An Integrated “Model-based” Methodology To Construct Type-well Profiles In Unconventional Reservoirs

Author block: D. Ilk, C. Holasek, N. Hosseinpour-zonoozi, E. Bryan, R. Richard, DeGolyer and MacNaughton

Abstract

Objectives/Scope: Type-well profiles in unconventional reservoirs play an important role in field development planning and asset life cycle. The construction of type-well profiles is, at first glance, generally considered to be an easy task; however, after many years of unconventional reservoir development in North America, experience has illustrated that constructing type-well profiles is challenging due to the complexities of these reservoirs. We present an integrated “model-based” methodology to construct type-well profiles that address the shortcomings of traditional methods and provides guidance on procedures based on the maturity of development phase.

Methods, Procedures, Process: The proposed methodology includes time-rate-pressure data along with reservoir properties and well completion data. The methodology proposed to construct type-well profiles includes three key elements: (1) diagnostics of well production performance and identification of characteristic behavior, (2) model-based (rate transient) analysis of representative well(s), and (3) fracture modeling to characterize fracture geometry for representative wells. Based on these steps, a representative model, including uncertainty on key parameters, is obtained, and this model can be adjusted to account for future well completions and spacing considerations.

Results, Observations, Conclusions: Standard/traditional methodologies to construct type-well profiles in unconventional reservoirs are mainly based on statistical/averaging techniques established with decline-curve analysis. While the results can be described easily, it has generally been observed that production from new wells can easily be over-estimated or under-estimated, since these methods are empirical in nature and cannot account for changing reservoir properties, fracture geometry, or well spacing.

In this work, we provide examples from several unconventional plays in the United States that demonstrate the proposed methodology. General conclusions are stated as follows:

• Diagnostics of production performance illustrate the exhibited flow regimes and assist with the identification of the characteristic production behavior which is attributable to the area of interest.

• The incorporation of history-matching the as-pumped conditions from fracture modeling eliminates the uncertainty associated with fracture geometry obtained from model-based analysis.

• The calibrated model is used to generate future production profiles based on a specific pressure drawdown, well completion, and well spacing.

• The resulting profiles can be translated to a standard decline-curve equation (e.g., modified Arps’ hyperbolic) to be used in economic analysis.

• Various economic runs are performed to investigate favorable development conditions based on a specific well spacing and completion.

Novel/Additive Information: The application of the proposed methodology in emerging plays with short production history has considerable potential with resource classification and development planning. The incorporation of a model calibrated by rate transient analysis and fracture modeling is able to capture implied flow behavior and predict potential changes based on various development considerations. These results are compared against standard averaging-based techniques to identify limitations and provide opportunities for future implementation in the construction of type-well profiles.