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Soil Transfer Parameters Estimation: Comparison of Field Infiltration Methods

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Protection of water resources in general and more specifically in industrial context requires a good understanding of the fate and transfer processes of contaminants in the surface layers of soil (vadose zone). A key point to enhanced groundwater protection is to improve the reliability of hydraulic soils parameters acquisition needed to predict contaminants transfer in the vadose zone. Some key parameters include the retention curves and their representativeness of in-situ conditions.

The BEST procedure (Lassabatere et al., 2006) proposes to acquire soil hydraulic properties through different stages including single ring infiltrometer field experiment (Beerkan) and to estimate hydraulic curves h(θ) and kr(θ) parameters using a mathematical model which approximates the Richards equation under certain conditions. Even though single ring models have been widely analyzed in the literature with modelled infiltration data (Braud et al., 2005; Touma et al., 2007; Valiantzas, 2010; Vandervaere et al., 2000a), there is few investigations assessing the adequacy of Beerkan estimates on real in situ experiments (Bagarello and Massimo Iovino, 2003; Lassabatere et al., 2006). Indeed, the Beerkan hypothesis (homogenous soil, low initial humidity, steady-state infiltration) are scarcely verified in real in situ conditions.

This study focuses on the comparison of different in situ infiltration methods for acquiring hydrodynamic transport parameters in the vadose zone in the context of industrial loamy-sand backfilled soils. The BEST procedure was used on site and generated estimates for hydraulic conductivities and Richard's equation parameters. The BEST hydraulic conductivity estimates were compared with those obtained through two field measurement techniques: i) determination of the permeability coefficient by various load infiltration test in a borehole; and ii) use of a trench Porchet test (1926). BEST estimates of Richard's equation parameters were also compared to estimations obtained by Rosetta hierarchical pedotransfer program (Schaap et al., 2001) using textural classes of soil samples.

It has been found that BEST hydraulic conductivity estimates were influenced by the in situ conditions, especially the soil initial moisture content. The results show that BEST estimates of hydraulic curves h(θ) and kr(θ) are in the expected range of the Rosetta values. Moreover, most of Ks estimates performed by both BEST and Rosetta were found relevant comparing to Ks reference values estimated with the Porchet field permeability technique . However, even this largest scale infiltration method was influenced by slight vertical heterogeneities of backfilled soils in the vadose zone.

As field investigation of the vadose zone is still a challenge, the combination of literature/pedotransfer data with field acquisitions should be used for assigning relevant uncertainties of hydraulic parameters and corresponding modelling results.

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