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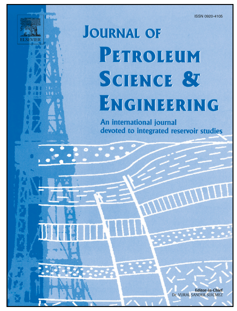

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Numerical Modeling of Multiphase Steam Flow in Wellbore

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Abstract

Steam injection is applied as a technique to extract heavy oil due to the fact that thermal energy carried by steam can heat reservoir and hence significantly lowering oil viscosity. One important thing in steam injection is to ensure more heat injected can reach perforation interval but not lost to surrounding formation when steam flows through wellbore tubing. In other words, steam quality is demanded to be as high as possible when steam reaches reservoir. In addition, more studies are required on unsteady state (transient) flowing process, since the rapid temperature and pressure change in unsteady state flowing process may make pipe components work under a severe condition and increasing the risk of mechanical damage.

In this work, a fully-implicit numerical model is developed to predict steam quality, temperature and pressure profiles along a vertical steam injection well. The model includes wellbore section and surrounding formation and employing a heat transfer coefficient to calculate heat loss from wellbore to formation. In wellbore section, detailed mass balance equation, momentum balance equation and energy balance equation are utilized as governing equations and a drift-flux model is integrated to simulate the multiphase steam flow. Heat transmission inside formation section is expressed by a two-dimensional Fourier heat conduction equation. The whole system of differential equations are discretized by refined grids and solved implicitly by Newton-Rapson method. Formulation of complete governing equations (e.g. accumulation terms are not