Schlumberger

OpenPath Sequence Service Delivers More Uniform Scale Control Treatment

Cycles of fiber-laden diversion pills maximize wellbore coverage of chemicals to treat scale-prone well in the North Sea

CHALLENGE

Chemically treat 200-ft [60-m] perforated length of a subsea oil well with chemicals to minimize scale deposition risks due to waterflooding.

SOLUTION

Deliver antiscale chemical treatment using OpenPath Sequence* diversion stimulation service.

RESULTS

Improved uniformity of treatment as demonstrated by 25% higher treating pressure for each diversion stage.

Nonuniform scale treatments impair production

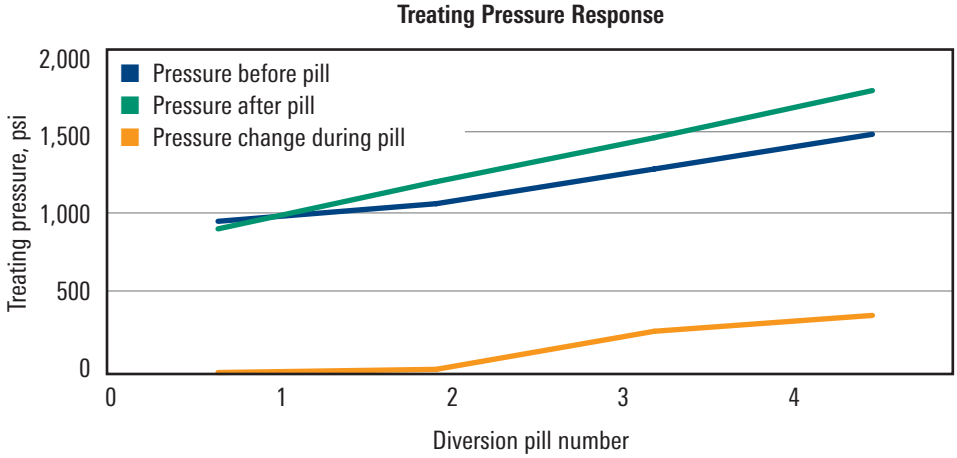
An operator with a number of oil wells in a chalk formation of the North Sea uses waterflooding for pressure maintenance. The combination of the chalk and the injected water significantly increases the risk of scale deposition that can rapidly reduce oil production. To prevent it, the wells are routinely treated with scale prevention and stimulation systems.

The standard completion in the field is a 5½-in [139.7-mm] cemented liner with 5 clusters of perforations across 200 ft [60 m] of heterogeneous formation. When bullheading fluids into the formation, some form of diversion is required to ensure complete and uniform treatments; otherwise, high-permeability sections will take all of the treatment fluids and lower-permeability sections are left untreated, increasing the risk of further reduction in permeability—and productivity—due to scale deposition. The excess fluid in the overtreated sections is also wasted because most will simply flow back out of the well without being imbibed onto the formation rock.

Conventional treatments in the area included balls sealers to divert the chemicals, but as wells age and perforations erode due to production, balls can no longer seal the perforations and therefore cannot block the high-permeability perforations from taking all the fluid. To try to achieve a better seal, rock salt was pumped as a diversion option, but pressure response indicated no diversion from this method. A better, more efficient solution was required.

Fiber-and-particle pills improve the diversion efficiency

Schlumberger recommended the OpenPath Sequence service, which applies stimulation chemical systems with engineered diversion pills. The pills combine degradable fibers and degradable multimodal particles to temporarily block perforations more effectively than conventional diversion technologies such as ball sealers, rock salt, and benzoic acid flakes. After treatment, the proprietary blend of fibers and particles fully degrades within hours or days at downhole temperatures from 130 to 300 degF [54 to 149 degC] without further intervention. The service also requires no specialized equipment.



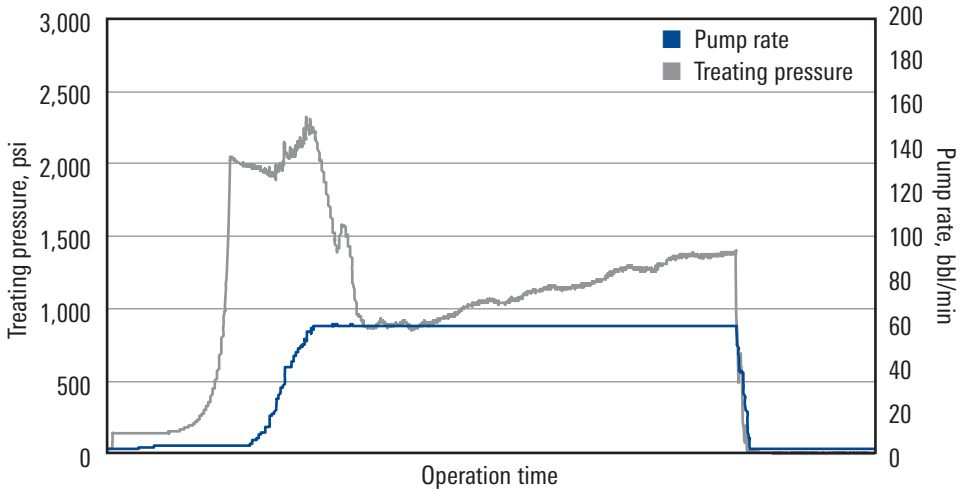
OpenPath Sequence service diverted scale chemical flow from high-permeability areas to increasingly lower permeability areas, as demonstrated by the steady increase in surface pressures.

Operation pressures indicate full wellbore coverage

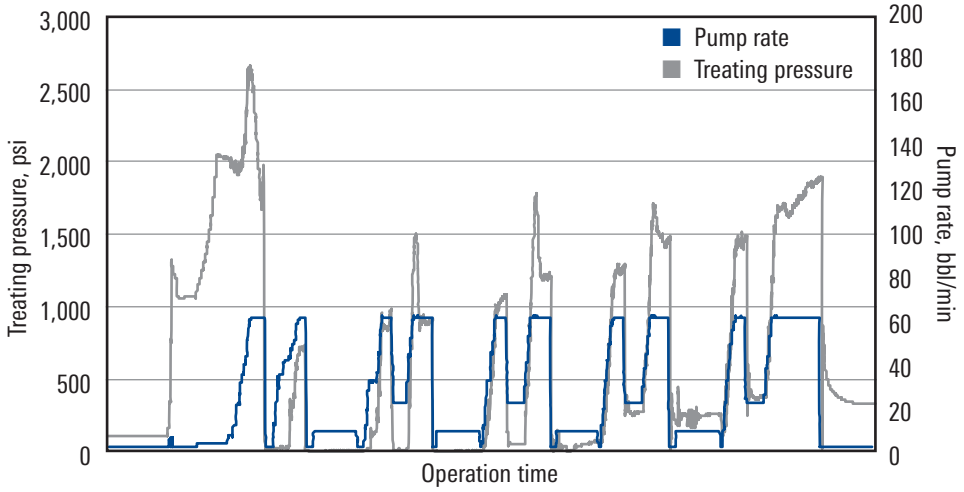
In November 2016, Schlumberger pumped an OpenPath Sequence service to uniformly inject 2,500 bbl [400 m^3] of scale prevention and stimulation treatment across the full perforated length. Engineers designed the treatment with 5 cycles of chemical treatment and diversion pills and pump rates up to 60 bbl/min [9.5 m^3/min].

Each cycle experienced in an incremental increase in treating pressure, with an average increase of 25% compared with the previous cycle. With consistent rate and wellbore fluid, the pressure increase is a result of the diversion material plugging the highest-permeability perforations and allowing fluid to reach lower-permeability perforations.

In addition, at the beginning of the operation, the well was on vacuum; upon shutdown, the diversion material supported a full column of wellbore fluid corresponding to a bottomhole pressure of 4,550 psi [31.4 MPa]. This indicates complete wellbore coverage of all open perforations. On completion of the treatment, the well was shut in, allowing the diversion material to fully degrade and provide full access to the reservoir.



Conventional ball seal diversion becomes increasingly inefficient as perforations erode and material builds up in the wellbore. Small pressure increases can be seen as balls partially cover a few perforations in this treatment, but clear diversion is not seen, and the final pressure indicates incomplete wellbore coverage.



Treatment in the same well with the OpenPath Sequence service demonstrates good, clear diversion in four cycles of treatment and diverter pills. The final instantaneous shut-in pressure also indicates complete wellbore coverage.

slb.com/openpath

Schlumberger