Schlumberger

OpenPath Reach Service Improves Acid Efficiency and Increases Oil Production 500%

Acid fracturing treatment with new retarded acid system uses 40% less raw acid than prior job with conventional acid gel, Kazakhstan

CHALLENGE

- Stimulate oil production from a deep carbonate formation.
- Minimize acid volumes and improve logistics by improving acid system efficiency.

SOLUTION

Perform an OpenPath Reach* extended-contact stimulation service based on the DUOFRAC* alternating-viscosity acid fracturing technique with repeated sequences of YF* crosslinked, water-base fracturing fluids; a new low-viscosity, single-phase retarded acid; and VDA* viscoelastic diverting acid.

RESULTS

- Reduced raw acid volume by 40%.
- Eliminated 33% of the acid hauler and chemical truck trips.
- Increased production by 500%.
- Increased productivity index by more than a factor of 10.

Achieve production targets by improving acid efficiency

An operator in Kazakhstan is exploring a thick carbonate platform with good reservoir properties. Initial wells were drilled vertically, cased, perforated, stimulated through 4½-in tubing with acid fracturing, and produced with natural flow. Bottomhole static temperature (BHST) is approximately 212 degF [100 degC], which in combination of highly reactive rock made the stimulation program a challenge. For one initial well, Schlumberger designed a stimulation treatment using the DUOFRAC technique with conventional polymer-gelled 28% hydrochloric (HCl) acid and crosslinked gel, resulting in acceptable production improvement.

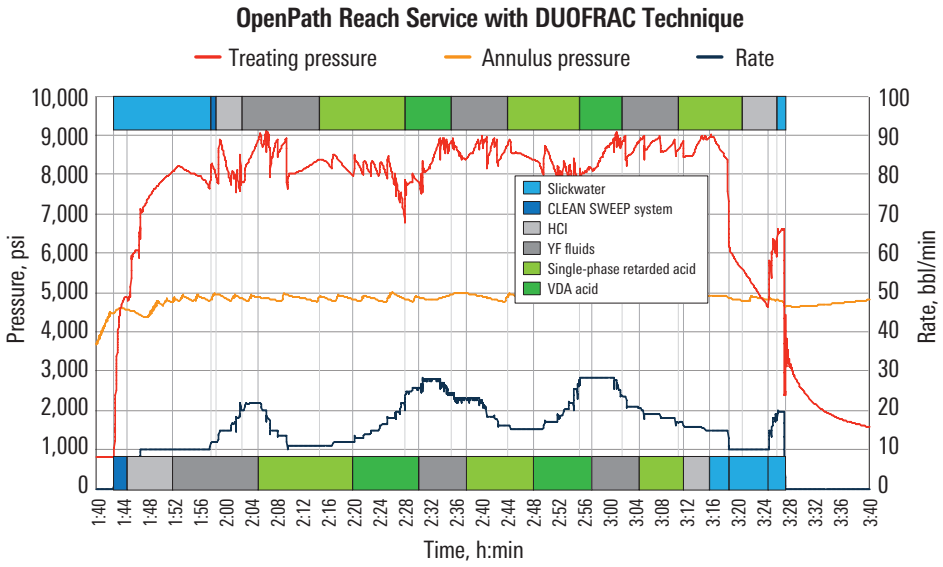
The OpenPath Reach service achieved the production target with a low-viscosity, retarded acid system that improved fracture face etching.

For subsequent wells, the operator asked Schlumberger to change three aspects of the stimulation design: minimize polymer gels to decrease formation damage, include a retarded acid system to increase penetration, and reduce acid viscosity to improve fracture face etching. Because the wellsite was 155 miles [250 km] from the nearest supply base, the operator also asked for acid efficiency improvements that would reduce fluid or chemical volumes, logistics, and HSE risks of transporting materials.

Adding to the challenge, the next completion was designed with 3½-in tubing, raising concerns about fluid friction limiting the ability to achieve the pump rates required to maintain open fractures as the acid reacted. This concern precluded the use of emulsified acid, a conventional retarded acid option, because it is incompatible with friction reducers. Emulsified acid also did not suit the customer's logistics request because it increases environmental footprint and requires complicated batch mixing and transport.

Reduce polymer risk and improve acid penetration

Schlumberger proposed an OpenPath Reach service with a new single-phase retarded acid to maximize reservoir contact and maintain high-conductivity channels through the rock after the treatment. Engineers recommended a pumping schedule based on the DUOFRAC technique, which is based on the viscous fingering effect that occurs when a low-viscosity acid is pumped into a bank of high-viscosity fluid.



The OpenPath Reach service achieved the operator's production target with 40% less raw acid than prior operations and enabled the use of friction reducer to accommodate the rapid pump rate changes required to maintain open fractures as the acid reacted.

In this case, the treatment sequence comprised high-viscosity YF fluids to create and extend fractures followed by the new low-viscosity retarded acid to slice through the gel and selectively etch the fracture face. This left strong pillars of unetched rock to prop open the fracture and maintain the high-conductivity channels after the treatment. VDA acid was also designed into the treatment to control leakoff.

Of the three fluids systems, the proposed treatment design eliminated polymers from two: the retarded acid and VDA acid. In addition, simulations using FracCADE* fracturing design and evaluation software indicated the treatment would improve the etched fracture half-length because of the slow reaction and lower viscosity of the new acid system. Finally, all of the fluid systems are compatible with friction reducers, eliminating concerns about being able to achieve the necessary rates to complete the job.

Hit production target with less acid, better logistics, and lower risks

The stimulation treatment started with CLEAN SWEEP* damage removal solvent systems to remove leftover mud filtercake and organic damage. It then followed with the OpenPath Reach service, alternating the three stimulation fluid systems. The treatment was pumped as designed with
no incidents. In particular, the friction reducers in the acid systems enabled engineers to rapidly increase pump rates and maintain pressures as the acid systems reacted with the formation.

Well production increased by 500% and the production index more than tenfold, matching the results from the prior treatment in an offset well—but with 40% less raw acid, 50% less acid preparation time, and 33% fewer acid haulers and chemical trucks.

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