Modeling Kinetic Interphase Mass Transfer During Field Scale Air Sparging Operations with a Dual Domain Approach

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Previous numerical simulations of air sparging using T2VOC and similar codes have demonstrated that the basic injected gas flow patterns that occur below the water table during air sparging can be simulated. These earlier simulations, however did not attempt to model rates of contaminant removal during air sparging. Various laboratory and field test data suggest that air sparging contaminant removal tends to be a non-equilibrium process at local scales. This means that the local equilibrium assumption used in each normal gridblock of a T2VOC or TMVOC simulation will result in an overprediction of the rate of contaminant removal. A simple way to include this local kinetic mass transfer is to use a dual domain formulation, where the bulk characteristics of the porous media are preserved, but where gas is allowed to flow preferentially through part of the domain. In this type of model, the local mass transfer rate is determined by the rate of diffusion from higher water content locations into the locations with flowing gas. Simulations of an air sparging field experiment using TMVOC show that the apparent mass transfer coefficient is scale-dependent, decreasing with increasing scale. In particular, sparging mass transfer coefficients measured at the laboratory scale are about 100 times larger than those calibrated to the field data.