Baker Hughes

Case study: Vietnam

MICRO-PRIME system and DISPLEX software improve wellbore cleanup, recover $ZnBr_2$ brine, saved $1.8 M USD

The client's objective was to displace a high-performance water-based mud (HPWBM) to a high-density zinc bromide ($ZnBr_2$)-inhibited brine in a high pressure/high temperature (HP/HT) well with minimal circulations to achieve NTUs below 30 and mitigate downhole losses. Downhole temperatures averaged 329°F (165°C), pressures averaged 9600 psi (653 atm), and total depth (TD) was 3690 m (12,106 ft). Moreover, the use of $ZnBr_2$ presents safety and environmental challenges due to its corrosive nature. The client also wanted to recover as much $ZnBr_2$ as possible for use in future wells because it is expensive and required in high volumes (2,200 bbls) for this well.

A team comprising of Baker Hughes specialists from Drilling and Completions Fluids, Drilling Services, and Completions, Intervention, and Measurements, worked together to develop and submit the optimal solution that includes fluids management, displacement, and brine recovery.

The DISPLEX™ integrated mud displacement software was used to model and plan the displacement operation. The team also conducted several lab tests to select the adequate spacer train formulation.

To reduce the risk of contaminated brine, Baker Hughes recommended its proprietary MICRO-PRIME™ high-efficiency wellbore cleaning spacer system. Using advanced mesophase technology, the spacer system is designed to optimize the wellbore cleaning process when displacing drilling fluids prior to completing the well, leaving all surfaces water wet. The proposed displacement design comprises of three pills:

- Transition spacer is formulated with PRIME™ 100 surfactant blend to push the HPWBM from the wellbore
- Cleaning spacer, with PRIME™ 770 surfactant blend, is a solids-free cleaning pill that will be pumped in turbulent flow to clean and water-wet all downhole surfaces, and
- Viscous tail spacer (viscosified brine pill) that is designed to sweep residual solids before pumping the completion brine.

Once Baker Hughes completion personnel arrived at the rig, a pit management plan was developed. Any potentially hazardous areas were identified, eye wash stations were checked, and all rig personnel were given safety training on the use and handling of $ZnBr_2$ brine. The $ZnBr_2$ brine was safely transferred from the supply vessel to the rig.

The results of the mud displacement and cleaning job confirmed that Baker Hughes is committed to delivering consistent performance to the client, as it has for several years.

The wellbore cleaning was executed safely and efficiently, with no health and safety issues, no spills, and no nonproductive time (NPT). Only two full circulations were required to deliver a clear brine with an NTU of less than 30 returning to surface. The wellbore

Challenges

- Perform well cleaning job with minimal fluid losses and formation damage
- Displace the well with a high-density brine with minimal fluid circulation to achieve NTUs below 30
- Safely handle and recover high-density $ZnBr_2$ brine
- Logistics and personnel deployment during Covid pandemic proved challenging

Results

- Successfully displaced the well and achieved NTUs < 30 in two complete circulations
- Saved $1.8 million USD by reconditioning/reusing $ZnBr_2$ and minimizing operating costs
- Achieved zero discharge of brine to sea
- Ran operation smoothly with zero spills and no NPT

cleaning and $ZnBr_2$ brine displacement were completed one day ahead of schedule, saving the client $300,000 USD in rig time and engineering and equipment costs.

The high density of the brine (16.8-17.75 sg) was always maintained. The brine was filtered and stored for the following year's drilling campaign, saving $1.5 million USD in brine replacement costs.

The client was satisfied with the smooth, safe project execution, which was their first time using $ZnBr_2$ brine in country.