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Please fill in your abstract title.	A New Technique for Quantifying Pressure Interference in Fractured Horizontal Shale Wells

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Abstract

Objectives/Scope:
Pressure communication is commonly observed in fractured horizontal shale wells, particularly at early times when wells are placed on production. This paper will present a new technique, based on the diffusion exponent from the power-law model, to quantify connectivity in multi-stage hydraulic fractured wells with complex fracture networks. In addition to explaining the theory and analysis techniques, we will present examples utilizing measured bottom-hole pressure (BHP) from the Permian Basin Wolfcamp Shale, which illustrate the utility of this technique to better understand the relationship between completion size, well spacing, and well performance.

Methods, Procedures, Process:
Chen and Raghavan (2015) recently developed a one-dimensional, fractional-order, transient diffusion equation to model fluid flow in complex geological media. They showed power-law behavior is the norm in unconventional reservoirs such as Permian Basin Wolfcamp Shale. Under the framework of power law behavior, we plot pressure interference test (PIT) data in terms of the Chow Pressure Group (CPG), which enables us to define an indicator of connectivity reflecting temporal and spatial effects. On each test, we derive a diffusion exponent reflective of the magnitude of pressure interference (MPI). We will show among other things that multiple PITs over time often indicate degrading connectivity between wells.

Results, Observations, Conclusions:
From PIT analyses in Permian Basin Wolfcamp Shale, we were able to establish a relationship between MPI and well spacing. The first example demonstrates analyses of PITs between wells during the production phase and also shows how connectivity between wells diminishes over time. A second example applies the same analysis techniques to quantify inter-well connectivity during the post-stimulation phase by analyzing a pressure falloff (PFO) after communication with other wells. A third example illustrates an application of desuperposition to remove the effect of a power-law pressure trend on interference tests.

Novel/Additive Information:

Techniques to analyze PITs assuming radial or linear flow have been previously developed; however, Raghavan and Chen (2018) showed apparent radial or linear flow could exist under anomalous diffusion for heterogeneous reservoirs. In this work, we present a technique for analyzing power-law PIT data, which is typical of most horizontally fractured shale wells. This model is a unique approach to understanding flow behavior, quantifying well interference, and analyzing & predicting well performance in unconventional reservoirs. Our examples, which are based on high-quality BHP gauge data, show how this technique could shorten the cycle time for operators to determine the well spacing for a given completion design.