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Eco-Engineering Solutions to the Problem of De-Icing Salts Motorway Runoff

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Extended Abstract

Highway and road de-icing operations provide safe driving conditions during winter in Canada, north of US and Europe. However, the runoff from salted roads adversely affects aquatic and terrestrial ecosystems by increasing salts and other contaminants (Pb, Ni, Zn, Cd, nutrients and petroleum hydrocarbons) concentrations [1]. Many Canadian provincial Ministry of Environment have revised the environmental policy for the use of de-icing chemicals, de-icing salts are since 1995 in the list of contaminant priority substances [2]. Notwithstanding and due to winter conditions, de-icing salts are being used and will continue to be used in future for road safety.

Eutrophication affects many of Canadian Lakes and rivers and the influence of de-icing salts are unknown, according to recent research it may accelerate eutrophication reducing biodiversity of flora and fauna or encouraging the dominance of salt-tolerant species. Therefore, salted road runoff should be treated before discharge into water bodies in order to protect natural resources and to benefit from ecosystem services. A series of laboratory and greenhouse assays were conducted as means to develop two eco-processes using eco-engineering. Based on these results a pilot system was constructed near Felix Leclerc (A40) in the watershed of Saint-Augustin Lake, close to Quebec City on a heavily urbanized area. This highway was built in 1974 and crosses 2 km of the lake's catchment area. Since then, the lake suffers from elevated concentrations of salts due to the discharge of salted road runoff. The electrical conductivity (EC, directly related to salt) of lake water was increased from 280 µS/cm prior to construction of highway to 1200 µS/cm in 2009 [3], while the Quality Criteria (QC) is about 250 µS/cm.

As a result of the above, a compact, innovative, economically viable and ecologically sustainable system was built in 2009 and is in operation since. The system includes an adapted constructed wetland (ACW) that uses salt-tolerant and halophytes plants, and an active filter bed (AFB) that uses calcite as reactive filter media. Several salt tolerant and strict halophyte indigenous of the south shore of the St. Lawrence River estuary (natural saline wetlands of Kamouraska, Quebec) included: *Atriplex patula, Salicornia europea* and *Spergularia Canadensis*.

The monitoring of the system from years 2011-2012 shows that all the plants in the wetland absorbed salts in different concentrations. The filter bed retained between 80 and 100% of Phosphorous and trace element metals including Pb and Cd.

References

[1] Environnement Canada, "Sels de voirie - Loi Can. sur la protection de l'environnement," 1999.
[2] T. Mayer, W. J. Snodgrass, and D. Morin, "Spatial characteristics of the occurrence of road salts and their environmental concentrations in Canadian surface waters and benthic sediments," *Water Qual. Res. J. Can.*, 1999.
[3] R. Galvez-Cloutier, S. Leroueil, and Pérez-Arzola, "Le Lac Saint-Augustin, sa problématique d'eutrophisation et le lien avec les produits d'entretien de l'autoroute 40," Rapports MTQ I, II, III., 2006.