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New Framework for Multiphase Flash in Compositional Simulation

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Compositional simulation of many underground processes, such as gas injection, thermal recovery with solvent, and CO_2 sequestration, requires robust and efficient multiphase flash calculation. For a system of *C* components and *F* phases , the conventional approach solves *C*(*F*-1) equations where the dependent variables need to be updated dynamically. We propose a modified RAND method which solves *E*+*F* equations (*E* is the number of independent elements) for reactive systems and *C*+*F* equations for non-reactive systems. The RAND-based flash formulation has several advantages: (1) It provides quadratic convergence; (2) All phases and components are treated in the same manner and no complicated bookkeeping is needed for multiphase flash; (3) Chemical reactions can be easily included (useful for CO_2 sequestration, for example); (4) Various flash specifications can be used; (5) Volume-based formulation makes calculation using complicated EoS more affordable; (6) The RAND formulation satisfies the material balance during iteration, meaning that Gibbs-energy can be used to monitor convergence in isothermal flash. It is worthwhile to consider the RAND-based formulation as new multiphase flash framework for future compositional simulation.