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Absorption of artificial piggery effluent by soils: Inverse optimisation of hydraulic, solute transport, and cation exchange parameters using HP1 and UCODE

Diederik Jacques (1), Chris Smith (2), Jirka Simunek (3), and David Smiles (2)

(1) Institute for Environment, Health, and Safety, Belgian Nuclear Research Centre (SCK•CEN), Boeretang 200, B-2400 Belgium. djacques@sckcen.be, (2) CSIRO Land and Water, Canberra, ACT 2601, Australia. Chris.J.Smith@csiro.au, (3) Department of Environmental Sciences, University of California Riverside, Riverside, CA, USA. jiri.Simunek@ucr.edu

Smiles and Smith (2004) performed controlled laboratory experiments on the transport of major cations (Na, K, Mg, Ca) during water absorption in horizontal soil columns for three different times. Experimental data consists of profiles of water contents, Cl concentrations, total aqueous and sorbed concentrations of the major cations. Numerical simulation of the experimental dataset requires a coupled code that can consider variably-saturated water flow, multi-component solute transport, and geochemical reactions (aqueous complexation and cation exchange). The HP1 code, based on coupled HYDRUS-1D and PHREEQC, is used to simulate this data set. The sorption of the major cations is described as a competitive cation exchange process.

The objective of the study is to calibrate hydraulic, transport, and geochemical parameters using HP1, the universal optimization code UCODE_2005 (Poeter et al., 2005), and the experimental dataset of Smiles and Smith (2004).

The dataset was used to calibrate three types of parameters: soil hydraulic parameters (the parameters of the van Genuchten-Mualem model for the soil hydraulic functions), solute transport parameters (dispersivity), and geochemical parameters (exchange coefficients for the major cations and the cation exchange capacity). Different calibration runs were performed with different sets of input data, different sets of optimized parameters, and different formulations of the cation exchange process (i.e., Gapon, Rothmund-Kornfeld). Overall, the description of the dataset with the coupled code is satisfactory. Estimated parameters are within expected ranges for the type of material used.

References

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