SIMULATION OF WATER FLOW AND SOLUTE TRANSPORT IN A HYDROPHOBIC SANDY SOIL

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Heterogeneity of soils is often organized in an hierarchical manner on a variety of scales. It has been found that the presence of large structures (at the scale of observation) and the effectiveness of these structures for water transport play a crucial role for the effective transport behaviour on the system scale.

We present a case study which aimed at identifying transport processes in a sandy soil contaminated by miscellaneous wood preservatives like chromated copper arsenate (CCA) and coal tar creosote. Due to the extensive application of creosote, the soil exhibited a distinct hydrophobic surface horizon which induced highly heterogeneous and preferential flow patterns in the subsurface soil. Laboratory experiments were performed to characterise mobility, reactivity and desorption kinetics of arsenic and chromium. In a monitoring study in the field, soil solution was continuously sampled at 16 positions on-site over a period of nine months. A dye experiment at the end of the study provided useful information on the spatial distribution of preferential flow paths. Based on this information, the experiment was simulated in a semi-conditional manner using the 2D-FE-model Hydrus-2D, considering the stochastic small scale heterogeneity as well as the structural large scale heterogeneity. The on-site concentrations proved to be spatially very variable, but less variable with time. The simulation showed that the temporal evolution of local solute fluxes and concentrations are very different, dependent on the position relative to the hydrophobic structures. When compared to the homogeneous case, the (areal integrated) leaching of the contaminants to the groundwater occurred faster, but the total amount of contaminant leaching was considerably reduced.