**Case History**

**N-FLOW™ Filter Cake Breaker System**

**N-FLOW™ 325 Filter Cake Breaker Helped Operator Stimulate Fishbone Well**

**Location:** Offshore Qatar

**OPERATOR’S CHALLENGE** – The operator wanted to drill and stimulate a multiple branch (“fishbone”) monolayer multilateral well in the Mishrif Formation. The well has a main lateral drain with a 7” cemented liner and a 6” open-hole extension. Four 6” open-hole lateral drains are sidetracked from the 7” liner. Additional perforated intervals in the 7” liner are also planned.

Reservoir data indicated downhole temperatures around 54° C (130°F) with a formation pressure range of 0.58 – 0.97 SG (4.8 – 8.1 ppg) EMW. The operator was seeking a stimulation treatment that could be performed for each lateral after drilling each 6” lateral hole.

The drilling/stimulation intervals were as follows:
- Main Hole: 3326 to 4600 m MD (1274 m section length)
- L1 Lateral: 3192 to 4040 m MD (848 m section length)
- L2 Lateral: 2825 to 4040 m MD (1215 m section length)
- L3 Lateral: 2525 to 4040 m MD (1515 m section length)
- L4 Lateral: 2225 to 3710 m MD (1485 m section length)

**HALLIBURTON’S SOLUTION** – The Halliburton Baroid technical team proposed 1.03 – 1.06 SG (8.6 – 8.85 ppg) BARADRIL-N* drill-in fluid with an optimized particle size distribution.

The 6” mother hole was drilled from 3326 to 4600 m with average down hole losses of 0.4 m³/hr (2.5 bbl/hr). The hole was then displaced to inhibited filtered sea water. The recommended stimulation treatment was N-FLOW™ delayed action filter cake breaker, an acid precursor that converts to formic acid downhole with time and temperature.

Lab tests and field observations showed that the filter cake on the surface dissolved completely after 6 hours at 20°C. The initial loss rate was steady for 4 hours at 0.4 m³/hr (loss rate while drilling), then started to increase to 1 m³/hr after 6 hours, indicating that the N-FLOW breaker had converted to acid and had started to react with the filter cake (Fig. 1).

![6”Original hole N-FLOW™ Loss Rate](image)

*Fig. 1-Downhole loss (m³/hr) after N-FLOW breaker treatment*
The loss rate started to increase again after another 6 hours, indicating that the N-FLOW breaker system was entering the formation and acting as a stimulation fluid. Cumulative losses steadily increased with time (Fig. 2).

![Graph showing cumulative losses](image_url)

**Fig. 2-Cumulative downhole loss after N-FLOW breaker treatment**

A whipstock was set and a window in the 7" liner was opened. The L1 lateral was drilled and stimulated using the same technique as the mother hole. This technique was repeated for laterals L2, L3 and L4 with successful results.

**ECONOMIC VALUE CREATED** – The operator was very satisfied with the performance of the N-FLOW breaker system throughout the entire job. All of the above jobs were performed during rough weather with no way for a stimulation vessel to approach the rig and perform an acid stimulation. By using N-FLOW delayed action filter cake breaker, the operator saved 5 days rig time, and eliminated the resources required to mobilize and demobilize a stimulation vessel. This lead to a minimum of $700,000 saved during the entire job.

The pH measurements on surface (Fig. 3) indicated that formic acid started to release slowly after 2 hours and reached maximum acidity after 7 hours, at which point all filter cake had been dissolved completely (Fig. 3).

![Graph showing pH vs time](image_url)

**Fig. 3-pH vs. time for surface samples**