Combined Method for Computation of Multicomponent Compressible Flow in Porous Media

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ABSTRACT: The mathematical modeling of transport of multicomponent mixtures in porous media is important for many applications including oil recovery or CO2 sequestration. The traditional approaches use either the fully implicit method or a sequential method. The fully implicit method is stable, allows for long time steps, but leads to extremely large systems of linear algebraic equations whose size is proportional to the number of mixture components. Alternatively, in sequential solution procedures like IMPEC (implicit pressure, explicit concentrations), the size of the system is reduced significantly to a size independent of the number of components. However, this approach is conditionally stable and the time step has to be chosen prohibitively small in many cases. We propose a new scheme for the numerical modeling of multicomponent compressible flow. Our method is based on a combination of the mixed-hybrid finite element method for the discretization of total flux, and the finite volume method for the discretization of transport equations. The scheme is almost fully implicit, allowing for long time steps, yet, it is possible to reduce dimensions of the final system of linear algebraic equations to a size independent of the number of components. We will show several simulations using our new approach.