XVIII International Conference on Water Resources
CMWR 2010
J. Carrera (Ed)
CIMNE, Barcelona 2010

# A TWO EQUATION MODEL OF BIOLOGICALLY REACTIVE SOLUTE TRANSPORT IN POROUS MEDIA

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**Summary.** Modeling transport in porous media of organic chemical solute in presence of a bacterial population growing as biofilms is an important area of research for environmental applications, for example for remediation of groundwater contaminated by organic pollutants (biosparging, bio-barriers …). Biofilms, which are composed of bacteria and extracellular organic substances, grow on the pore walls of the porous medium. Bacteria degrade the organic solute by their metabolism and thus may contribute to pollution decrease. Bio-reactive transport of an organic solute in a porous medium including a biofilm phase is a strongly multi-scale (from the bacteria scale to the scale of the aquifer heterogeneities) and coupled (involving hydrodynamic, physicochemical and biochemical phenomena) process. The organic solute is transported by convection and diffusion in the fluid phase and diffuses into the biofilm phase, where it is degraded by bacterial metabolism.

The goal of this work is to develop a macroscopic model of bio-reactive transport at the Darcy-scale through volume averaging based on the data available at pore-scale. In the general case, the macroscopic system obtained by averaging pore-scale equations is a two coupled equations system (one equation for each phase), called two-equation model. The use of this model implies the numerical solving of three closure problems, in order to set up the values of the macroscopic transport parameters (macroscopic dispersion tensor, macroscopic interfacial flux …). Computations of these effective coefficients have been performed in different situations of mass transport in porous medium, and a study of the macroscopic parameters has been carried out (impact of transport features, comparison with previous models designed for more specific conditions). Finally, the results of this model have been compared with direct simulations performed on a simplified geometry representative of a two-dimensional porous medium including a biofilm phase. Based on these comparisons, the validity domain of this model has been identified in terms of hydrodynamic and biochemical conditions of transport (i.e. the Péclet number and the Damköhler number).