Big Technology Makes the Little Field

THE BACKGROUND
New fracture-mapping technologies allow us to directly measure fracture parameters that were previously only modeled or assumed. Limitations exist, however, with every diagnostic technology and one of the greatest limitations has been the need for a nearby offset monitoring well… until now.

New Dominion LLC is developing a Hunton play in the Little Field of Central Oklahoma. These wells are acid-fractured with no proppant and the geometry of the acid fracs is not well understood. Formation mechanical properties, acid reactivity, and other parameters have made it difficult to model created fracture geometry. Due to lack of nearby offset well locations, Halliburton and Pinnacle’s new Treatment Well Tiltmeters were employed to measure fracture geometry during a live acid fracture treatment.

Although offset well tilt-mapping is well understood and has been utilized on more than 600 frac treatments in the past three years, tilt-mapping from the treatment well brings a new set of challenges. We are measuring minute wellbore movements in the midst of a high-velocity flowstream – fortunately the fracture induced tilt signals are much higher than the induced noise from fluid motion in the treatment well. Fracture height and width are measured in real-time during treatment well tilt-mapping procedures and those dimensions are then used in conjunction with FracproPT to estimate fracture length based on these measurements and matching modeled to actual net pressure data.

PINNACLE PERFORMS
A treatment well array was installed to map real-time fracture growth on the acid fracture treatment in the perforated interval from 4320’ – 4400’. Eight tiltmeters spanned the interval from 25’ below the bottom perforation to 115’ above the top perforation.

The pumping rate was held constant at 20 BPM during the first 10 minutes of the treatment, during which time the fracture height was measured to be contained largely within the perforated interval with at most 30’ of height growth above the...
perforations. After the first ten minutes, pumping rate was increased to 50 BPM and held constant at that rate through the end of the 90,000 gallon treatment. After the rate increase, fracture height was seen to grow rapidly upwards, reaching more than 100' above the top of the perforated target zone within a few minutes. The rapid height growth after the rate increase can be seen on the raw tilt data versus time from the top tilmeter (placed at 4205'). As is seen, the fracture-induced tilt is relatively unchanged until the rate increase and then is seen to rapidly increase as the fracture top approaches this tool. The reversal in tilt response seen at 13:44 is due to the fracture diverting elsewhere (decreasing tilt) and then approaching this depth again. More details are available in SPE 71648.

**THE RESULTS**

From the treatment well tilmeter data, it is clear that the treatment stayed reasonably centered on the target interval during the lower rate pumping stages, but later fracture growth is primarily out of zone during the higher rate pumping stages. Treatment well tilmeters will be used for measuring rate-dependant fracture geometry and making changes to a treatment "on the fly" to help contain the treatment to the pay interval or to avoid undesirable fluid contacts (water zones, gas caps, etc.) In this case, a maximum critical pumping rate was identified and its impact upon fracture geometry can be seen for future design and optimization considerations.