Schlumberger

OpenPath Sequence Service Raises Disposal Well Injectivity More Than 800% for Lukoil-NVN

Engineered diversion service evenly stimulates a horizontal well through naturally fractured carbonate and sandstone formations, Caspian Sea

CHALLENGE

Restore injectivity of an offshore water disposal well in naturally fractured carbonate and sandstone formations.

SOLUTION

Deliver OpenPath Sequence* diversion stimulation service with VDA* viscoelastic diverting acid and multimode diversion particles for carbonate stimulation and with MSR* mud and silt remover to treat the sandstone.

RESULTS

- Increased injectivity index in the carbonate zone by 823%.
- Increased injectivity index in the sandstone zone by 32%.
- Enabled Lukoil-Nizhnevolzhskneft (Lukoil-NVN) to reopen two oil producers.

Injector needs stimulation, but fluid leaks into natural fractures

In the Korchagina field in the Caspian Sea, Lukoil-NVN operates extended-reach oil producer and water injection wells. Over time, injectivity fell in one of the disposal wells. Without another option for disposal, the operator had to shut in oil production from two nearby wells.

The water wells are drilled and completed in two zones—a naturally fractured carbonate reservoir and a sandstone formation—which created stimulation challenges. The operator injected a citric acid-based fluid to stimulate the well, but the fluid leaked off into the natural fractures, leaving 1,000 m untreated. Another option was needed to distribute the stimulation fluid uniformly along the wellbore.

Fluid and particle diversion improves stimulation uniformity

Schlumberger designed an OpenPath Sequence service comprising a diverted matrix acid treatment to stimulate the carbonate formation and a filtercake cleanup treatment for the sandstone formation.

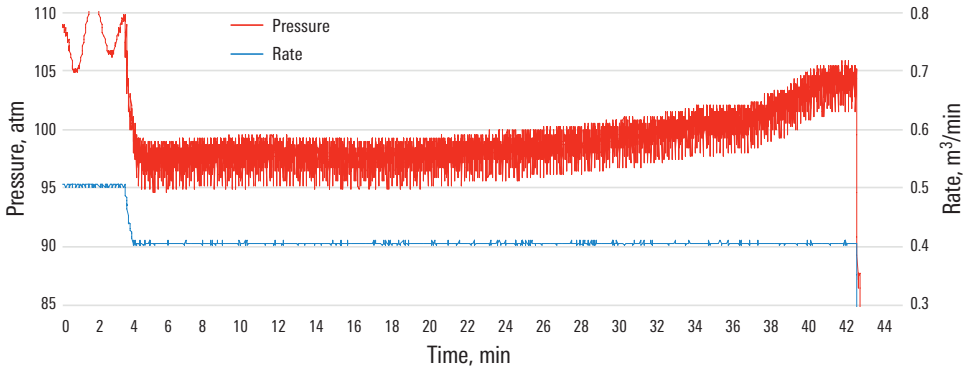
For the carbonate formation, the design used VDA acid with 15% HCl. It develops viscosity as it spends in the formation, which is adequate to divert treatments with small permeability variations. To improve diversion in the naturally fractured area, the fluid was blended with degradable fibers and multimode particles that create temporary mechanical blocks in thief zones. The combination effectively forces stimulation fluids to flow into lower-permeability rock. Hydrocarbons or solvents break the fluid, and the particles dissolve with time.

For the sandstone formation, which was treated in a separate operation, MSR remover was used to dissolve the hydrocarbon filtercake and damaging clays.

Treatment improves injectivity, and oil production resumes

After the full carbonate zone was treated, the injectivity index was 88.6 $m^3/d/atm$—an 823% improvement over the zone's prejob injectivity index of 9.6 $m^3/d/atm$. After treatment of the sandstone zone, the zone's injectivity increased 32% from 37.2 to 49 $m^3/d/atm$. As a result, Lukoil-NVN restarted production from the two nearby oil wells.

For more details about the well and operation, see SPE 189027.



When the diversion pills entered a natural fracture or loss zone, the pressure increased. This indicated the impermeable particles diverted the treatment away from the fracture and into lower-permeability areas.

slb.com/openpath

Stimulation