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Validation and Extension of a New Cost Effective Method for Estimation of Formation Pressure in Unconventional Reservoirs

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Abstract

Tight gas and shale gas reservoirs have seen increased activity over the past few years. Horizontal wells and multiple transverse hydraulic fractures have played a crucial role in making production economically viable from such low permeability scenarios.

Critical to production using these techniques and to reservoir management is accurate estimation of reservoir flow properties, stress state in the formation, and pore pressure. Traditionally, buildup tests have been used to measure permeability and initial pressure of a reservoir. These tests however do not translate well from conventional to unconventional reservoirs, since low permeability causes the tests to be uneconomically long.

Instead, unconventional reservoirs are analyzed using tests called fracture calibration tests or DFIT's. By analyzing before and after closure trends of fractures, the reservoir permeability, initial pressure and the closure stress of the reservoir can be estimated.

This work proposes an improved model for a method proposed as an alternative to fracture calibration tests. Fracture calibration tests can be expensive and can take unreasonably long times to perform and analyze. Our new test, called the Baseline/Calibration method, involves injection of water at varying rates, separated by intervals of falloff. By analyzing the trends of pressure versus invasion, the permeability and initial pressure can be measured quickly and effectively.

In this work, the baseline/calibration method is modeled rigorously using a moving interface composite reservoir model. Generalized plots for pressure profile after each injection and falloff stage are created using the model. From the results, field recommendations are made on the best way to efficiently design a program for reservoir characterization.