Society of Petroleum Engineers

SPE-184976-MS

Application of Multiazimuth Vertical Planes MAVP to In-Situ Extraction of Heavy Oil from Shallow and Stranded Oil Sands

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This paper was prepared for presentation at the SPE Canada Heavy Oil Technical Conference held in Calgary, Alberta, Canada, 15-16 February 2017.

Abstract

Throughout the past five decades, the heavy oil industry has developed various in-situ techniques for oil recovery from the vast global heavy oil reserves. The diversity of these techniques goes hand in hand with the diversity of the world reserves in terms of viscosity, burial depth, and reservoir complexity. Reservoirs exist, however, wherein the currently available commercial methods might not be technically and economically feasible. In particular, reservoir quality and caprock integrity can impose significant limitations on the feasibility of conventional methods, such as steam assisted gravity drainage (SAGD). This paper summarizes the results of a series of field trials in weakly cemented formations based on the creation of highly conductive multiazimuth vertical planes (MAVP) in soft formations. These planes are mechanically initiated and hydraulically propagated and have typical dimensions of 0.03×5×30 m and can be used in a new steam injection design. The potential application of this technique to enhanced oil recovery is investigated using a thermal reservoir simulator.

Reservoir simulations show promising results in terms of cumulative steam oil ratio (CSOR) and oil production rate. Stabilized production was observed immediately after the startup and CSOR dropped to under 3.0 m^3/m^3 in less than two years. The overall performance is nearly comparable to that of conventional SAGD, while it outperforms SAGD in certain conditions, including low vertical permeability and in the presence of low permeable shale streaks. Simulation results show that the performance of MAVP is nearly unimpaired when planes' projection is discontinuous in either vertical or horizontal directions. The results also showed that the presence of a confined top water zone does not have a detrimental impact on the performance of MAVP; however, penetration into the top water zone must be avoided to achieve the best results in terms of CSOR. While surface mining and variations of SAGD are respectively used for very shallow and relatively deep reservoirs, the new methodology is applicable to reservoirs in the depth range of 70 to 600 m, where weak caprock integrity can impose a significant challenge. In addition, complex reservoir features, such as the presence of low permeable shale layers or low vertical permeability, have minimal effect on the performance of this technique.