A MULTISCALE HYBRID METHOD USING MIXED FINITE ELEMENTS FOR TWO-PHASE FLOW CONSIDERING GRAVITY EFFECTS

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Abstract. The scope of this work is the implementation and application of a multiscale mixed finite element - finite volume scheme to solve fine detailed geological realizations. The multiscale approach MHM-Hdiv [1] is a new version of the MHM method on [2] for the Darcy's component of the multiphase equations. The strong formulation being considered is the weighted pressure formulation [3] for the two-phase case (water and oil system). The MHM-Hdiv use local mixed finite element solvers in the downscale stage solving efficiently conservative fluxes on both, coarse and fine scales. Once these fluxes are determined, they are used to solve the transport equations of the flowing phases. The nonlinearities associated with the two-phase model are treated with a squentual scheme to approximate the solution of the full coupled system. We present how to account the buoyancy effects using the upstream differencing scheme [4], as well evaluations for computational efficiency and accuracy on a series of full and corresponding multi-scale reservoir models with a high degree of realism, highly heterogeneous rock properties distributed in a representative domain considering complex reservoir and wells geometric descriptions. The multi-scale approach allows us to compute every simulation states in a reasonable time, and it represents a robust and fast approach that enable us to simulate detailed geological realizations not allowed be possible with current upscaling methods.

Keywords: Multi-scale Method; Mixed Finite Elements; Reservoir Simulation; Sequential schemes.

Mathematics Subject Classifications (2010): 65M60; 76S05; 76T99;

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