Impacts on Environment

Overview

All deicers and abrasives used in winter maintenance impact the environment. Water pollution is a notable problem caused by deicing practices. Only two and a half percent of all the water on Earth is fresh water, only a small fraction of the fresh water (less than one percent) is accessible for use.[1]

Water in urban areas is more at risk of chloride pollution from winter maintenance.[2,3] In urban areas, water drains from impervious surfaces, which includes roads and parking lots, through storm drains. In places that have separate stormwater and sanitary sewer systems, storm drains transport water to a lake, river or stream. This water is not sent to a treatment plant first, which means that chlorides and any other pollutants in the stormwater runoff end up in local waterways. Even in areas with combined sewer systems, many treatment plants are not able to remove chloride from the water without costly upgrades to their facilities.

Water and pollutants that enter storm drains go into the nearest surface water.

In rural areas, water drains through networks of drainage tiles and ditches. Rural areas have less roads, sidewalks and other impervious surfaces, which relates to less chloride pollution from winter maintenance in surface waters.[2,3]

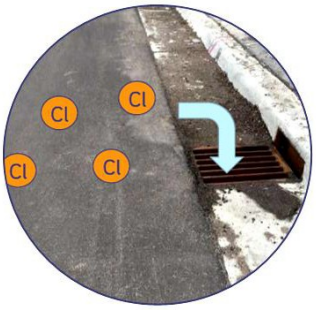
You have the power to reduce the effects of winter maintenance pollution on our water.

Everyone has the power to protect our water. By making smart, informed and advanced decisions about winter maintenance, you can protect the water and continue to keep people safe.

This manual includes tips and strategies to practice responsible and effective winter maintenance. Use these tips to promote innovation within your organization and become a leader in winter maintenance.

Winter Maintenance Material Pollution Overview

Chlorides (salt)
Most common deicers contain chloride



- Road salt contains chloride.
- Chloride is a toxic pollutant.
- Chloride is very difficult and costly to remove.

Abrasives
Sand

- Collects oils and grease
- Clogs storm drains and fills in water bodies
- Clouds water

Non-chloride deicers
Acetates and agricultural by-products

- High biochemical oxygen demand, which lowers oxygen levels in water and can harm aquatic life

Chloride: long-lasting impact

Most common deicers, like rock salt (NaCl), magnesium chloride ($MgCl_2$) and calcium chloride ($CaCl_2$), contain chloride. Chloride can be toxic to aquatic life at certain levels. Wisconsin established chloride water quality standards of 395mg/L (chronic) and 757mg/L (acute).[4] Once chloride is in the water, there is no simple way to remove it. Chloride is considered a permanent pollutant because it does not break down, but accumulates in water. Because road salt accumulates in water and soil, it is expected to take years or decades until the reduction of salt use will result in reduction of salt levels in the environment.[5]

Abrasives: impact on aquatic life

Winter abrasives (sand) can clog storm drains and fill in water bodies. Abrasives can also cloud water, irritate fish gills, and cover habitat, all of which harm aquatic life. Oil and grease from cars can also become attached to sand and be transported into our waters.

Non-chloride deicers: highly visible, but shorter lasting impacts

Organic products, such as acetates or agricultural additives (i.e. beet juice, molasses, distillers' solubles, and corn syrup), break down in the water. This process of breaking down consumes a high amount of oxygen from the water (referred to as high biochemical oxygen demand). The resulting drop in aquatic oxygen levels can harm aquatic life. They also increase nutrient content of the water, which leads to algal blooms in lakes and ponds. These problems can be severe and lead to fish kills. These products are safer for vegetation, noncorrosive and are not permanent pollutants.

Tip ***Help protect the environment by using the product that will perform the best in the smallest amount.***

Salt Impacts on Water Bodies

Lakes

Chloride used in winter maintenance may wash into lakes. Salty water is heavier than fresh water, so it will sink to the bottom of lakes and pose a threat of chemical layering (stratification). Heavy, bottom layers may disturb the natural, seasonal turnover that occurs in lakes. Without this turnover or with an altered turnover cycle, the nutrients and oxygen are not optimally distributed throughout the lake.[6]

A full turnover of a non-salty lake (left) and an altered turnover in a salty lake (right).

Streams

Chloride also washes into streams. The United States Geological Survey (USGS) found between 1990 and 2010, chloride increased in northern U.S. streams. The USGS found that the increases were most pronounced in urban areas with high amounts of snowfall.[3]

Groundwater

Chloride can pollute groundwater, which supplies about half of the United States' drinking water supply.[7] Groundwater is the source of drinking water for more than two-thirds of the residents in Wisconsin.[8] Shallow groundwater also feeds some surface waters, which can lead to elevated chloride in surface water, even during non-deicing periods.[3]

Drinking Water

Chloride can be detected by taste at concentrations greater than 250mg/L.[9] Chloride in drinking water generally affects the water aesthetically, meaning it is not harmful but affects the taste of water. However, in some places the salt concentration in drinking water can be high enough to affect people who are on low-sodium diets.[5]

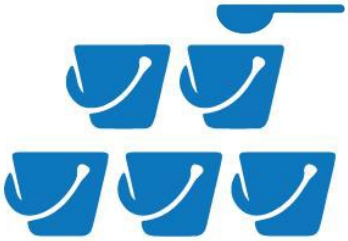
Increased chloride in drinking water sources increases the corrosiveness of the water. Corrosion of metal components can mobilize heavy metals into drinking water. Older pipes can contain metals that are dangerous to human health, such as lead or copper. The Flint, Mich. water crisis, which involved high levels of lead in drinking water, was caused in part by a new water supply with a high level of chloride.[10]

Water Bodies in Wisconsin

The average amount of salt applied yearly to just public roads in Wisconsin is 650,000 tons[11], which is enough to pollute over 400 billion gallons of water. To see a list of Wisconsin's chloride impaired waters, visit the Wisconsin DNR's Impaired Water Search.

Aquatic Life

The federal government has established a chronic chloride concentration of 230mg/L, which is lower than the Wisconsin standard due to different research methods. Above this level, chloride can harm aquatic life including fish, amphibians, macroinvertebrates and insects.[12] Chloride can affect these species' rate of survival, reproduction and growth. Lower chloride concentrations impact smaller organisms and eggs and disrupt the food chain. Higher chloride concentrations can impact larger organisms.



Graphic Credit: Wisconsin Saltwise

One teaspoon of salt pollutes five gallons of water (230mg/L)

Other Impacts of Salt

Infrastructure

Chloride corrodes the metal used in infrastructure such as bridges and roads. This corrosion can cause potholes and possibly require complete roadway replacement.[13] Considering the damage to infrastructure, the real cost of road salt adds up to about five times the initial cost of the road salt and labor to apply it.[14]

Vegetation

Deicers can affect vegetation if salt spray comes into contact with stems, buds, needles or leaves by causing salt burn and drying out buds.[15] Chloride may also be transported into the plant through the root system and reach toxic levels to plants after repeated exposure.[16] In the worst cases, this may result in plant death and require replacing landscape plants, turfgrass or even trees in the spring. In addition to roadside vegetation, aquatic vegetation in surface waters can be harmed by a high chloride concentration.[17] In some places, the native plant community could be affected. This could lead to replacement of native species with salt-tolerant, invasive species.[18]

Soils

When rock salt gets into soils near roads and sidewalks, sodium can alter the soil chemistry and structure. The altered structure leads to poor drainage and compaction.[13] Sodium can also make soil more alkaline, which can reduce available nutrients important to vegetative growth.[13] Salt may also kill soil bacteria, which can increase erosion.[19]

An example of dead turf grass next to the sidewalk caused by chloride

Rusting and concrete damage caused by corrosion from chlorides

credit: https://www.wisaltwise.com/documents/PDFs/Madison-Parking-Lot-Manual-Final-7-19-2019.pdf