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Modeling microbial degradation of propylene glycol: electron acceptors and their related redox conditions

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De-icing chemicals are applied in large amounts at airports during winter conditions to keep the runways and aircrafts ice-free. The commonly used propylene glycol (PG) is easily degradable by local microbial communities, but anoxic zones develop and soluble Fe+2 and Mn+2 ions can reach the groundwater. To enhance microbial induced remediation and reduce the release of iron and manganese, it was proposed to add NO_3- together with PG. However, experiments conducted in the unsaturated zone at Gardermoen airport, Norway, revealed that manganese and iron were preferred over NO_3- as electron acceptor [1]. The objectives of this study are to quantify mechanisms which control the order of reduction processes in an unsaturated sandy soil, and to test whether measured redox potentials can help to determine underlying biogeochemical reactions.

We are modelling the microbial degradation of PG using Monod kinetics described for the chemical equilibrium tool ORCHESTRA [2], following an approach of [1]. The model is calibrated against gas measurements of CO_2, NO_2 and N2 released from batch experiments performed under controlled conditions. Fe+2 and Mn+2 were measured for the start and end of the experiment, as well as bulk resistivity, pH and electrical conductivity. With the calibrated model we are working towards a tool to quantify microbial induced redox reactions under different soil water saturations to account for seasonal water fluxes especially during snowmelt.

[1] Schotanus, D., Meeussen, J.C.L., Lissner, H., van der Ploeg, M.J., Wehrer, M., Totsche, K.U., van der Zee, S.E.A.T.M., 2013. Transport and degradation of propylene glycol in the vadose zone: model development and sensitivity analysis. Environ Sci Pollut Res Int.
[2] Meeussen, J.C.L., 2003. ORCHESTRA: An Object-Oriented Framework for Implementing Chemical Equilibrium Models. Environ. Sci. Technol. 37, 1175–1182.