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Title Potential of Multilateral Wells in Water Coning Situations
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Abstract

This paper presents the results of a numerical study performed in order to confirm the merits of a multilateral well to replace a pattern of parallel horizontal wells to produce an oil reservoir in the presence of a bottom aquifer. The basic assumptions for the study are a same total drilled length from the surface for both production patterns and a homogeneous reservoir. The production of an elementary volume of width a, length L, oil thickness h and depth is simulated considering n parallel horizontal wells of length L or just a single multilateral well composed of a main hole of length L and lateral arms of length a/2 perpendicular to the main hole.

Results of the numerical study show that the reduction of coning is very important with the multilateral well. For instance, for a 14 m thick oil reservoir located at a depth of 1000 m, the oil recovery with the multilateral well is 1.7 the recovery of its equivalent pattern of horizontal wells. A three times increase in oil recovery is even obtained within a 4000 m deep reservoir indicating that the oil recovery is significantly improved by increasing the number of lateral arms and reducing the drawdown applied to the reservoir.

These results confirm the interest of developing and producing an oil field using multilateral wells rather than conventional horizontal wells.

Introduction

Many oil (and gas) reserves in the world are found in reservoirs that are underlain by a bottom aquifer. When a well drilled in the pay zone is put on production, it experiences more or less rapidly what is defined as the coning phenomenon. Water rises from the water leg to the perforated interval and breaks through at the well. Once water has entered the well, water production increases with the detrimental consequences of declining oil production and higher operating costs. A factor which contributes to coning is the potential drop or drawdown near the wellbore due to production.

Because of its extended exposure with the reservoir, a horizontal well usually has less pressure drawdown for a given production rate than does a vertical well. Moreover, the standoff from the bottom water can be maximized with the horizontal well located high in the oil pay. For 15 years now, these specific advantages of horizontal wells have been at the basis of their successful and intensive use to replace vertical wells to produce oil reservoirs in the presence of a bottom aquifer or a gas cap. Undoubtedly, it can be stated that horizontal wells have become the standard procedure to produce these reservoirs.

At the same time, in the last few years new developments in drilling technology have allowed the drilling and completion of multiple lateral wellbores from a single, horizontal or vertical, primary wellbore. In fact, what is achievable with multilateral wells is the capacity to travel within the formation to steer the well in several directions to the oil. Another obvious advantage of using a multilateral well to replace several conventional horizontal wells is that the drilling of the non reservoir sections before the actual entrance into the reservoir is done only once. For the same total drilled length from the surface, the fraction of the wellbore exposed to the reservoir is therefore greater with the multilateral well. In coning situations, such as production of oil reservoirs with a bottom aquifer or a gas cap, a larger exposure to the reservoir implies a reduced drawdown on the formation and a larger drainage area. Thus, reduction in water coning effects is expected with a multilateral well with the benefits of greater oil recovery and substantial reduction both in investment and operating costs and in surface environmental exposure.

The objective of this paper, from a numerical study, is to demonstrate the potential of using a multilateral well instead of several parallel horizontal wells to economically increase and accelerate the overall recovery of oil in reservoirs underlain by an active bottom aquifer. The main assumptions considered in this study are: a homogeneous formation, no gas cap, same total drilled length from surface for the pattern of parallel horizontal wells and for the multilateral well.