Baker Hughes

Case study: North Sea

First North Sea deployment of DELTAFLOW OCF delivers well 100 hours early, saving $1.7 million USD

The operator needed a reservoir-friendly, clay-free invert emulsion system to drill a short reservoir section. They required a fluid that could inhibit the thick shale band at the top of the reservoir. Their technical specifications also demanded a system that minimized skin damage and worked seamlessly with a filter cake breaker fluid designed for the planned gravel pack. In addition, the fluid had to tolerate wellbore strengthening (WBS) additives introduced during drilling.

Baker Hughes Integrated Solutions partnered with Drilling and Completion Fluids (DCF) to recommend the **DELTAFLOW™ organophilic clay-free (OCF) system**. This next-generation oil-based drill-in fluid (DIF) replaces organophilic clay with a new package of rheology modifiers and advanced additives. The result is a formulation that delivers the required fluid properties in sensitive formations.

Designing the optimal DIF

Baker Hughes DCF teams in the UK and the operator's staff in Houston collaborated to design the DELTAFLOW OCF system. They adopted a simplified DIF approach that leveraged a low oil/water ratio (OWR) to reduce fluid losses, emulsification, and viscosification while meeting the project's strict fluid specifications.

The DELTAFLOW OCF system incorporated DELTA-LIFT™ 4153, an environmentally friendly liquid viscosifier and rheology modifier. This additive provided the necessary rheological properties to the DIF without increasing the risk of formation damage.

Engineers used the BRIDGEWISE™ software to identify the optimal formulation for minimizing fluid loss and validated the bridging package through ceramic disc testing.

During filter cake breaker development, the team also ran compatibility and corrosion tests to ensure the breaker fluid did not adversely interact with other wellbore fluids.

As a final validation, Baker Hughes performed two liquid mud plant (LMP) trials to evaluate the DELTAFLOW OCF's real-world performance and stability. Both trials demonstrated that the fluid met all customer specifications.

Based on these insights, the final formulation was prepared and mixed at the LMP. To simplify logistics, the initial WBS material was added directly to the DELTAFLOW OCF system, while engineers made additional offshore WBS treatments as drilling progressed. The fluid arrived at the rig stable and homogeneous, with no solids separation issues.

Efficiently deploying the DIF

Baker Hughes deployed the 10.4-ppg DELTAFLOW OCF system with a 55/45 OWR as part of the Integrated Solutions project. The system helped drill the well 100 hours ahead of the P50 schedule, saving the operator an estimated $1.7 million USD in project AFE costs.

Challenges

- Design a stable clay-free invert emulsion DIF for the UK North Sea
- Deliver the fluid to the rig site without issues
- Utilize the new system while managing wellbore strengthening material additions
- Minimize formation damage
- Maintain fluid properties within specifications

Results

- Successfully delivered and deployed the DELTAFLOW OCF system in the reservoir section without fluid-related issues
- Maintained the 500-micron bridging package while drilling with the WBS premix
- Safely drilled the well with minimal skin damage and zero downhole losses
- Managed and maintained the fluid properties within the customer specifications during drilling
- Delivered the planned well 100 hours ahead of schedule, saving an estimated $1.7 million USD in integrated project AFE costs

The custom, premixed WBS enabled successful drilling with zero losses to the formation. Onsite slot tests confirmed the fluid's ability to bridge a 500-micron slot, validating its wellbore strengthening capability.

Engineers monitored the system to maintain fluid properties within specification, which required minimal treatment. As a result, section fluid cost averaged just $0.06 USD bbl/ft—far below the programmed $0.20 USD bbl/ft.

After drilling out cement at the top of the section, the DELTAFLOW OCF system was used to drill through the shale and into the gas-bearing sandstone reservoir at an average rate of penetration of 40 ft/hr with a flow rate of 400 US gal/min. The wellbore remained clean throughout the 40° section, with subsequent evaluation confirming minimal skin damage.

After underreaming the gas reservoir to 9 ½ in. and circulating clean, the DELTAFLOW OCF system was conditioned to pre-screen test specifications for screen running. The acid breaker proved effective, showing increased loss rates after gravel pack deployment. The final well test exceeded expectations, with higher-than-anticipated gas production.

Recognizing successful results

The customer commended the project's seamless execution, highlighting the exceptional delivery achieved through Baker Hughes Integrated Solutions and the coordinated efforts of all product lines.