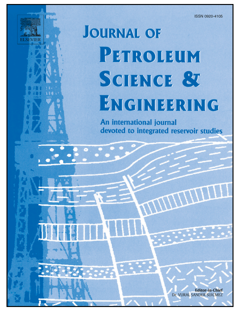

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Use of dimensionless scaling groups to interpret reservoir simulation results

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Abstract

In conducting studies to make reservoir management decisions, it is important to efficiently interpret results of reservoir simulations. An understanding of how and why predicted reservoir performance changes with model parameters guides evaluation of production strategies as well as exploration of the impact of uncertainty in reservoir description. The aim of this work is to demonstrate the use of dimensionless scaling groups to interpret and qualitatively predict simulation results of multiphase flow in subsurface reservoirs with a large number of wells. Dimensionless scaling groups which quantify the balance between the forces causing fluid flow were computed between well pairs to rationalize simulation results. The data required to partition the model according to injector-producer pairs and estimate the scaling groups were obtained within minutes using simplified, single-phase numerical experiments. We show that scaling groups can be used to classify multiphase flow behaviours observed over the field into a small set of flow regimes characterized by the combination of their dominant forces. Changes in fluid distribution and reservoir performance with the model parameters can be analyzed in terms of changes in the force balance, and qualitatively predicted using the scaling groups. Predictions made using scaling groups may guide, and thereby reduce the use of, time-consuming multiphase flow simulations to optimize field development plans, to improve the calibration of reservoir models to production data and interpreted subsurface heterogeneity, and to assess the impact of reservoir uncertainties on production.

Keywords: Scaling groups, Dimensionless numbers, Reservoir heterogeneity, Flow diagnostics, Reservoir prediction

1. Introduction

Numerical simulation of subsurface flow plays a critical role in providing forecasts of hydrocarbon production based on a set of subsurface data, reservoir assumptions and production constraints. In common reservoir engineering practice, reservoir models are calibrated so their predictions agree with

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