Managing Salt Impacted Water at Maintenance Yards

Presented to the:

Transportation Association of Canada

Calgary

2005

ecoplans Limited

Abstract

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The Code of Practice for the Environmental Management of Road Salt recommends that Best Management Practices be developed that target three objectives. One of the identified objectives is improved salt storage and associated salt handling practices with the goal of reducing salt impacts to the surrounding environment. Salt impacts to the environment from a patrol yard can result from the release of dry (bulk) salt, a spill of liquid (brine) material and the poor management of salt impacted washwater and stormwater. A number of options are available to improve the management of salt and reduce its impact on the environment.

Improving the management of dry (bulk) salt and liquid (brine) materials generally yields good results. This involves providing training, implementing good housekeeping practices, storing and handling all salt under cover and ensuring all material is contained and secure. The management of washwater and stormwater generated at patrol yards is generally a longer-term initiative and can involve a significant investment.

The focus of this paper is to discuss the various site mitigation design alternatives that can be applied at maintenance yards to effectively manage salt impacted water and thus minimize and manage any salt releases to the environment. The goal of reducing salt impacts to the environment will only be met if both short and long-term options are implemented to manage the dry and liquid material sources and the washwater and stormwater streams.

Paper

Managing Salt Impacted Water at Maintenance Yards

Introduction

The Code of Practice for the Environmental Management of Road Salt issued by Environment Canada, recommends that Best Management Practices be developed that target three objectives[1];

- *Improved Salt Storage and Handling;*
- *Effective Snow Disposal;* and
- *Optimized Salt Application.*

All three objectives have the common goal of reducing salt impacts to the surrounding environment. This paper will focus on the first of the three objectives: *Improving Salt Storage and Handling Practices.*

Salt is typically stored and handled at maintenance, patrol or operational yards and they become a potential source for salt contamination. The yards should therefore, be the focus of improvement efforts.

At the yards, salt related impacts to the environment can result from:

- *an uncontrolled release of dry (bulk) salt*;
- *a spill of liquid (brine) material*; and
- *the poor management of salt impacted washwater* and *stormwater*.

Salt, carried in water, is the primary pathway by which salt enters the environment from a yard. Proper planning for and managing of the salt impacted water at the yards should provide the most significant benefit in reducing salt related impacts. Remember, an accidental release or spill of material (either liquid or dry) is never planned; but the potential for a spill can be planned for and managed.

Salt, once dissolved in water, can not easily be removed due to its very high solubility. Evaporation is one of the few natural processes that can remove significant amounts of salt from water. In the absence of evaporation or a desalination plant, chlorides will stay in, and move with, the water. This is true for both surface water and groundwater.

The three R's (Reduce, Reuse/Recycle and Release) can be applied to properly plan for and manage salt impacted water. There is considerable concern as to how to effectively manage salt impacted water. The solubility of chlorides makes it difficult to contain and remove this element.

This paper discusses specific aspects of the 3-R approach to managing salt impacted water.

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[1]/ Code of Practice for the Environmental Management of Road Salt; Section 12; sub-sections a, b & c

Reduce

Reduce has two components. Reduction of the volume of salt impacted water at a yard and reduction of the salt concentration in the impacted water. Both are important and improvements focusing on them should be near the top of the implementation priority list.

Some simple and relatively inexpensive measures can be implemented that will yield significant reductions in the concentration of salt in the impacted water. **Improved good housekeeping practices** can be implemented quickly and at a relatively low cost at most yards. These include:

- quickly cleaning up any bulk solid salt spilled and returning it to the stockpile;
- sweeping, blowing and shaking loose solid salt off vehicles before washing;
- patching roof holes in salt storage facilities;
- covering the openings to salt storage areas;
- not allowing water to pond near the stockpiles; and
- not overloading the trucks or the loader buckets.

These measures, while quickly implemented and relatively inexpensive, do not generally have a huge impact in the volume of water to be managed, but will reduce the concentration of salt in the water.

Other measures can significantly reduce the amount of salt impacted water:

- separation of "clean" stormwater (roofs, etc.) from salt impacted water (salt storage and handling areas);
- separation of the washwater from the maintenance bay area water;
- treat most drainage water during the summer as "clean" stormwater;
- provide secondary containment around any brine storage tanks and brine transfer areas to contain spills;
- cover the stockpiles and ensure they are on impermeable pads; and
- load and unload salt undercover and on an impermeable pad.

These measures can have a significant impact on the volume of salt impacted water to be managed, however, they tend to have a longer implementation period and require capital or infrastructure improvement money.

Collecting and Reusing/Recycling

Once you have reduced as much as you can; now what to do with the water you do have? The "clean" drainage can be dealt with like other site runoff as stormwater. This should involve passing it through a settling pond or an oil/grit/water separator before discharging to the environment or a storm sewer. The salt impacted water however, will have to be directed to a collection point on site and managed separately.

Strategies are available that will allow the salt impacted water to be collected and managed on-site. **Directing and collecting** the salt impacted water can be as simple as doing some site grading and laying asphalt to direct and contain the flow of water. Channelization in and around the salt storage and handling area can help in directing the water to the collection area as well.

The impacted water can be directed to a cistern, holding tank or even a pond that will act as on-site storage. It is considered a best practice to add an oil/grit/water separator inline to pre-treat the water prior to storing it, even temporarily. Filtering options (while still new) are available however, they tend to be more expensive than traditional oil/grit/water separators and their cost-effectiveness has yet to be determined.

Once collected in the on-site storage area, the salt laden water can be **reused** as a source of water for the on-site production of brine. A significant number of yards, particularly rural yards on wells, have a limited supply of water for brine production and may not have sufficient volume to meet their brine production needs, even for pre-wetting. Reusing the salt laden water (and even the stormwater) may provide the yard with a sufficient volume of water to supply their brine needs.

Reusing the water in brine production will take some careful planning. The supply of water almost never matches the production need. The volume of the supply/source of water should be estimated on a monthly, or even weekly, basis for the whole year. An estimate of the requirements for brine production should also be done on a weekly, or even a twice-weekly basis, for the winter season only. On-site storage must be of sufficient capacity to handle the over supply at various times of the year, particularly late fall before winter production begins.

It may also be possible to **recycle** the water as washwater. Although little work has been done to determine the long term corrosive effects of using a low concentration brine solution as washwater to remove salt, it may be an option at rural yards where the on-site well may have a poor yield.

Collecting, Treating and Releasing

In some cases recycling/reusing the salt laden water is not an option. In other cases only a portion of the water may be able to be used. What to do with the rest of the salt laden water? **Releasing** or **discharging** the water is only one of a number of options available.

Pumping and hauling it away

Pumping the water out and having a private company haul it away for proper disposal is an option in some areas. It is generally prohibitively expensive in large volumes. It may however, prove cost effective for emergency needs or as a short term solution; say in the spring when the supply can be significantly greater then the requirements for brine production.

Evaporation

In areas with a drier climate and sunny days taking advantage of natural evaporation has proven to be a cost effective solution. Salt laden water is pumped from a collection pond or tank to the top of a sloped asphalt pad and allowed to flow in sheets down the pad. The water evaporates leaving behind a dusting of salt that can be swept up and reused in brine production or even put back into the stockpile. Controlling the pump with a photocell or even a solar panel helps ensure that the system only runs when the potential for evaporation is high enough. This option will not likely address all of the impacted water in most areas.

In some drier locations, evaporation pits can be used. This will concentrate the salt in the pit. The pit may ultimately need to be rehabilitated in the future.

Release

The remaining options involve some form of release or off-site discharge of the salt laden water. Best practices recommend that some form of pre-release treatment of the water be done to improve the quality of the water.

<u>Pre-release treatment options</u>

As stated earlier, besides evaporation or an expensive desalination or reverse osmosis system, it is difficult to remove salt from water. Pre-release treatments focus on reducing other contaminates in the water such as suspended solids, oil and grease, etc. to achieve local water quality objectives. Dilution with un-contaminated water may also be an option. The "clean" stormwater from the site could be used for this purpose.

Typical options combine storage with pre-treatment and a controllable (engineered) outlet. It is important to keep in mind that treatment usually addresses suspended solids, hydrocarbons and heavy metals. It does not generally remove the chlorides.
A number of options are available.

Ponds
Ponds are one method available and allow for storage, pre-release treatment and controlled release of the salt laden water. Various pond designs are available making them fairly adaptable for many situations. Most jurisdictions are familiar with ponds in some form for stormwater management and the technology is relatively mature.

Various contaminates can be removed and the outlet can be engineered to control the release. Typically a forebay is included to settle heavier particles. Oil skimmers can be added as an enhancement. Maximizing the vertical depth of the pond allows for significant storage and reasonable retention times however, a relatively large area is needed. Ongoing maintenance is required to remove

sediment and repair the banks. Safety and security may be an issue in some locations. Some studies have shown that stratification can occur in these ponds, thereby concentrating the salt in the deeper areas.

Wetlands
Wetlands are another method available. They also allow for storage, pre-release treatment and controlled release of the salt laden water. Designs are usually specific to a site but adaptable for many situations. Few jurisdictions are familiar with wetlands especially the long term maintenance of them. Like ponds, wetlands can remove various contaminates and the outlet can be engineered to control the release. Aesthetically, communities usually prefer wetlands to ponds.

Most wetlands tend to be fairly shallow and cover large areas, allowing for significant storage and long retention times however, a very large area and a year round source of water is required. Ongoing maintenance is required to remove vegetation and at times sediment and repair the banks and outlet. Safety and security may also be an issue in some jurisdictions.

Filters
At sites where space is limited, a small pond with a short retention time or tank may be all that can be used. In order to reduce the contaminate level a filtering system may be required. Filter systems are considered a mature technology for many industries but have seen very limited use at maintenance yards. Filter systems are usually designed specifically for a site and situation (contaminates to be removed, flow rates, etc.). Filters also tend to have relatively high maintenance needs, as the filter media must be changed regularly.

Now that the water has been treated it must be released. Any release into the environment should only be done after some form of treatment has been done (see above). The release should also be controlled through an engineered outlet. This will allow the release volume to be optimized to what the receiver can handle. Monitoring, both upstream and downstream in the receiver, should be done as well to monitor the systems ongoing effectiveness and it effect on the environment.

Depending on the location of the yard various receiving options are available.

Deep-well Injection

In some locales, transporting salt impacted water to deep-well injections sites is an option. However the cost of trucking and disposal is proving to be cost-prohibitive in many cases.

Release to Sanitary Sewer

In urban areas, discharging the water to the sanitary sewer system is possible in some jurisdictions. It would however, be subject to strict guidelines that may not always be

able to be met. Some on-site pre-release treatment (see above) and monitoring would have to be implemented to ensure contaminates in the water are within acceptable levels and the flow through the discharge point would have to be controllable.

Release to Surface Water Body

Surface waterbodies, such as watercourses, wetlands or lakes, are commonly used as receivers. Various Federal, Provincial and Municipal regulations, guidelines and recommendations are in place governing releases into surface water bodies. The receiving waterbody's ability to assimilate the release should be assessed to ensure that water quality and ecological processes are not impaired.

Release to Storm Sewer

This option may only be viable in urban environments where the Storm Sewer system is sufficiently isolated from the surrounding environment to ensure the water reaches the intended receiver, and that the intended receiver has sufficiently high volume to provide an acceptable level of dilution. Rural drainage and storm systems that rely on open ditches may not be adequate as a receiver for salt laden water as open ditches and other features usually allow for significant uncontrolled infiltration into the ground.

Conclusion

Good salt management requires that all salt, in both solid and liquid forms, be managed well. An inescapable fact is that chlorides are very soluble – making them hard to contain and manage. Therefore, initial efforts should focus on **reducing** the concentration of salt in water and the volume of salt laden water that needs to be managed. However, once salt-impacted water has been created, efforts should be made to **reuse** and **recycle** this water. Ultimately salt laden water may have to be **released** necessitating treatment and monitoring. The following summarizes the options discussed in this paper:

Reduce

- Good Housekeeping Practices
- Keep Solid Salt Dry
- Manage all the Water at a Yard On-site

Reuse/Recycle

- Reuse in brine production
- Recycle as washwater

Release

- Pump out and haul away
- Evaporation
- Pre-release treatments
    - Ponds

    - Wetlands
    - Filters
- Release to:
    - Sanitary Sewer System
    - Surface Waterbody
    - Storm Sewer System

References:

1. TAC Syntheses of Best Practices - Design and Operation of Road Maintenance Yards – Prepared by Ecoplans Limited