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Numerical Study of Impacts of Effective SRV on Tight Oil Production Coupled with Reservoir Geomechanics

Sheng Yang, Wei Wu and Zhangxin Chen
University of Calgary

Summary

Establishing a stimulated reservoir volume (SRV), which is mainly illustrated by microseismic events cloud, is one widely accepted approach to represent and evaluate hydraulic fracturing performance. However, microseismic interpretation cannot fully illustrate hydraulic fracture properties, which makes an estimated SRV uncertain. Microseismic data interpretation, lithology interpretation, rock mechanical tests, flow back tests and rate transient analyses are usually integrated to identify the effective part of a SRV and improve the accuracy of estimating a SRV. As a result, an estimated SRV is not unique through different approaches. However, the influences of different SRV scenarios and their characterizations on tight oil production are not well understood and neglected in previous studies.

In this study, based on core measurement and FMS log interpretation, the presence of natural fractures is conceptually represented by a dual-permeability reservoir model. According to lab measured rock mechanical properties, a geomechanical module updates porosity, permeability and fracture conductivity simultaneously. History matching from a horizontal tight oil production well is performed to validate this reservoir model. Different effective SRV scenarios are established based on different evaluation principles. Then simulation runs with these different SRV scenarios are performed to illustrate different well performance. The influences of an effective portion of a SRV, hydraulic fracture morphology, a volume size of a SRV and SRV continuity on tight oil production are also thoroughly investigated.

The study results demonstrate that a production rate and a decline curve are majorly controlled by an effective portion of a SRV and morphology of a SRV. Cumulative oil is not strongly correlated with a SRV size. An ineffective SRV has very little contribution to oil production, and the complexity of a SRV complicates initial undrained areas. Coupled geomechanics simulation results show that the geomechanical effect generally cause 20% reduction in the cumulative oil. This paper provides operators with a clear insight of impacts of the effective portion of a SRV and other SRV characterizations on tight oil performance and optimization of a well treatment design.