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Generalized semi-analytical solutions to multispecies transport equation coupled with sequential first-order reaction network in arbitrary heterogenious medium using GITT

Heejun Suk
Korea, Republic Of (sxh60@kigam.re.kr)

This paper presents a semi-analytical procedure for solving coupled the multispecies reactive solute transport equations, with a sequential first-order reaction network in arbitrary heterogeneous media using General Integral Transformation Tecgnique(GITT).This proposed approach was developed to describe behavior of reactive multicpecise transport on spatially or temporally varying flow velocities and dispersion coefficients with distinct retardation factors, which might be function of space and time. This proposed approach deals with general initial conditions, and arbitrary temporal variable inlet concentration as well as arbitrary heterogenous media. The proposed approach sequentially calculates the concentration distributions of each species by employing only the generalized integral transform technique (GITT). Because the proposed solutions for each species' concentration distributions have separable forms in space and time, the solution for subsequent species (daughter species) can be obtained using only the GITT without the decomposition by change-of-variables method imposing the limitation of identical retardation values for all the reactive species by directly substituting solutions for the preceding species (parent species) into the transport equation of subsequent species (daughter species). The proposed solutions were compared with previously published analytical solutions or numerical solutions of the numerical code of the Two-Dimensional Subsurface Flow, Fate and Transport of Microbes and Chemicals (2DFATMIC) in all verification examples. In these examples, the proposed solutions were well matched with previous analytical solutions and the numerical solutions obtained by 2DFATMIC model. A hypothetical single-well push–pull test example and a scale-dependent dispersion example were designed to demonstrate the practical application of the proposed solution to a real field problem.