Dynamic Modelling of Solution-Gas Drive in Heavy Oils

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ABSTRACT

Abstract

Some of heavy oil reservoirs in Canada show a typically high production rates and high primary oil recoveries under solution gas drive. In this paper we develop a dynamic model which captures many important processes that affect oil recovery. The non-equilibrium early time behaviour is modeled by introducing a first order kinetic equation. The equation is derived based on an analysis which takes into account instantaneous bubble nucleation and diffusion-based bubble growth. Furthermore, the decay of bubbles due to coalescence is included in the model. A second component of this model captures the low gas mobility and its dependency on withdrawal rate and oil viscosity. The proposed relative permeability function depends not only on gas saturation but also on a dimensionless group that accounts for the effect of viscous forces on gas mobility. The model is used to predict oil recovery from 1-D depletion experiments. It is shown that the modifications suggested in this model enable predicting many of the unusual behaviour observed in solution-gas drive in heavy oils, including high recovery and low producing GOR.