CULLEN COLLEGE OF ENGINEERING UNIVERSITY of HOUSTON

DOCTORAL DISSERTATION DEFENSE ANNOUNCEMENT

AT THE CULLEN COLLEGE OF ENGINEERING

The Petroleum Engineering Department Presents

New Models and Analysis Techniques for Diagnostic Fracture Injection Tests

Ibrahim Eltaleb

July 13th, 2023; 1:00 PM - 3:00 PM (CST)

Location: Technology Bridge Building 9, Classroom 104

Zoom: https://uh-edu-cougarnet.zoom.us/j/3764002223?pwd=VnRDVzhOaUhWZkl1ZEtmSEJEZnJxdz09

Meeting ID: 376 400 2223 Passcode: 7132023

Committee Chairs:

Mohamed Y. Soliman, Ph.D. | S. M. Farouq Ali, Ph.D.

Committee Members:

Birol Dindoruk, Ph.D. | George K. Wong, Ph.D. | Hossein Emadi, Ph.D.

Abstract

This dissertation comprehensively explores various aspects of hydraulic fracturing diagnostic testing with a primary focus on accurately assessing in-situ stresses and determining formation permeability. Traditional fracture injection/shut-in tests (DFIT's) play a critical role in this assessment; however, their applicability is limited in ultra-tight formations due to prolonged test durations. To overcome this challenge, pump-in/flowback tests have been employed to expedite the testing process. However, the use of pump-

in/flowback tests has declined due to uncertain and inconclusive results obtained from existing techniques found in the literature.

To address these limitations, this dissertation proposes an innovative analytical model that overcomes the challenges associated with estimating minimum stress. The model significantly reduces the need for multiple field trials to achieve the desired flow rates, ultimately enhancing the efficiency of hydraulic fracturing diagnostic testing. The effectiveness of the model is demonstrated through the analysis of DFIT field examples that involve complex natural fractures. Importantly, this model offers an advantage over current methods by providing improved insights into injection/flowback testing, particularly when the flowback procedure fails to consistently indicate fracture closure. This may be attributed to increased near wellbore tortuosity.

Furthermore, this dissertation introduces an innovative approach for calculating formation permeability and reservoir pressure by analyzing the rebound pressure observed following pump-in/flowback tests. This approach enables the analysis of the post-closure period without the need for conventional injection tests, providing a significant time advantage.

Moreover, a novel signal processing-based methodology is proposed to effectively denoise the test data and analyze fracture injection tests. Unlike conventional techniques, this methodology does not rely on assumptions regarding fracture geometry and rock properties. Additionally, it takes into account the impact of heat exchange between the fracturing fluid and the hot rock, surpassing the limitations of conventional tools.

The developed models and analysis techniques are meticulously validated through comprehensive numerical simulations and rigorous field measurements. The cumulative findings of this dissertation make significant contributions to advancing the understanding and optimization of hydraulic fracturing and flowback testing processes. These insights hold significant value for the industry, fostering improved practices and outcomes in hydraulic fracturing operations.