Numerical Simulation of Multicomponent Compressible Flow in Porous Medium

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Abstract

The article focuses on the numerical modelling of the compressible single-phase flow of a mixture composed of several components in a porous medium. Firstly, the physical-chemical properties of mixtures with the constant number of components are described and the equations describing the single-phase flow are introduced. On the basis of the equations and established initial and boundary conditions the mathematical model of the solved problem is formulated. Further, the composed model is solved numerically using a combination of the mixed-hybrid finite element method for the Darcy's law discretization and the finite volume method for the discretization of the transport equations. For the time discretization the Euler method is used. The combination of the numerical schemes leads to a large system of nonlinear algebraic equations which is solved using the Newton-Raphson iterative method. The dimensions of the resulting matrices of the system of linear algebraic equations are significantly reduced using the hybridization technique so that they do not depend on the number of mixture components. Finally, the results of simulations, which have been computed by written programme, are introduced. The convergence of the numerical scheme is verified on two testing problems in a homogeneous medium. Moreover, we present several results of methane injection simulations into a reservoir filled with propane and spreading of the mixture in the heterogeneous reservoir containing the blocks of fractured medium.