Geophysical Research Abstracts
Vol. 13, EGU2011-13716, 2011
EGU General Assembly 2011

Aquarehab: Integration of groundwater remediation technology models in river basin management

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Advanced in-situ groundwater remediation technologies such as permeable reactive barriers, activated riparian zones and wetlands, groundwater-river interaction zones, and drains treated with carrier material are used to remove micropollutants from groundwater before they end up in the surface water. In the 7FP EU project Aquarehab, we investigated reactive transport models for the different remediation technologies with the objective to (1) create optimal experimental design schemes for feasibility tests for the different remediation technologies and (2) to integrate the models in river basin management tools. Reactive transport models were parameterized using batch and column tests at the lab scale for simulating the removal of chlorinated aliphatic hydrocarbons in zerovalent Fe-containing permeable barriers and in groundwater-surface water interaction zones. The reactions and transport processes were implemented in a groundwater model for contaminated sites in the Scheldt river basin and further evaluated using monitoring data. Similarly, nitrate and pesticide removal in a wetland in the Odense river basin was modeled. The models were used to advice future technology feasibility tests. Special attention in the case of Fe PRBs needs to be paid to an independent characterization of iron corrosion rate in a separate batch experiment as to uniquely identify corrosion rate parameters, to perform separate column experiments without Ca in order to determine which mineral contributes most to the iron deactivation process (iron-carbonate or calcium-carbonate), to perform a more quantitative microscopic mineral characterization, e.g. comparison of coating thickness and extent for various minerals. In case of wetland removal processes, different sources of water to the riparian zones need to be determined. These are groundwater discharge, infiltrating rainwater, river water during flooding (mainly in dry period), and possibly vertial leakage. Also redox zonation for pesticides is important, since it mostly affects the shape of the toe of the plume. The models are now being used to determine the governing parameters that affect reduction of pollutant fluxes and to derive parsimonious relations between pollutant abatement rate and soil or site characteristics. These relationships will be incorporated in a decision management tool with the aim to optimize remediation of contaminated groundwater at the river basin scale. We will show setup, optimization and results of the reactive transport models and their reduced forms.