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DEICING COMPOUNDS AND UTAH LANDSCAPES

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INTRODUCTION

Landscape maintenance in Utah includes the management of snow and ice in winter to ensure public safety and provide convenient public access. Mechanical removal alone is often inadequate when ice accumulates on sidewalks, driveways, and road surfaces. Fortunately, there are a number of products that chemically melt ice or physically improve traction; however, use of these materials is not without significant direct and indirect cost. The various chemicals available can be expensive, and many damage vegetation, landscape structures and surfaces (hardscaping), indoor carpet and flooring, vehicles, and the environment.

Chemical deicing is based on the fact that solutions containing salt freeze at lower temperatures than pure water. Pure water freezes at 32 degrees Fahrenheit (0 degrees Celsius). Water with salt dissolved in it freezes at temperatures below 32 degrees Fahrenheit. Once a deicing compound is applied to a surface, it melts the ice, creating a brine solution with a freezing point lower than that of pure water. The process continues until all of the ice is melted, or the meltwater dilutes the salt solution to a point where it re-freezes.

Public Safety vs. Landscape Damage?
Even though deicing salts annually cause millions of dollars in damage to vegetation, hardscapes, vehicles, and the environment, their continued use is necessary to ensure public safety. Any decision to limit the use of deicing compounds should be based on an assessment of the impacts on public safety and organization liability.

Ideally, deicing compounds should be effective, economical, and cause minimal damage. The type of salt and the relative amount of salt and ice present on the surface influence whether all of the ice will be melted from the surface, and whether the salt will damage vegetation, hardscaping, indoor surfaces, or the environment. Because many factors are involved, there is no one material that is ideal for every situation. Select a deicing compound based on existing conditions such as temperature, the potential for damage, and public safety. Where possible, use deicing salts in moderation and combine with other management practices such as mechanical removal to reduce the amount of chemical needed and the impact to the landscape.

EFFECTS OF DEICING COMPOUNDS

Vegetation. Salt applied to surfaces may run off and enter soil, or be splashed by vehicles and snow plows onto the surface of vegetation adjacent to the treated area. In soil, salts reduce the availability of water to plants, and significantly increase water stress during spring and summer months. This effect has been referred to as *chemical drought*. Salts deposited directly on foliage may also burn and kill the affected parts, or the entire plant. This is commonly observed where salts from winter maintenance damage evergreen trees and shrubs adjacent to roadways. The sodium and chloride components in certain salts are especially damaging to vegetation.

Hardscape. Salts are corrosive and accelerate rusting of metal railings, grates, drains, and door frames, and underground utility lines if they are not properly protected. Salts may also cause scaling, or flaking of surface layers from concrete. Salt solutions enter void spaces in concrete and expand by 10 to 20% in volume when they freeze. The pressure exerted by this expansion fractures the surface of concrete. Porous brick, masonry, and natural stone are especially vulnerable to damage and should be avoided in areas where deicing salts are used. Concrete which is properly formulated for environments where freeze-thaw cycles are common resists scaling caused by deicing salts. Corrosion resistant paints and sealers will also minimize the impact of deicing compounds on the hardscape, and are recommended for areas where deicing salts are used.

Indoor surfaces (floors and carpets). Residues from deicing chemicals are frequently tracked into buildings and deposited on floors and carpets. Salts degrade wax and other finishes, leaving a dull appearance on floors and requiring more frequent cleaning and maintenance of indoor surfaces. Sodium and potassium chloride salts are relatively easy to remove from floors and carpets. Calcium and magnesium chloride salts, however, leave a greasy film and require wet cleaning with detergents to remove the residue. Abrasive materials such as sand also mar the finish on floors and can be difficult to remove from carpets.

The environment. Salts move rapidly with water off surfaces and into the surrounding soil. If sufficient water is moving through the soil, components of the salt may leach to ground water. Salt may also run off and enter surface waters, potentially degrading quality and killing fish and other organisms. Certain salts have greater potential for environmental damage than others. For example, nitrogen salts have a high risk for surface and ground water pollution while organic salts (calcium magnesium acetate, CMA) have a high risk for surface water pollution.

COMMON AND ALTERNATIVE DEICING COMPOUNDS

Sodium chloride (table salt). Historically, sodium chloride has been the most commonly used deicing salt. While inexpensive, sodium chloride is highly corrosive and may damage plants, soils, and the environment.

Calcium Chloride. Calcium chloride is a common substitute for sodium chloride. Calcium chloride is highly corrosive but slightly less damaging to vegetation and soils than sodium chloride. Calcium chloride is hygroscopic (absorbs water from the air) and will cake and irritate skin and eyes. Special storage and handling is required.

Magnesium chloride. Properties are similar to calcium chloride.

Potassium chloride. Potassium chloride is a common fertilizer sold as potash (0-0-60)

and is relatively easy to handle and store. This salt is highly corrosive but slightly less damaging to vegetation than sodium chloride. The effective melting temperature of potassium chloride is not as low as other compounds.

Calcium magnesium acetate (CMA). CMA generally causes less damage to plants than the chloride salts; however, runoff of CMA into surface water may degrade water quality. CMA is generally not as corrosive as the chloride salts. The main disadvantage of CMA is the high cost relative to other deicing compounds (as much as 40 times more expensive than sodium chloride).

Urea, ammonium sulfate, and other nitrogen salts. Nitrogen salts are rarely used as deicers because of the potential for nitrogen runoff and leaching into water sources. In many areas nitrogen salts are not approved for deicing because of these environmental concerns.

Corrosion-inhibiting salts. Many deicing salts are sold with added corrosion inhibitors. These materials may reduce corrosion, but not eliminate it entirely. No deicing salt, even if it contains a corrosion inhibitor, is entirely corrosion proof. Corrosion-inhibiting additives vary and their effects on plants and the environment are often unknown. Since many corrosion-inhibiting materials are combinations of one or more of the chloride salts mentioned above, some damage to vegetation could be expected when using these products.

Abrasives. Abrasives such as sand, cinders, and ash have relatively few impacts on the environment or plants. These materials do not melt ice but improve traction on slippery surfaces. The disadvantage of these materials is that they accumulate in the landscape, and may require frequent removal or create dust problems when they dry later in the year after the deicing season.

Enhanced radiation absorbers. Application of a dark colored material such as coal ash or graphite to a snow or ice surface increases radiation (sun energy) absorption and accelerates the rate of melting. These materials generally work slowly, may be tracked into buildings, and lose effectiveness as they are covered by new snow and ice.

Combination products. Various products are sold which contain combinations of one or more of the compounds discussed above. The label should indicate the proportion of different compounds in the product. The overall effect of the product can be generalized from the effects of the dominant compound in the mixture.

Follow Label Instructions

All compounds should be used according to label instructions. Products may have little or no adverse effect if used according to instructions, but cause significant problems if applied at rates or in a manner inconsistent with labeling.

PRACTICAL RECOMMENDATIONS

It is clear that there are advantages and disadvantages to all deicer compounds and alternatives. Planning and a combined chemical and mechanical approach to snow and ice control can often minimize the impacts of deicer compounds in the landscape. Consider the following suggestions:

- Use more mechanical removal. The more snow and ice present, the more deicing compound is needed for melting. Reduced amounts can be used if large accumulations of snow and ice are removed first. The cost of labor for physical removal may be offset by savings in reduced damage to the landscape.
- Use abrasive materials in conjunction with mechanical removal and/or chemical deicers. If possible, select abrasives that can be incorporated into the landscape to reduce the need

for removal after the deicing season.

- Use deicing compounds with minimal effects on plants (Table 1). If possible, plant salt tolerant vegetation in areas receiving large amounts of deicing salt, or as a barrier between salt sensitive vegetation and the site of deicer application. Locate salt sensitive plants away from the site of deicer application and splash. Use hardscaping (gutters, barriers) to channel deicing solutions away from planting areas. When removing snow containing deicer residues, do not pile on or near salt sensitive plants. Irrigate once heavily in spring to leach accumulated salts from the root zone of plants.
- Use concrete formulations, sealants, and other treatments specifically designed to resist deicing compounds to reduce damage to hardscaping.
- Use deicing compounds that are easily cleaned from indoor floors and carpets (Table 1), or use these products immediately outside of building entrances. Place easily cleaned, durable multi-purpose carpeting and floor mats immediately outside and inside building entrances to capture as much deicing compound as possible.

Table 1. Select properties of common and alternative deicing compounds.

Compound	Effective Temperature, ºF*	Effect on:			
		Hardscape	Carpet/ Floors	Vegetation	Environment
Sodium chloride	-6	severe	slight	severe	moderate
Calcium chloride	-67	severe	severe	moderate	slight
Magnesium chloride	-28	severe	severe	moderate	slight
Potassium chloride	+13	severe	slight	moderate	slight
Corrosion-inhibiting salts	depends on compounds	slight/ moderate	varies	depends on compounds	depends on compounds
Calcium Magnesium Acetate (CMA)	+15	slight	moderate	slight	slight/ moderate
Nitrogen salts	variable	none/ severe	moderate	slight	severe
Abrasives	--	slight	moderate	none	slight
Radiation absorbers	--	slight	moderate	slight/none	slight

*The effective melting temperature depends on the concentration of the deicing chemical. Values generally represent the lowest effective melting temperature possible with highly concentrated solutions of the compound.

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