

Left Image: Drill2Frac's engineered diversion input. The OmniLog® plot (top) maps the heterogeneity along the horizontal. Although the heterogeneity here is low to moderate, it is a key factor for effective diversion. Differences in rock strength must be considered in the design, as they might be enough to inhibit diverter deployment.

The gamma ray (GR) log (lower plot) often correlates to changes in rock's mechanical properties but the small changes required for diversion treatment design are often not captured.

Improving Perforating Cluster Efficiency using Engineered Diversion



CHALLENGE

An Eagle Ford operator wanted to better understand diversion results in order to improve cluster performance and reduce operational complexity prior to scaling up operations.

SOLUTION

Model the diversion so that results are more consistent, diverter responses are more predictable and operational complexity is reduced.

RESULTS

Using Drill2Frac's OmniLog® lateral profile, combined with flow simulations performed with PerfAct™ equations, an alternate diversion was designed in collaboration with the operator.

KEY ACTIONS INCLUDED

- ✓ Evaluating the lateral heterogeneity in the horizontal wells by analyzing drilling data.
- ✓ Using PerfAct application to select perforation placements for each stage based on the rock hardness values.
- ✓ Reducing operational complexity by decreasing the number of diverter drops from three to two drops per stage.



Diversion is used to more effectively fracture a well by plugging dominant fractures in order to divert the pressure further down the wellbore. This is to enable more perforations to be effectively stimulated, ensuring a uniform distribution of treatment fluid across the treatment interval. Diverting agents inhibit flow to dominant clusters, distributing the fluid to clusters which may be under-stimulated.

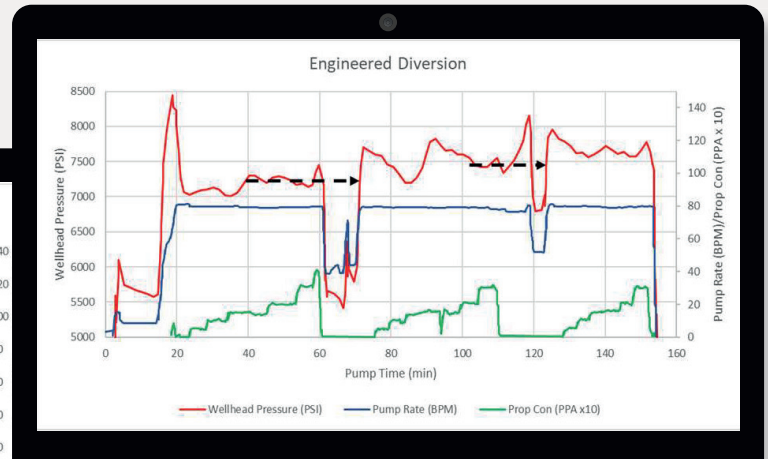
Drill2Frac's Engineered Diversion application analyzes a well's lateral heterogeneity and integrates the analysis with the completion design. This helps model diversion performance. As a result, clusters are stimulated in a consistent, predictable manner resulting in maximum productivity while minimizing screen outs.

(Further: "Getting More From Fracturing With Diversion" S. Rassenfoss JPT June 2017).

CASE STUDY



Below: Standard Diversion: no sustained wellhead pressure increase (red curve) after diverter hits formation on first drops at approximately 62 and 102 minutes.



Above: Engineered Diversion Sustained pressure increase (~250 psi in this case) when the diverter hits the formation, plus a significant change in pressure slope, indicate that new rock is being stimulated after both drops of diverter material. Operational advantages were also realized with a reduction in the number of diverter drops.



Results & Validation

The Drill2Frac Engineered Diversion was validated with a clear indication of positive diversion and a significant reduction in operational complexity for the stages being pumped, going to two diversion drops from three.

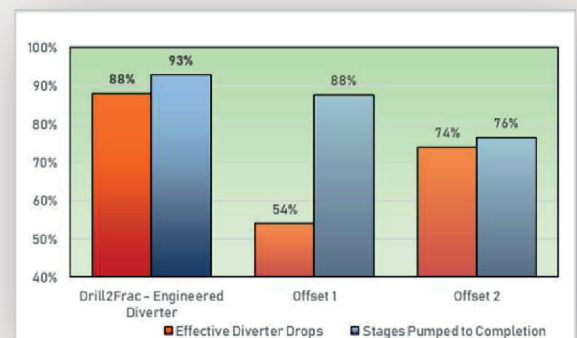
One well was completed using the Drill2Frac Engineered Diversion technique. At the same time two offset wells were completed on the same pad, using a conventional diversion design.

Post-job fracture treatment reports showed that 88% of the diversion drops in the Drill2Frac recommendation were successful. In contrast, the two offset wells averaged 64% effectiveness. Also, the number of screen-outs in the Drill2Frac well was just one-third the number of screen-outs in each of the offset wells.

Engineered Diversion Results vs. Conventional Diversion Results

The chart compares the Drill2Frac technique to two direct offset wells drilled on the same pad, to the same target zone and completed at the same time with a conventional diversion technique.

Pressure response showed that diversion drops were on average 25% more effective when designed around lateral heterogeneity and resulted in 66% fewer stages being terminated early due to excessive diversion pressures.



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