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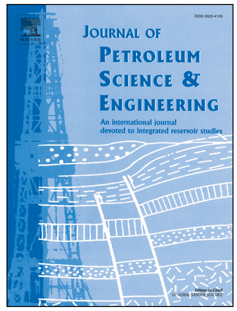

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Mohammad Rashedi, Ouguan Xu, Seraphina Kwak, Shabnam Sedghi, Jinfeng Liu,
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An Integrated First Principle Modeling to Steam Assisted Gravity Drainage (SAGD)

Mohammad Rashedi[a], Ouguan Xu[b], Seraphina Kwak[a], Shabnam Sedghi[a], Jinfeng Liu[a], and Biao Huang[a,*]

[a] Department of Chemical & Materials Engineering, University of Alberta, Edmonton, AB T6G 2V4, Canada
[b] Zhijiang College, Zhejiang University of Technology, Hangzhou 310024, China

Abstract

In this work, we present the development of a mathematical model and simulation algorithm for the three key constituents of the steam assisted gravity drainage (SAGD) process, namely the steam generator, the steam injector, and the steam chamber. The modeling equations are derived by applying the conservation principle and adopting several empirical/algebraic correlations that support state estimation. In order to avoid the excessive design complexity and the computational load involved in existing models in the current literature, we attempt to develop the reduced-complexity models so that they can be compatible with the state estimation schemes and useful for control related applications. The developed models for the steam injector and the steam chamber are validated through either the simulation results of Petroleum Expert as a reservoir simulator or the similar models in the literature.

1 Introduction

A growing energy demand and depletion of fossil fuel resources have stimulated intensive research in recovering bitumen through oil sands processes. Having the world's largest crude bitumen resource, Canada's bitumen reserves are comparable to the conventional oil resource in the Middle East. Alberta contains almost all of the heavy oil and bitumen deposits in Canada and the majority of these deposits are located in Athabasca. Around 20% of oil-sands reservoirs have a shallow overburden depth of only 40 to 75 meters which makes them suitable for mining and extraction; however this method can cause significant landscape disruptions. The rest of the bitumen deposits are too deep and have to be recovered by underground or in-situ recovery methods [1]. Although in-situ methods are alternative solutions for recovery of deep tar sands reservoirs, the difficulties

*Corresponding author: B. Huang. Tel: +1-780-492-9016. Fax: +1-780-492-2881. Email: biao.huang@ualberta.ca.

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