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Laboratory-scale evaluation of selected remediation techniques for propylene glycol-based de-icing fluids

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A combined soil amendment was tested in microcosm experiments for the enhanced natural attenuation of propylene glycol (PG) based aircraft de-icing fluids during and following the infiltration of contaminated snowmelt, with an aim to preferably apply minimal-invasive techniques. The key objectives under field conditions may be to supply sufficient amount of nutrients, to ensure aerobic conditions and to degrade a higher proportion of the organic pollutants in the surface soil where higher microbial activity and plant rhizosphere effects may contribute to a more efficient biodegradation of PG, compared to subsoil ground layers, where electron acceptors and nutrients are often depleted. Microcosm experiments were set up in Petri dishes using 50 g of soil mixed with appropriate additives. The samples contained an initial de-icing fluid concentration of 10 000 mg/kg soil. A combined amendment resulted in significantly higher degradation rates for PG both at mesophilic and at low temperatures. Most probable numbers of bacteria capable to utilize 10 000 mg/kg de-icing fluid as a sole carbon source were about two orders of magnitude higher in the amended soil samples compared to unamended controls. The elevated numbers of such bacteria in surface soil may be a source of cells transported to the subsoil by snowmelt infiltration. The near-surface application of amendments tested here may also enhance the growth of plants and plant roots in the contaminated area, as well as the microbes to be found at larger depth, and hence increase the degradation of a contaminant plume in the ground. This work was supported by the SoilCAM EU FP7 project.