MONITORING AND MODELING OF CALCITE PRECIPITATION KINETICS INDUCED BY CO_2 EXCHANGE DYNAMICS - EXPERIMENTS IN A RAILWAY TUNNEL

Wedenig, M.[1], Eichinger, S.[1], Wagner, H.[2], Leis, A.[3], Boch, R.[1] & Dietzel, M.[1]

[1]Institute of Applied Geosciences, Graz University of Technology, Rechbauerstraße 12, A-8010, Graz, Austria
[2]ÖBB-Infrastruktur-AG, Europaplatz 2, A-8020 Graz, Austria
[3]JR-AquaConSol GmbH, Steyrergasse 21, A-8010 Graz, Austria
e-mail: michael.wedenig@student.tugraz.at

Calcium carbonate precipitation from a supersaturated aqueous solution is one of the main challenges when it comes to clogging of e.g. tunnel drainage systems, which leads to high costs from maintenance and cleaning procedures over its operating lifetime. In order to be able to predict and prevent, or getting ideas how to easily remove $CaCO_3$ scaling, on-site experiments were conducted in an Austrian railway tunnel, where pH, electric conductivity (EC) and temperature of a locally occurring acidulous groundwater were in-situ and continuously monitored.

The experimental setup is based on a 1:1 drainage test track, supported by stationary reactor experiments, where the drained groundwater is monitored by a newly developed online sensor system and time-resolved sampling of solutions and solids. In distinct experimental sets, effects of e.g. flow rate, turbulences and gas exchange on scaling formation were tested. Results support the sensitivity of the monitored master parameters to successfully describe potential and ongoing coupled carbonate precipitation and CO_2 exchange with the tunnel atmosphere by fitting the measured pH, EC and solution chemistry with PHREEQC based modelling results using a reaction kinetics approach.

Data obtained from a ~300 days study period and modelling results are presented and discussed with regard to typically occurring physicochemical and precipitation conditions. The study shows that in-situ monitoring coupled with an advanced reaction kinetics modelling approach can be successfully used to detect and follow ongoing calcite formation in the above mentioned environment, i.e. a promising tool to be applied for scaling issues in geotechnical settings.