Optimal Application of Rejuvenation Technologies to Increase Hydrocarbon Recovery Based on Sensitivity Analysis of Reservoir Modeling Variables

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Abstract

Although the rejuvenation of shale reservoirs has been successful in many cases, the complexity of the intervention process brings along with it many variables that still need to be better understood. The absence of information from sources such as production logging tools, microseismic and tracers make it challenging to identify zones where re-stimulation would be beneficial. The objective of this study is to optimize the application of rejuvenation technology on an existing well by understanding its impact on the reservoir, to be able to accelerate or even increase hydrocarbon recovery. In particular, this paper focuses on reservoir simulation modeling of horizontal unconventional wells that have employed rejuvenation technologies such as fluid diversion and a method of selective zone treatment. We show that renewed focus on understanding reservoir response to various rejuvenation technologies will enable us to provide informed solutions.

The production history matched reservoir model of the wells simulates the injection, flow-back, shut-in and production periods during the initial and re-stimulation treatments. Pressure-dependent permeability variation and the effect of capillary pressure are included to simulate the varied dynamics of the reservoir. While employing the use of fluid diversion, significant uncertainty lies in understanding how the fluid pumped during re-stimulation affects initial completions and untouched zones. This study presents a sensitivity analysis on various cluster efficiencies that may be possible while using fluid diversion, in order to understand its impact on recoverable reserves. As selective zone treatment is modeled, a key challenge is to identify untapped reservoir potential. We model the reservoir response based on effective pressure depletion of the reservoir over time.

This study provides an insight into parameters that are influential in effective depletion of the reservoir as well as an understanding of the short-term and long-term consequences of rejuvenation technologies. When planning an optimal rejuvenation treatment, these parameters ultimately affect the economics of the decision-making process. We also provide a methodology to effectively model these technologies to estimate recoverable reserves and hence, make informed decisions about the application of various rejuvenation technologies.