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A New Approach to Stimulating Thin and Stranded Oil Sand Reservoirs: A Simulation Study

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Abstract

Several recovery processes have been proposed for heavy oil and oil sand reservoirs, depending on the reservoir and fluid properties. Among these, steam-assisted gravity drainage (SAGD) is widely used, and surface mining is considered the best approach in very shallow depths. However, deposits exist that are too shallow for SAGD but too deep for mining, requiring special techniques to recover the hydrocarbon economically. In addition, significant reserves are left behind as stranded reserves, as well as reserves that are usually characterized with weak caprock integrity and without enough pay thickness for SAGD to be economically viable. This paper focuses on a new technology that involves creating several mechanically induced inclusions in a single well. The production process is similar to a single-well SAGD. This method is proposed to assist both more uniform steam injection and bitumen production processes. The current setup is developed for vertical well applications; however, upon successful planning, the next version will be employed for horizontal applications.

The current system consists of a vertical well with multiple vertical inclusions, which are used for simultaneous steam injection and liquid production purposes. Steam is injected into the upper part of the formation, and the drained liquid is collected at the bottom of the inclusions. Unlike the conventional steam chamber geometry in SAGD processes, steam moves outward from the inclusion faces into the formation and tends to move laterally out and vertically upward over time. Simulation studies of the system show that the success of such a technique depends on the inclusion dimensions as well as injection rate and pressure. In this study, the effects of inclusion dimensions and steam properties on the performance of such a process are investigated. Reservoir simulations of realistic reservoir conditions show promising results in terms of cumulative steam oil ratio (CSOR) and production rate. Early peak oil production occurred at approximately 100 days from the startup, and the CSOR dropped to under 3 m^3/m^3 after 100 days. The optimum inclusion dimensions and the best injection scenario for different net pays at different depths and geological conditions are illustrated in the paper.

Introduction

The province of Alberta is host to numerous thermal application processes designed to reach and produce the large deposits of bitumen in oil sand formations. Because the oil is practically immobile in the bitumen