

# Operator Uses Innovative Filter Cake Breaker Technology on High-Temperature Well Offshore Norway

**N-FLOW 408® FILTER CAKE BREAKER PACKAGE DELIVERS EFFICIENT CLEANUP AND DIRECT INJECTION, ELIMINATING COSTLY FLOW BACK**

**NORWEGIAN SEA**

## CHALLENGE

- » Design a non-damaging, non-aqueous fluid
- » Ensure temperature stability up to 284°F (140°C)
- » Remove filter cake and provide breakthrough time of two hours

## SOLUTION

Engineer a low solids fluid and filter cake breaker solution, including:

- » N-FLOW® 408 filter cake breaker system
- » BaraKlean-926® casing cleaner
- » WELLCAT™ casing design software
- » Extensive return permeability testing
- » Clean-up pill train and breaker spotting procedure

## RESULTS

- » Successfully drilled reservoir section without any wellbore issues
- » Injection in zone 1 exceeded the expectation from all 5 zones
- » Saved the customer time and operation cost by eliminating well flow back

## OVERVIEW

Halliburton Baroid was commissioned by an operator in the Norwegian Sea to design a reservoir drill-in fluid and filter cake breaker system that would allow direct injection, without the need for flow back to the drilling facility. This was a particularly challenging well with a 4,921-ft (1,500-m) reservoir section and a static bottomhole temperature (BHT) of 279°F (137°C).

## CHALLENGE

Flowing back an injection well has the advantage of lifting off any filter cake and cleaning up the near-wellbore area; however, installing equipment on a rig to handle this is expensive and time-consuming. Having the ability to go directly to injection is, therefore, an attractive option, although there are challenges associated with this method. To achieve optimum injection rates, one must achieve controlled and thorough filter cake removal and minimize near-wellbore damage.

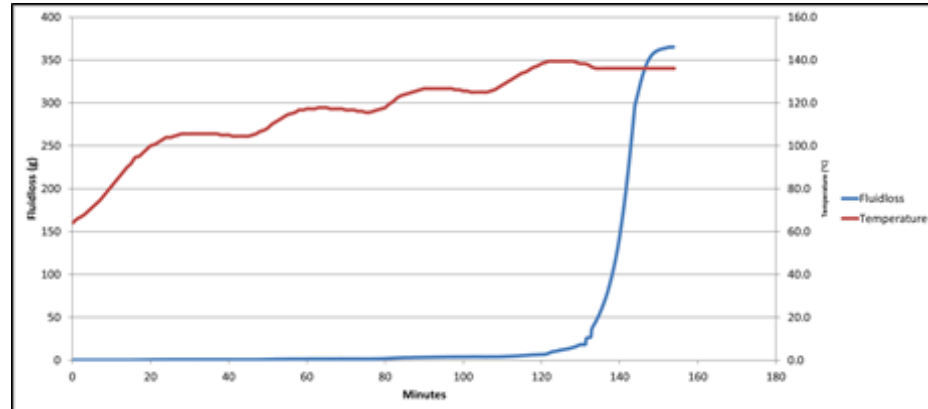
Due to the extensive length of the reservoir section, monitoring and maintenance of the drilling fluid were crucial to the success of the well. Additionally, the very high BHT made it more difficult to slow the downhole acid generation to an acceptable time, which allows for reservoir isolation before losses are observed.

## SOLUTION

To meet the specific challenges of this well, the Halliburton Baroid team engineered a 1.26 sg (10.5 lb/gal) low-solids oil-based drilling fluid (LSOBM) with calcium bromide (CaBr<sub>2</sub>) as the internal phase and XP-07 as the base oil, and different sized BaraCarb® ground marble bridging particulates. Comprehensive testing was performed to effectively bridge the formation and minimize invasion. For filter cake removal, a breaker package was designed, incorporating N-FLOW® 408 capable of generating acid under downhole conditions, along with other additives to get the required delay. The filter cake breaker was pumped with a pill train ahead comprising base oil, followed by a mutual solvent pill. The breaker package also included BaraKlean-926® for water wetting and a corrosion inhibitor to protect the downhole completion tubulars.

**RESULT**

The drill-in fluid properties were maintained within parameter requirements throughout the drilling operation, ensuring minimal formation invasion and optimal filter cake quality. The breaker formulation was mixed and displaced, as per program, and the desired delay time was accomplished, i.e. no losses within the first two hours. Injection started 11.5 days after the breaker was pumped into the well.



*Breakthrough testing result, showing fluid loss and temperature ramp-up based on WELLCAT™ casing design software simulation.*