SALMON-SAFE INC.

SALMON-SAFE INFORMATION SHEET

A Comparison of Alternative Road Deicers

Salmon-Safe recognizes the wintertime balance between public safety on ice- or snow-covered roads and environmental protection. We seek to inform companies and institutions that have achieved Salmon-Safe accreditation and certification, including road maintenance departments, about options for reducing toxicity of road deicing chemicals and potential negative effects on salmon and other aquatic life in water bodies receiving road runoff.

From the salmon perspective, the specification of a deicer should be especially carefully evaluated when a road drains to any relatively small, salmon-supporting water body. If deicer use cannot be avoided in such cases, the best protection would be to channel runoff through an extensive vegetated area to capture and hold the potentially harmful deicer components.

Sodium chloride is by far the most common deicer for roads. Magnesium and calcium chlorides are in some use, being effective to lower temperatures although more expensive and requiring greater application mass because of decreased freezing point depression. All chloride-based deicers are potentially toxic to aquatic life, damage roadside vegetation, and corrode metals in bridge structures and concrete reinforcing bars. Sodium can diminish human cardiovascular health when contaminating wells and other water supplies. Chloride is usually not a threat to human health but can cause taste and odor problems in drinking water. Magnesium, especially, but also sodium, calcium and potassium damage concrete. All of these light metals can release potentially toxic heavy metals from contaminated soils through ion exchange reactions. Additives to counter corrosion, concrete damage, and the tendency of the products to cake can also be toxic to aquatic life. The potential impact of all of these negative effects is dependent on the concentration of the chemical, pointing out the importance of using the minimum needed. In proper use, elevated potential for aquatic toxicity problems should only occur in relatively small water bodies.

Exhaustive research on calcium magnesium acetate (CMA) has demonstrated the only potential environmental problems at any anticipated environmental concentration are aquatic dissolved oxygen reduction and soil metal release (Horner 1988).[1] The concentration necessary to depress oxygen, however, is sufficiently high that it would only be expected to occur in small, poorly flushed lakes and small, slowly flowing streams. Metals in soils were not mobilized in sufficient quantities to be a concern but could be if CMA meltwater flows over a highly contaminated soil, as with any deicing option other than urea. Because of its high cost, CMA use is mostly limited to locations sensitive to aquatic toxicity or corrosion. It has, for example, been the choice for new bridges to avoid the beginning of progressive chloride corrosion. The University of Oregon, a campus transitioning to Salmon-Safe certification, uses CMA exclusively for its deicing.

Road deicers on the market differ in their deicing ability, negative effects on the environment, price and secondary costs resulting from damage to roadway materials. The following table is a summary comparison of alternative

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[1] Horner, R.R. 1988. "Environmental Monitoring and Evaluation of Calcium Magnesium Acetate (CMA)", *National Cooperative Highway Research Program Report 305*. Transportation Research Board, Washington, DC.

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road deicers with respect to these factors. In general, Salmon-Safe recommends avoiding all chloride-based deicers where the runoff can flow to a headwaters (third-order or smaller[2]) salmon spawning or rearing stream, unless it passes through green stormwater infrastructure (GSI) designed to reduce the discharge quantity through infiltration and evaporation and decreases chloride in the remaining runoff through plant and soil contact. If providing adequate GSI treatment is impossible and deicing is still essential, Salmon-Safe recommends highly targeted application of CMA, using the minimum amount, number of applications, and area coverage necessary for safety. With respect to any deicer involved in the drainage of any water body or groundwater recharge area, careful use of the minimum needed is the best rule.

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Deicer	Aquatic Ecosystem Effects	Other Environmental Effects	Material Effects	Low Temperature Limit (°F)	Freezing Point Depression (°C/unit weight)	Usage Consistent with Salmon-Safe Certification	Cost Relative to Sodium Chloride
Sodium chloride (rock salt)	Chloride and additive toxicity	Sodium contamination of drinking water source; vegetation damage; mobilization of heavy metals in soil	Corrosive; concrete damage	20	1	Avoided in drainages to headwater streams unless adequate GSI treatment; used in minimum needed amounts in drainages to larger water bodies and groundwater recharge areas	$1.00
Magnesium chloride	Chloride and additive toxicity	Vegetation damage; mobilization of heavy metals in soil	Corrosive; concrete damage	5	0.29		$2.40
Calcium chloride	Chloride and additive toxicity	Vegetation damage; mobilization of heavy metals in soil	Corrosive; concrete damage	-25	0.53		$5.70
Potassium chloride	Chloride and additive toxicity	Vegetation damage; mobilization of heavy metals in soil	Corrosive; concrete damage	12	0.78		$1.60
Calcium magnesium acetate	Dissolved oxygen reduction	Mobilization of heavy metals in soil	Concrete damage	0	0.30	Targeted usage in minimum needed amounts in drainages to headwaters streams	$19.30
Potassium acetate	Dissolved oxygen reduction	Mobilization of heavy metals in soil	Concrete damage	-15	0.60		$26.30
Urea	Ammonia and additive toxicity; eutrophi-cation			15	0.97	same as chloride deicers	$1.80

[2] When two first-order streams come together, they form a second-order stream. When two second-order streams come together, they form a third-order stream. Streams of lower order joining a higher order stream do not change the order of the higher stream.

[3] After: (1) Kelly, V.R., Findlay, S.E.G., Schlesinger, W.H., Chatrchyan, A.M., Menking, K. 2010. "Road Salt: Moving Toward the Solution", *The Cary Institute of Ecosystem Studies*, Milbrook, NY. (2) Public Sector Consultants, Inc. 1993. "The Use of Selected Deicing Materials on Michigan Roads: Environmental and Economic Impacts", Michigan Department of Transportation, Lansing, MI.