

Case study Fracture Flow

Diagnosing water production and resolving uncertainties in openhole multistage fracturing



Location: Kingdom of Saudi Arabia

Customer: Saudi Aramco

Well type: Horizontal gas producer with multistage fracturing completion

Reference: SPE-204668

Case benefits

- Conducted production fracture flow evaluation behind the liner with advanced acoustic and flow modelling diagnostics, and inside the liner with a production log
- Enabled a reduction of water production in a stimulated lateral well
- Confirmed that all fracturing ports were active and productive
- Assessed the number of active fractures and confirmed a positive correlation between interval length and fracture density
- Identified bypassed packers and evaluated effectiveness of dual mechanical isolation packers to prevent interstage communication

Challenge

Multistage fracturing is a highly effective development strategy for ultralow- to low-permeability reservoirs. However, in uncemented completions with fracturing sleeves and packers, it can be challenging to identify fracture initiation points and confirm the number of fractures initiated in each treatment.

A lateral wellbore in a horizontal gas producer was completed with more than 3,000 ft of open hole (OH) section across five fracturing stages in a high-temperature and high-pressure tight-gas interval. This well presented several key challenges.

- With OH intervals ranging from 200 to almost 1,000 ft, the operator could not be sure how many fractures had been created or where precisely these fractures were located.
- The initial stage plan was not sufficient to guide packer placement. Placement had to be decided in conjunction with the caliper log and gauged hole analysis.

- Interstage communication owing to packer bypass or ball failure is a common problem in completions of this kind. This can be caused by higher differential pressures being exerted on the packers during fracturing.

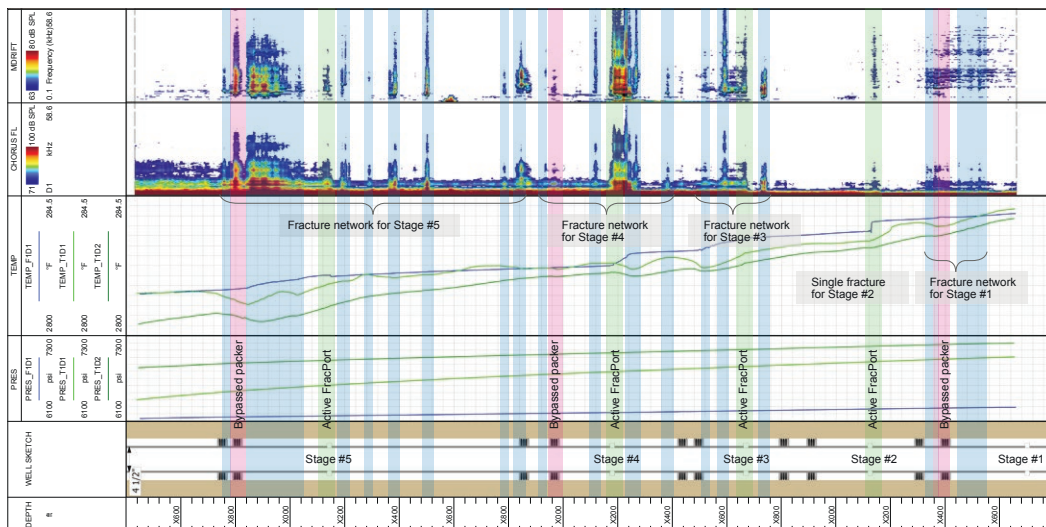
Solution

Fracture Flow is delivered by TGT's analysts and engineers using the True Flow system with Chorus and Cascade platforms. Integrating insights from a Chorus acoustic survey and Cascade temperature and flow modelling with the production logs, OH logs and calculated rock mechanical properties provides a better understanding of the fracturing process, completion performance and production performance in an OH multistage fracturing completion.

Chorus acoustics and Cascade flow modelling provided a quantitative assessment of flowing fractures and stagewise production from the reservoir behind the liner.

Figure 1

Active frac ports and fracture distribution across all stages and three bypassed packers.



Multi-array production logging results quantified the flow and flow profile inside the horizontal liner. The integration of datasets was conducted in a single deployment to deliver a comprehensive understanding of well completion and production, including clear identification of water-producing intervals.

Result

The Fracture Flow diagnostic programme evaluated the active fracture ports and fracture contribution in each stage. It also enabled the team to assess the packers, completion integrity, and production distribution behind the liner (Figure 1). Multi-array production logging was used to investigate the flow profile entering the liner.

The survey results identified 34 active fractures and showed that some flow was bypassing several packers. Figure 2 shows the reservoir flow profile provided by Cascade and the True Flow system. Most fractures were clustered around Stage 4 and Stage 5, and this had a major impact on production. Survey results revealed good completion integrity overall, with only three bypassed hydraulic packers. The dual packer isolation systems were shown to prevent communication between contributing stages.

Based on the comprehensive analysis result the water being produced from all fracture entry ports except Stage 5, where water contribution was minimal. Engineering work decreased the water-gas ratio to 5%.

Figure 2
Flow geometry and contribution across the horizontal section.

