Properly Conducting a DFIT™ Testing Service

For the past several years, the majority of tests performed are pre-frac injection fall-off tests aka DFIT™ test (Diagnostic Fracture Injection Test). Analysis of the DFIT™ test data is highly sensitive to the pressure data acquired, necessitating both high quality pressure/rate measurement and proper test design and execution.

When performing a DFIT™ service, it is essential to utilize a surface gauge with the ability to record high frequency, high resolution, temperature compensated data. Detection of subtle pressure changes over a short period of time is essential in analyzing the fall-off data accurately. In addition to quality pressure measurement, a DFIT™ test also requires a precisely recorded injection data. Simultaneous acquisition of rate and pressure data provides the engineer a better understanding of operational activities during the test and will improve the results of the subsequent analysis of the DFIT™ test data. Without this data, it is not uncommon for operators to receive poor quality rate data or no rate data at all. To effectively analyze the data, knowledge of the pumping rate, rate stability, fluid volume, and pump shut down is important.

Furthermore, it is necessary for the DFIT™ test to be conducted properly in order to get an accurate analysis from the fall-off data. The injection period is the most critical part of this test. Service companies must exercise caution when pumping low rate, low volume jobs as small errors while pumping can result in significant error/uncertainty in the analysis. There are key events which must be observed during a properly conducted pump-in. Initially while injecting pressures should steadily increase as the injection fluid is compressed in the wellbore. Next, there should be an indication of formation breakdown in order to establish communication with the reservoir. Pressures should also decrease as the fluid column relaxes during breakdown. After breakdown is observed, fluid is pumped until the planned volume is achieved or pressure has stabilized. While injecting, it is important to maintain a steady, constant rate to help determine breakdown and for verification of pressure stabilization. Halliburton routinely encounters pump-ins where the rate was not stabilized and volume was not accounted for, making the test difficult to analyze accurately.

Below are several examples of pump-ins which were performed poorly and examples of pump-ins we believe were performed correctly. Some of the poorly conducted pump-ins made the fall-off difficult to analyze while others made the analysis impractical.

Figure 1 is an example of a pump-in where rate was lost immediately following the injection period. It was hard to determine when the pumps were shut down and what exactly happened during the test. In this instance it may have been helpful to have the rate data to aid in determining what may have occurred.
Figure 1: Pressure was lost immediately after pump-in

Figure 2 displays a DFIT™ test where both pressure and rate were recorded. In this case rate was not held constant during the injection period.

Figure 2: Rate was briefly lost during the pump-in

Figure 3 shows an attempted step rate test. While performing a step rate injection it is important that each constant-rate step should take just enough time to allow the pressure to stabilize.
Figure 3: Step rate injection performed poorly

Figure 4 and 5 display DFIT™ tests where pressure and rate were recorded. Rate was held fairly constant and pressure was stabilized prior to shutting down. This resulted in an accurate analysis on both wells.

Figure 4: A properly conducted pump-in
Figure 5: A properly conducted pump-in

Operators routinely use the SPIDR® gauge system in DFIT™ testing services due to its ability to capture high frequency, high resolution pressure data while having the capability to simultaneously record accurate injection rates. It can interface directly with any size turbine flowmeter when using a magnetic “pickup” supplied by Halliburton. Having the rate data will help understand whether or not the DFIT™ test was performed correctly. Field personnel also have the option to watch the rate and pressure real-time via a supplied USB communication cable to help determine if the test is being conducted correctly or to make necessary decisions and changes.

The SPIDR® gauge with turbine meter pickup is available for rental and can be delivered overnight to any U.S. location and within 5 days to most international locations. Halliburton is available 24/7 for your well testing needs. We offer free test planning and consultation and a complimentary DFIT™ test analysis when a SPIDR® gauge is used to capture the surface pressure data.

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