas or do so based on rough measurements. Only 20% of respondents calculate site areas based on actual field measurements.

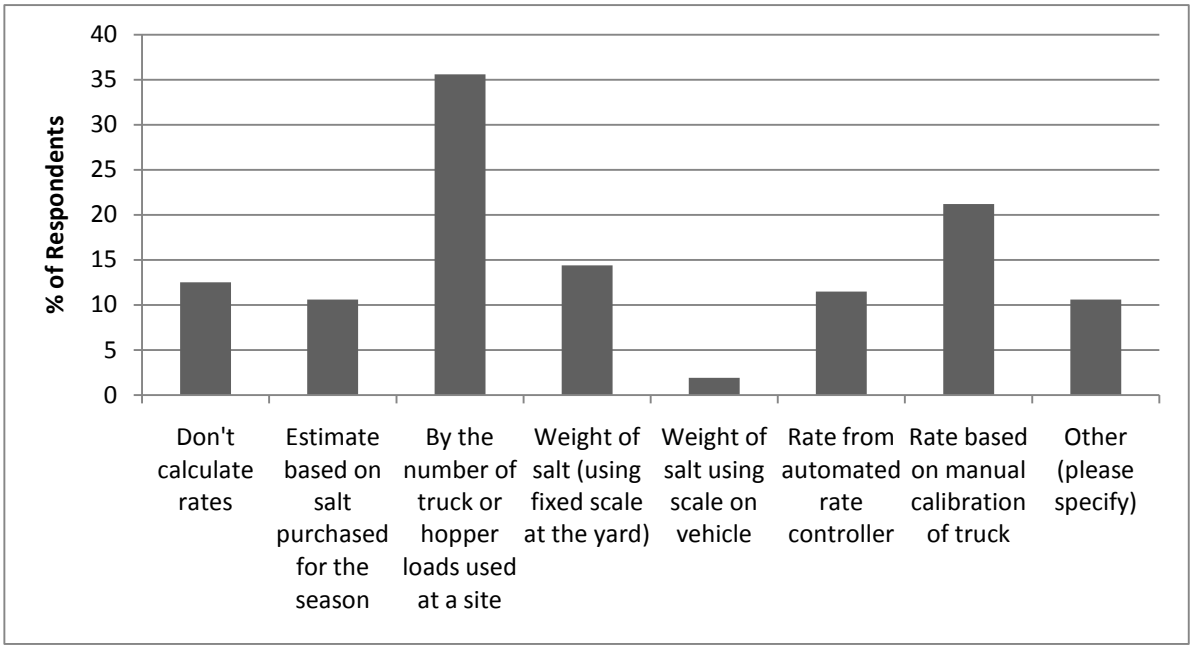

Figure 11: How Application Rates are calculated

Use of Technology

The survey asked about experience with a variety of new technologies available to aid in winter maintenance. For automated salt rate controllers, 28% of the respondents claimed to have used

them and liked the results whereas a large number of respondents either didn't know about the technology or did not want to use it.

Contractors were asked of their opinion on the usefulness of Infra-red (IR) thermometers and how frequently they were used on a regular basis. Despite their low cost and ease of use, IR thermometers were only used and recommended by 37% of the respondents while 50% thought that the technology was either not useful or was hard to adapt to.

GPS (Global Positioning Systems) were used and recommended by 40% of the respondents where majority believed them to be useful only in some situations. From responses in open-ended fields it could be observed that GPS is useful in providing proof of presence or due diligence in case of litigations and law suits.

Environment and Sustainability

Respondents were asked about the potential saving of salt that could incur if insurance claims and litigation were not a concern. Results shown in Figure 12 indicate that more than 75% of the respondents believe that 10% or more salt could be saved. Moreover, 29% of the respondents believe that the potential salt savings could be greater than 30% if litigation and insurance were not a concern. In a similar question, respondents were asked if the fear of slip and fall cases had led to over application of salt where 80% of the respondents were in agreement.

In another question, respondents were asked about their perception of the $ worth of environmental damage caused by every $1 spent on salt. As shown in Figure 13, majority of the contractors (66%) believe that every $1 spent on salt only causes 25 cents or less in damage.

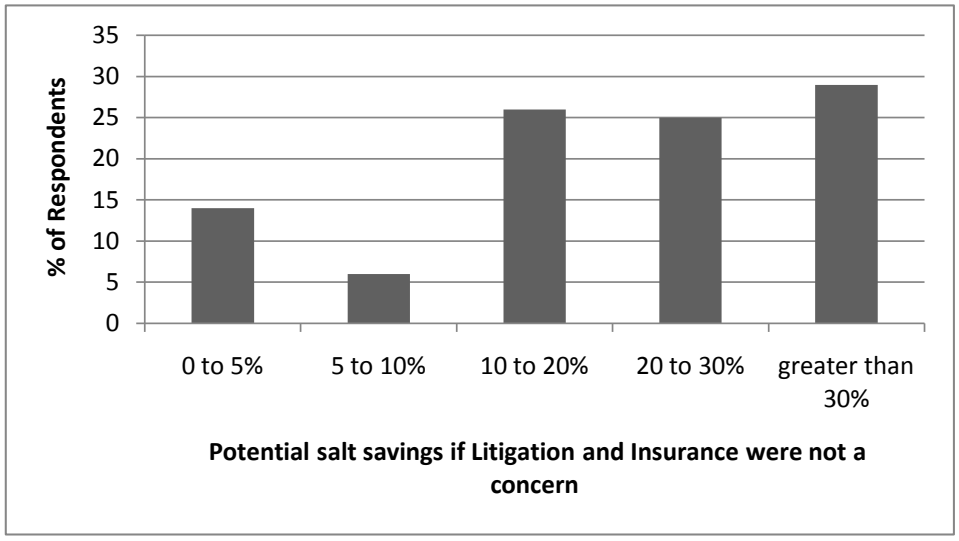

Figure 12: Potential salt savings if Litigation and Insurance were not a concern

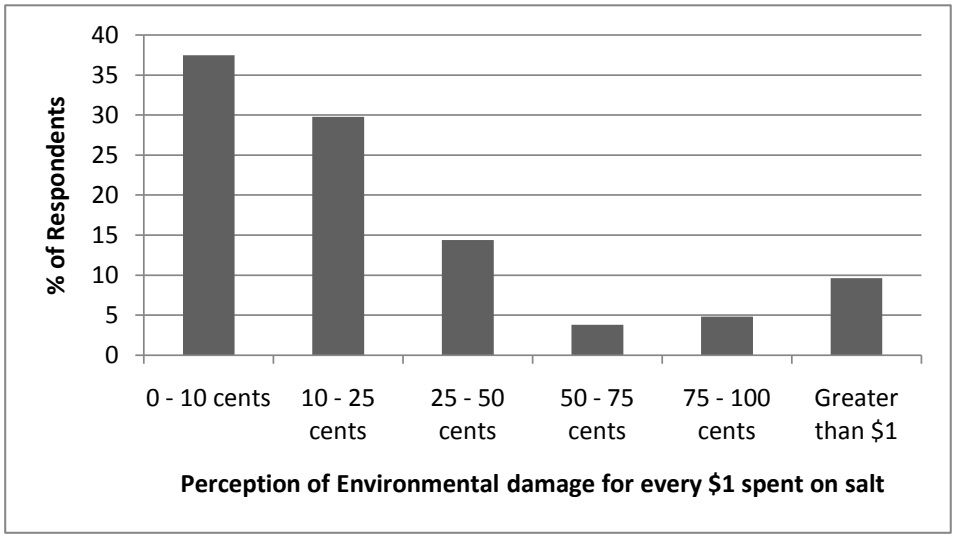

Figure 13: Environmental damage caused by every $1 spent on salt

CONCLUSIONS

This survey collects and documents information on various aspects of parking lot winter maintenance from the field practitioner's perspective. A number of important trends have been observed that will not only be useful in developing maintenance guidelines that are more practical but can also help improve the overall efficiency of the industry. The main findings are summarized as follows:

- Majority of the contractors (60%) prefer to have 'Salt Extra' contracts and this preference remains similar across contractors serving different types of clients. Moreover, with current proportion of 'Salt Extra' contracts at 51%, it can be inferred that more of these contracts will be seen in future. Given the limited guidelines and references available for this industry along with no incentive to save salt (as it is paid for by the client), it can be further inferred that the industry is currently heading towards a business environment that is prone to over application of salt.

- Regardless of their geographical location, a significant percent of contractors (31%) indicated using salt and sand mix. Despite its proven ineffectiveness under a number of conditions (Levelton Consultants, 2007), salt and sand mix continues to be a popular choice and thus warranting further research towards evaluating its effectiveness for parking lots and sidewalks.

- Despite their proven effectiveness under certain conditions (NCHRP, 2004), only a small proportion of contractors indicated that they have used pre-wet salt or DLA (25% and 15% respectively) for parking lot maintenance. While high initial cost is one of the major hurdles in adapting to new methods and technologies, another reason for the low

adoption rate is the lack of formal studies and guidelines that explain the correct use and potential savings for parking lots and sidewalks.

- The reported application rates have a large standard deviation, indicating that maintenance contractors are unsure of the amount of material that is needed for given conditions. It is also learned that more than 70% of the contractors currently do not have any equipment that can be used to accurately measure the amount of salt being used at different locations. Hence, if snow and ice control guidelines were to be prepared for use by field practitioners, this deficiency will have to be kept under consideration.

- From a sustainability perspective, majority of the contractors reported to over apply salt to avoid slip and falls, which often lead to litigations and increases in insurance premiums. Given the relatively low price of salt, minimal penalties for over application, and majority of contracts being 'Salt Extra', it can be inferred that this trend for over application of salt will continue. A large proportion of the respondents (75%) believe that 10% or more salt could be saved if litigations and insurance premiums were not a concern.

ACKNOWLEDGEMENTS

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