Dec. 1, 1992

Winter Road Management

Description

This BMP addresses the proper use and storage of road salt, and discusses alternatives to road salt.

Road salt, also called rock salt, is known chemically as sodium chloride. Use of road salt has been implicated in the elevation of chloride and sodium levels in surface and groundwater as well as in the surrounding environment, and causes corrosion to roads, cars, and bridges. Sources of road salt runoff are roads and parking lots, drains, ditches, salt storage piles, loading areas, truck garages, truck washing areas, and sites where snow is piled. It is estimated that Michigan uses 0.5 million tons of road salt per year, and nationally, 10-11 million tons are used.

Salt can enter surface and ground waters due to the fact that it is soluble. Elevated levels of chlorides entering the Great Lakes and tributaries can have a negative impact on the fresh-water ecosystem. At high levels, salt is toxic to fresh-water organisms adapted to a narrow range of salinity. High levels of chloride can also lead to density stratification in ponds and lakes, which can result in oxygen depletion and fish kills. High sodium levels in ground water can cause health problems such as hypertension, and can aggravate cardiac-related diseases.

Other Terms Used to Describe

De-icing Chemical Use

Pollutants Controlled and Impacts

A reduction in the application rate of salt may result in an improvement of surface water quality by reducing chloride and sodium concentrations. Reductions in salt application will also help protect ground water supplies used for drinking water.

Other benefits that may occur by reducing salt application rates and encouraging proper salt storage include:

-reducing density stratification in ponds and lakes
-reducing corrosion of vehicles and bridges
-reducing damage to roadside vegetation, and
-reducing the deterioration of soil structure.

By properly storing road salt, runoff from salt storage piles can be prevented.

Application

Land Use
Urban, transportation

Soil/Topography/Climate
Winter precipitation comes in the form of sleet, hail, freezing rain and snow, each of which produces different road conditions. All maintenance personnel should know the basic kinds of weather conditions and how to adjust their application procedures to result in the desired road condition. Weather information should be carefully monitored using the most reliable sources available. Some maintenance departments hire private forecasters to get the most reliable local weather information.

When To Apply
Apply this BMP when weather and road conditions require salt spreading for road safety.

Where To Apply
Apply this BMP on any roads which require the application of salt to maintain safe driving conditions, or wherever salt is stored in storage piles.

Relationship With Other BMPs

Street Sweeping can be used to eliminate salt residues on street curbsides.

Specifications

Proper road salt management includes protecting sensitive areas, determining appropriate areas to dump snow, proper salt storage, exploring alternatives to road salt, using proper salt application practices, supervising and training staff, and maintaining equipment.

Protecting Sensitive Areas:
Planning should be made to protect sensitive areas. Sensitive areas include surface waters, drinking water wells and vegetation. Ideally, direct discharges of storm drains to lakes and streams should be avoided in areas where road salt is used in high quantities. Where possible, these drains should be directed to detention basins. Protect ground water supplies by locating salt storage piles away from wells.

Planting salt-resistant vegetation and diverting drainage away from important vegetative areas will help minimize the effect road salt may have on vegetation. Consider installing barriers to protect roadside vegetation from road splash.

Determining Areas to Dump Snow:
When piling snow, do not place directly in or immediately adjacent to surface waters (including wetlands), nor in the vicinity of wellheads. Ideally, snow piles should be directed to detention basins so that the soil and other debris attached to the snow can settle out before the water is discharged to surface waters.

Salt Storage:
Some of the basic elements of a good salt storage policy are as follows:

1. Salt should be covered, preferably in a permanent, roofed structure, to prevent rain and snow from reaching it. If this is not feasible, the next best solution is a waterproof covering weighted and tied down.

2. Salt should be stored on an impermeable pad, not on the ground. Asphalt is the most widely used material for pads, since salt has little effect on it. However, concrete is sometimes used. Concrete must be high quality, air-entrained and treated with linseed oil or asphalt-type coatings to reduce chloride penetration, and prevent scaling or spalling (i.e. flaking).

3. Any runoff that might occur should be contained within the storage site through an appropriate drainage design. Storage pads should slope to let water drain away, and the water channeled to a collection point via ditches, pipes or tile. This brine can then be reapplied to the stockpile during dry seasons, or applied to spreader loads prior to street applications.

4. Any salt storage areas existing in sensitive areas (i.e. zone of influence of water supply wells, significant recharge areas, lakes and wetlands) should be relocated.

Advantages of Using Salt:

Although the use of road salt has many drawbacks, the advantages of using it are:

-it is effective in increasing vehicle traction and achieving the "bare pavement" policy which is currently desired in various parts of the country
-transportation time delays and work time losses are minimized
-it facilitates emergency response in adverse weather
-it doesn't clog drains (like sand might)
-it is relatively inexpensive, costing between $25-50/ton

Application Rate:

It is important to use only the amount of salt necessary to result in safe driving conditions. Rates should be tailored to local conditions.

Application Pattern:

The proper spreading pattern is dependent upon the traffic density and highway design. The type of storm dictates frequency of application, the type of de-icing compound, and the total amount of de-icing compound necessary. The following is given for salt applications:

1. Windrow application is typical of two-lane pavements with low to medium traffic. A 4 to 8 foot application down the center line allows for good traction under at least two wheels.

2. Traffic flow will move the brine toward the shoulders, gradually melting the entire road width. Full-width spreading should be done on multiple-lane pavements with medium to high traffic volumes. Care must be used in the full width spreading not to waste salt.

3. A strong wind blowing across a street or highway can cause salt to drift into gutters or shoulders as it comes out of the spreader. Operators should be aware of wind conditions and spread accordingly on the upwind side.

4. Salt brine will flow down and across a banked curve. Spreading salt on the high side of the road will allow gravity to pull the brine to the low side of the road.

Proper calibration of spreading equipment should be done to accurately apply the proper amount of salt.

Alternatives to Salt:

Some reports have estimated that the damage done by salt ranges from 6-30 times the initial cost of the salt, with 90% of the damage due to corrosion. With the corrosive damage to bridges, highways, and vehicles factored in, one study concluded that the actual cost of salt may be closer to $775/ton. The total annual national cost of salt-related damage is estimated at approaching $5.5 million.

Alternatives to road salt include calcium magnesium acetate (CMA), calcium chloride, urea, sand, natural brines, potassium chloride, magnesium chloride (Freeze Guard), sodium formate, and regular salt such as Quik Salt, TCI, and CG-90.

CMA (ICE-B-GON) is manufactured from dolomitic limestone and acetic acid. The cost of this material ($650-700/ton) is related to the expense of producing acetic acid. At this time, CMA seems to be the alternative of choice. It is reported to be 10-15 times less corrosive than salt, with little or no effects on terrestrial vegetation or soil physical properties. However, it can result in significant organic loadings to receiving waters caused by chemical oxygen demand. During significant runoff events, this may deplete oxygen in surface waters, causing harmful effects to fish and other aquatic organisms. It can also cause increased organic loadings to wastewater treatment plants which serve combined sewers.

Four main obstacles to switching from salt to CMA are:

1. Inadequate understanding of the extent of salt damage

2. Subsidy of infrastructure repair by the federal government

3. Corrosion and environmental costs are external to the typical highway maintenance decision-process

4. Tendency by political decision-makers to heavily discount future cost savings when confronted by the need to increase current outlays in the near term

Other alternatives cause various types of environmental damage. Calcium chloride is an effective deicer but contains chloride and costs $250/ton. Urea costs $250/ton and may result in nitrogen contamination. Sand costs only $3/ton but can clog drains and settle out in streams. Alternatives such as ethylene glycol, diethylene glycol, methanol, and propylene glycol have a high chemical oxygen demand. The former two chemicals are also toxic to humans and wildlife if ingested, and methanol is toxic if ingested or absorbed through the skin.

Other proposed methods to remove snow are listed below. These may or may not be practical according to specific circumstances:

1. The use of external and/or in-slab melting systems

2. Mobile thermal "snow melters"

3. Use of compressed air in conjunction with snowplows or sweepers

4. Inclusion of snow and ice adhesion-reducing substances in the pavement itself (i.e hydrophobic materials such as silicone rubber or silicone resin)

5. Pavement substances that store and release solar energy for melting

6. Road and drainage design modifications to enhance runoff

7. Salt retrieval or treatment possibilities enhanced by the addition of chelating agents

8. Improved tire and/or vehicular design so as to reduce deicing requirements

Supervising and Training Staff:
The following principles should be included in staff training programs:

1. The application of salt and salt alternatives should not be substituted for plowing.

2. The best designed spreader equipment should be employed to avoid scatter and waste.

3. On and off ramps should be addressed as quickly as possible--safe roads are of little use if access ramps are hazardous.

4. All equipment should be calibrated before use.

Ideally, the same crews should be assigned to the same road sections in each storm, and monitor the amounts dispersed from each spreader route.

Maintenance

Ongoing maintenance includes keeping equipment properly calibrated to ensure the salt or other substance is distributed at the proper rate and in the proper pattern. Another important part of the maintenance program is keeping good spare parts available.