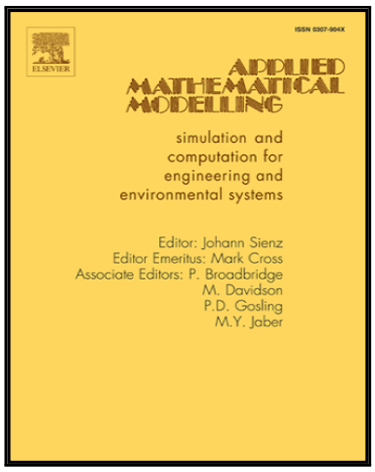

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An analytical model for carrier facilitated solute transport in weakly heterogeneous porous media

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Abstract

Carrier facilitated solute transport in heterogeneous aquifers is studied in a Lagrangian framework. The dissolved solutes and carriers are advected by steady random groundwater flow which is modelled by regarding the hydraulic conductivity as a stationary *random space function* (RSF). We derive general expressions of spatial moments pertaining to: i) the dissolved concentration, and ii) the concentration associated with the carrier phase. In order to reduce the computational effort, we use some approximate solutions for the flow field (Severino et al., 2005) which enable us to obtain simple (closed form) solutions for spatial moments. It is seen that the masses and the centers of gravity of the two propagating plumes depend only on the mean velocity field, and chemical/degradation processes. Instead, second and third order moments are affected by the coupling between reactions (both of chemical nature, such as sorption/desorption, and of physical nature, like degradation) among the three phases (i.e. dissolved, carrier and sorbed concentrations), and the heterogeneity of the aquifer.

We investigate the potential enhancing effect of carriers by comparing spatial moments of the two propagating plumes. The forward/backward mass transfer rates between the liquid and carrier phases combined with degradation coefficients are the critical parameters. It is

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