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Hydrodynamic modeling of petroleum reservoirs using simulator MUFITS

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MUFITS is new noncommercial software for numerical modeling of subsurface processes in various applications (www.mufits.imec.msu.ru). To this point, the simulator was used for modeling nonisothermal flows in geothermal reservoirs and for modeling underground carbon dioxide storage. In this work, we present recent extension of the code to petroleum reservoirs. The simulator can be applied in conventional black oil modeling, but it also utilizes a more complicated models for volatile oil and gas condensate reservoirs as well as for oil rim fields.

We give a brief overview of the code by providing the description of internal representation of reservoir models, which are constructed of grid blocks, interfaces, stock tanks as well as of pipe segments and pipe junctions for modeling wells and surface networks. For conventional black oil approach, we present the simulation results for SPE comparative tests.

We propose an accelerated compositional modeling method for sub- and supercritical flows subjected to various phase equilibria, particularly to three-phase equilibria of vapour-liquid-liquid type. The method is based on the calculation of the thermodynamic potential of reservoir fluid as a function of pressure, total enthalpy and total composition and storing its values as a spline table, which is used in hydrodynamic simulation for accelerated PVT properties prediction. We provide the description of both the spline calculation procedure and the flashing algorithm. We evaluate the thermodynamic potential for a mixture of two pseudo-components modeling the heavy and light hydrocarbon fractions. We develop a technique for converting black oil PVT tables to the potential, which can be used for in-situ hydrocarbons multiphase equilibria prediction under sub- and supercritical conditions, particularly, in gas condensate and volatile oil reservoirs. We simulate recovery from a reservoir subject to near-critical initial conditions for hydrocarbon mixture.

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