

BroadBand Sequence Service Increases Productivity Index More Than 600% in Refractured Shale Well

Advanced sequenced fracturing service doubles oil and gas production rates while quadrupling flowing pressure, Eagle Ford Shale

CHALLENGE

Increase production from depleted, previously fractured shale well.

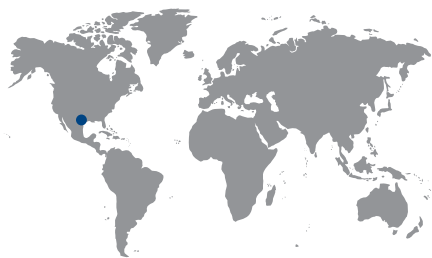
SOLUTION

Apply the BroadBand Sequence* fracturing service to enable effective refracturing through engineered application of a proprietary, fully degradable composite fluid comprising a blend of particles and fibers.

RESULTS

Improved production based on average results over the first 45 days after refracturing:

- Oil production increased from 89 to 195 bbl/d.
- Gas production increased from 227 to 428 Mcf/d.
- Flowing pressure increased from 922 to 4,034 psi.
- Productivity index (PI) increased by more than 600%.



Suboptimal well production in the Eagle Ford Shale

Operating in the Eagle Ford Shale, an operator has been working with Schlumberger to improve production from horizontal shale wells. New wells are completed in high-pressure, high-temperature (HPHT) areas with fracturing gradients of 0.85–0.95 psi/ft, TVDs of 12,000–13,500 ft, and bottomhole temperatures ranging from 300 to 345 degF. Typical completions are based on the plug-and-perf technique, with four to eight perforation clusters per interval isolated by bridge plugs.

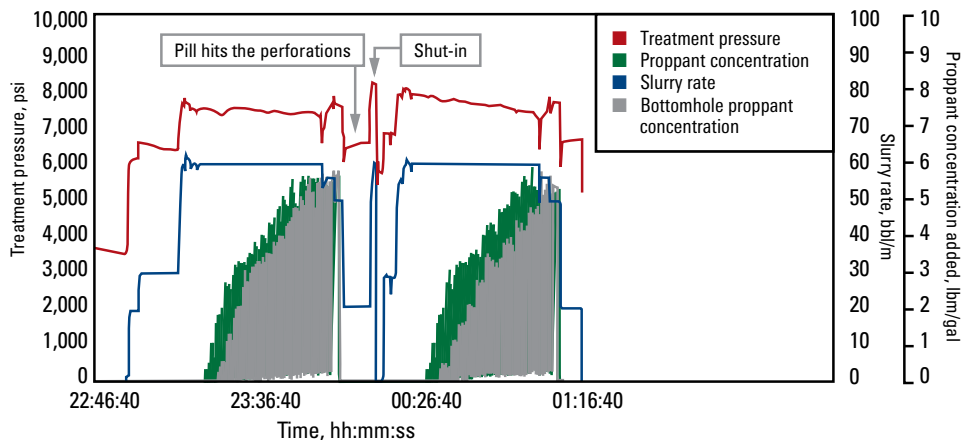
An area of recent interest for the operator is the restimulation of old wells. The operator sought to accelerate and increase the estimated ultimate recovery (EUR) of oil and gas by reestablishing conductivity in old hydraulic fractures and stimulating new reservoir volume. This endeavor is gaining significant traction across the industry because the number of candidates for refracturing is increasing rapidly as the shale plays continue to age.

A key challenge for refracturing operations is effective stimulation along the length of the wells (4,000–6,000 ft). Since all perforations are open, mechanical aids such as bridge plugs cannot be used.

Effective solution through sequenced fracturing service

The operator decided to address these challenges with the BroadBand Sequence fracturing service. The BroadBand Sequence service is a key enabler for refracturing operations since it delivers temporary isolation of clusters through engineered application of a proprietary, fully degradable composite fluid comprising a blend of degradable particles and fibers.

The candidate well, originally one of the field’s best oil producers, had been stimulated two years earlier with multiple fracturing stages. The refracturing operation included 13 fracturing stages, which were completed using an identical amount of proppant from the first stimulation campaign as well as the HiWAY* flow-channel fracturing technique. Composite pills were pumped between fracturing stages to enable temporary isolation of previously stimulated clusters. A shut-in was applied after placing each composite pill to monitor changes in fracturing gradient.



Treating plot for two refracturing stages featuring a composite pill pumped in between, followed by a pump shut-in to measure initial shut-in pressure (ISIP).

CASE STUDY: Sequenced fracturing increases productivity index by more than 600% in refractured well, Eagle Ford Shale

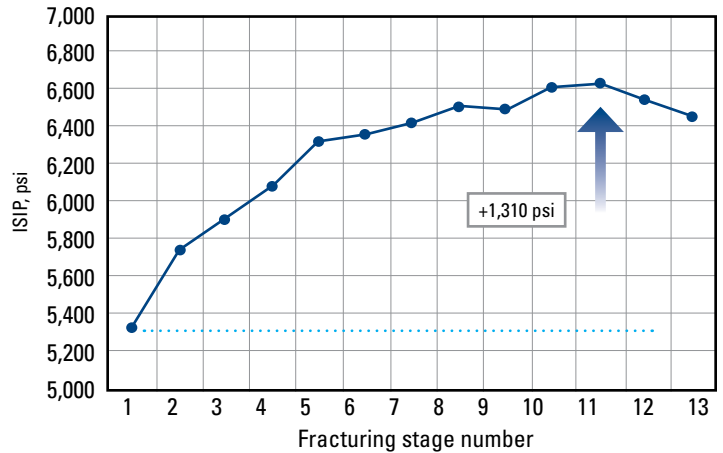
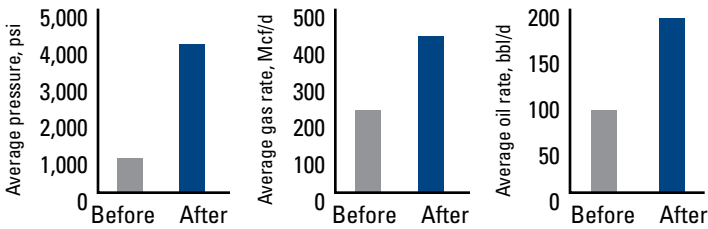
All 13 refracturing stages were pumped sequentially in 36 hours and without use of mechanical aids such as bridge plugs or inflatable packers.

Initial shut-in pressure (ISIP) measurements captured at the end of each stage showed progressive increase toward values that are characteristic of previously untreated rock in the area. These features demonstrate the ability of the BroadBand Sequence service to reinvigorate and isolate depleted areas while enabling stimulation of undepleted areas of the lateral.

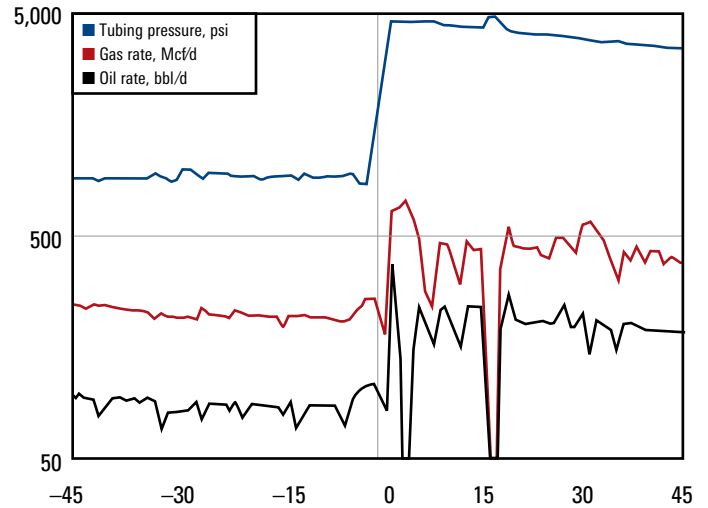
PI increase of more than 600%

After refracturing, the well was put in production using a smaller choke (1/64 in) than the one used prior to restimulation (1/4 in). Results over the first 45 days after restimulation show that, despite the increased restriction, oil and gas production rates doubled while tubing pressure increased fourfold. In addition, the well continues to retrieve fracturing fluid at a rate of 100 bbl/d, which means that the total fluid rate increased threefold.

Calculations for the well's productivity index (PI), which take into account both rates and pressures to normalize production, indicate an increase in PI of more than 600% after the restimulation operation. These outstanding results demonstrate the effectiveness of the BroadBand Sequence fracturing service to boost oil and gas production from depleted horizontal shale wells.



ISIP measurements showing progressive increase toward values that are characteristic of newly stimulated rock.



Well performance during the first 45 days before and after refracturing.

slb.com/BroadBand



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