

# A Black Oil Model for Primary and Secondary Oil Recovery in Stratified Petroleum Reservoirs

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## Abstract

Black-oil simulators are commonly used in petroleum reservoir engineering for the prediction of oil production, especially during the earlier stages of oil-field exploitation, while also serving to guide pressure maintenance strategies in the longer term. Such models account for fluid flow through the porous structure using generalized 2-phase expressions of the Darcy equation combined with appropriate experimentally-determined fluid formation volume factors and solution ratios to implement the effects of fluid compressibility and dissolved species at elevated reservoir pressures.

An appropriate, numerically stable, formulation of the black-oil model, based on the oil phase pressure and total fluid velocity, is developed and solved numerically using COMSOL Multiphysics. The Partial Differential Equation (PDE) interface in the general and coefficient forms for time dependent analysis is utilized, along with the appropriate initial and boundary conditions. This work constitutes the first attempt to formulate the actual black-oil scheme in the framework of the COMSOL PDE platform.

In this contribution, we present the application of the black-oil model in common oil recovery processes ranging from the natural pressure-driven fluid expansion, solution gas-drive to more elaborate pressure maintenance strategies relying on water-flooding and water-alternating-gas in a typical stratified and anisotropic petroleum reservoir.

## Figures used in the abstract

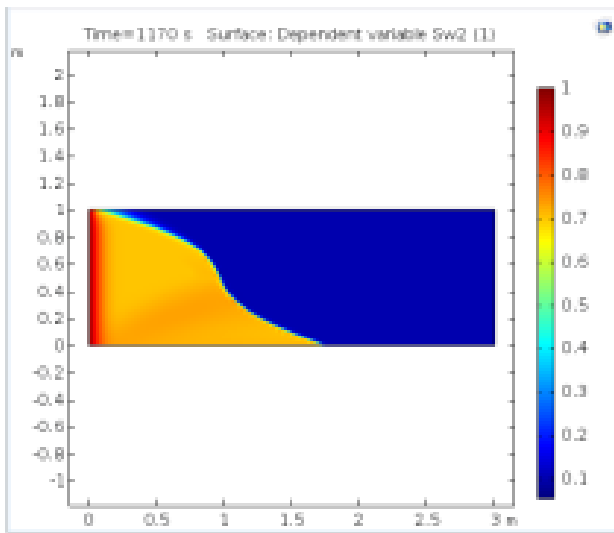


Figure 1