CULLEN COLLEGE OF ENGINEERING UNIVERSITY of HOUSTON

DOCTORAL

DISSERTATION DEFENSE ANNOUNCEMENT

AT THE CULLEN COLLEGE OF ENGINEERING

The Petroleum Engineering Department Presents

An Analytical Approach to Modeling Formation Fracturing

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May 4, 2023; 3:00 PM - 5:00 PM (CDT)

Location: Room 123, Technology Bridge, Bldg 9

VooV: https://voovmeeting.com/dm/y0WPg12llBmS

Committee Chair:

Syed M. Farouq Ali, Ph.D.

Committee Co-Chair:

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Committee Members:

James Sheng, Ph.D. | Kyung J. Lee, Ph.D. | Zeinab Zargar, Ph.D.

Abstract

Commercial numerical simulators with different capabilities and features have been developed and are used for hydraulic fracture modeling and tests. Most commercial numerical simulators are not open source, making it difficult for researchers to see the theory behind the simulators to explain and analyze the difference between the simulations and field data. This research presents a complete model for hydraulic fracturing based on different fracture geometries for multi-fractured horizontal wells (MFHW) for performance evaluation with detailed methodology and procedures.

Single fracture modeling is first studied as the foundation of this research. Carter model is a static fracture geometry model with a constant fracture width for a specific time. The strength of this model is that its area geometry can be arbitrary, which provides scenario flexibility. The fracture width of

the Pattillo model has an exponential variation relationship with time. The Hagoort and modified Carter model can generate both time-and-location-dependent fracture widths, which are more realistic and approach the real field cases. The complex branched-fracture model is used to model the pressure and flow rate of the flowback period for infinite and finite conductivity cases via fracture permeability calculated by the Kozeny-Carman equation and its extensions. The Perrine and Martin method is used for multiphase flow pressure and flow rate derivations.

The single fracture pressure solution is superimposed in the Laplace space for two dissimilar fractures and used to derive the flow rates via pressure gradients. The procedure can be extended to any number of fractures though illustrated for two fractures.

The results are extensively validated against the multiphase flow predictions of a commercial simulator for a multifracture system. The agreement between the analytical solutions and the simulator results is very good for all cases studied. Limitations of the present methodology are outlined for potential improvements in future studies.