BaraDrilN™ X Fluid Helps Customer Achieve Well Testing Operation in HPHT Environment

WESTERN OFFSHORE BASIN, INDIA

CHALLENGE

Many of these wells could not be tested to their full potential due to lack of an appropriate, cost-effective HPHT completion fluid:

- Elevated bottomhole temperature
- Density requirements up to 17.5 lb/gal.

SOLUTION

Baroid proposed the BaraDrilN™ X system, delivering several benefits:

- High-temperature stability
- Low corrosion rate
- Cost-effective replacement for high-cost high-density monovalent brine

RESULTS

- Packer operations were unimpeded, and the fluid transmitted pressure to operate the downhole tools during perforation and subsequent well testing operations.
- The BaraDrilN X fluid demonstrated a remarkably high stability during the 24 days it remained in the wellbore at almost static conditions.
- The key rheological indicators remained stable throughout: density of the fluid was shown to be unchanged despite the conditions.
- Further corroboration of fluid stability was inferred by the ease of unsetting the ST packer and visual inspection of BHA at surface as reported by the rig and operator.

OVERVIEW

OPERATOR SAVED
45% rental cost
of original high-density
monovalent brine

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In India, Oil and Natural Gas Corporation Ltd. (ONGC) was involved in the development of a high-pressure/high-temperature (HPHT) field in the western Mumbai Offshore Basin. Many of these wells could not be tested to their full potential due to lack of an appropriate and cost-effective HPHT completion fluid. Downhole temperatures were as high as 400°F (204°C), and densities as high as 17.5 lb/gal (2.1 SG) were required.

In critical wells, the customer was forced to use costly high-density monovalent brine to complete and test the HPHT reservoir objectives. A clear brine fluid was favored to ensure unimpeded pressure transmission to operate downhole tools, along with fully effective sealing of the packer assemblies.

The operator challenged Baroid to provide a cost-effective solution to replace high-cost high-density monovalent brine. Although zinc-based mixtures are available in the required density range, concerns related to corrosion and handling issues limited their suitability.

HIGH-PERFORMANCE, WATER-BASED HPHT COMPLETION FLUID ENABLES OPERATIONAL EFFICIENCIES AND COST SAVINGS

Although a solids-weighted fluid was a potential solution, many water-based fluids cannot achieve the required density and most do not display the necessary thermal stability. Baroid implemented its Technical Process with extensive testing to customize a fluid solution that matched, and, for several properties, surpassed the customer's specified design targets. As a solution, Baroid proposed the newly developed BaraDrilN™ X HPHT drill-in fluid system after screening all other HPHT systems.

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Figure 1. Corrosion test conducted over 14 days at 400°F (204°C). Coupon 1, control; Coupon 2, treatment with 1% by volume BARACOR® 100 corrosion inhibitor; and Coupon 3, treatment with 2% by volume BARACOR 100 corrosion inhibitor.

The BaraDrilN X system is an innovative high-temperature, brine-based, high-performance fluid system developed by Baroid to fill the technology gap in the HPHT drilling and completions market demanding a stable and non-damaging high-temperature reservoir drill-in fluid.

BaraDrilN™ X fluid system replaced a costly heavyweight clear brine for well testing operations in HPHT environments.

The operator realized further savings by re-utilizing the BaraDrilN X fluid either as a drill-in or completion/well testing fluid.

The BaraDrilN X fluid was prepared by using a 14.2-lb/gal (1.7-SG) calcium bromide brine as the base fluid. Higher densities up to 17.5 lb/gal (2.1 SG) were achieved with the addition of micronized manganese tetroxide. The micronized weighting agent fulfilled all the design conditions of low rheology, low solids load, and low sag tendency at high temperatures. The system was treated with BARACOR® 100 corrosion inhibitor and OXYGON™ scavenger in order to provide protection against corrosion, as required in the scope of work (**Figure 1**). Most importantly, the system demonstrated to be sag free after static incubation at 400ºF (204°C) for up to 120 hours (five days); sag index was reported to be as low as 0.51 (**Figure 2**). Moreover, surface testing of packer assemblies and downhole tools showed that the BaraDrilN X fluid did not interfere with or plug tool operation.

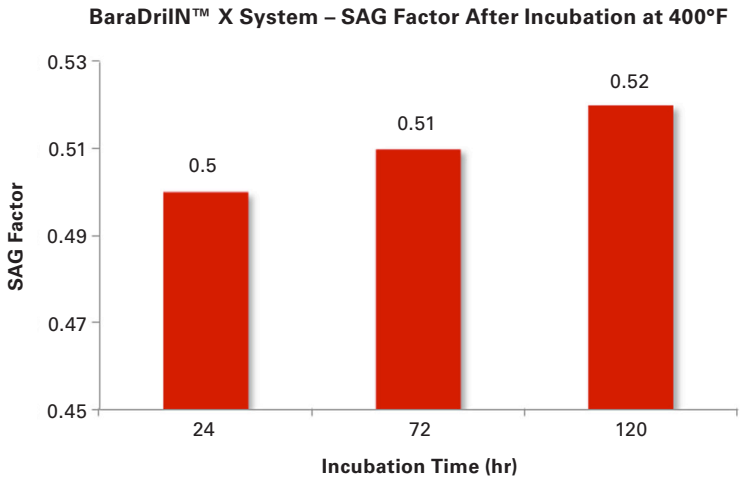

Figure 2. BaraDrilN™ X system – SAG test results after incubation at 400°F (204°C) up to 120 hours (five days).

Early in the design phase and risk identification, it was recognized that this application needed a shearing device that would allow the fluid to be conditioned offline, thus thus avoiding the use of rig pumps and several circulations to attain a homogeneous conditioned fluid. A Halliburton HT Shearing Unit was installed and rigged up to the mud pumps, and the fluid was then conditioned by several passes through the HT Shearing Unit while mixing all the components (**Figure 3**).

Figure 3. A Halliburton HT Shearing Unit was rigged up to the rig pumps and the fluid was sheared offline at 2,000–3,000 psi while mixing the fluid components.

The Baroid team executed the job shortly after gaining customer approval for this Critical First Well execution, and the required mud weight for the application was 15.2 lb/gal at a bottomhole temperature of 310°F (154°C). Baroid and the customer took regular fluid samples and conducted quality assurance tests in their in-house lab facilities (**Figure 4** and **Figure 5**).

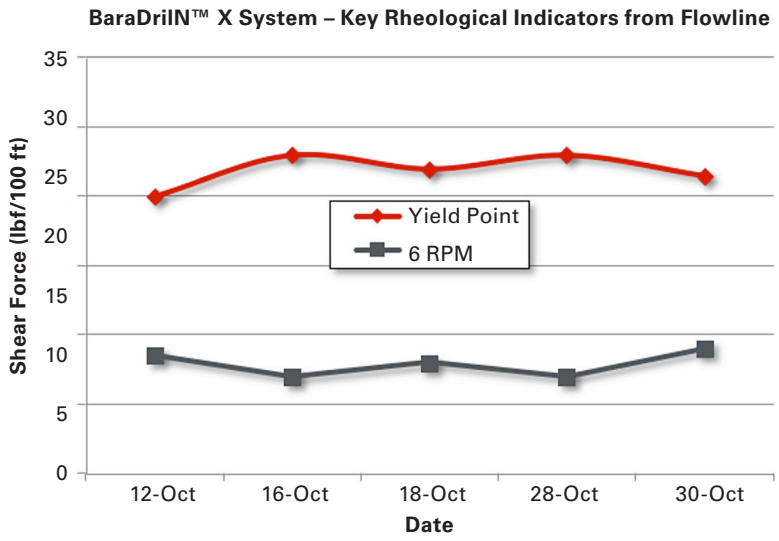

Figure 4. BaraDrilN™ X system's key rheological parameters. The fluid rheology was measured from samples of fluid taken from the flowline during the few occasions the fluid was circulated.

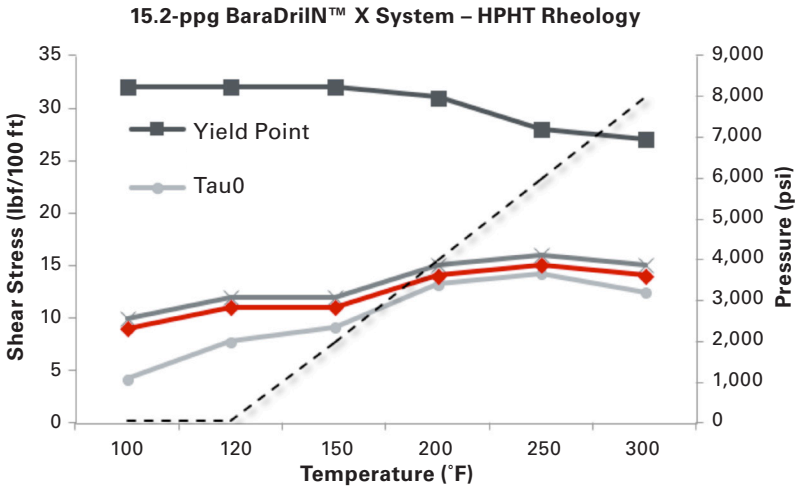

Figure 5. Rheological properties of BaraDrilN™ X fluid tested at different temperatures and pressures.

ECONOMIC VALUE CREATED

The BaraDrilN X fluid was proven to meet its full functional requirements in the field: packer operations were unimpeded, and the fluid transmitted pressure to operate the downhole tools during perforation and subsequent well testing operations. The BaraDrilN X fluid demonstrated a remarkably high stability during the 24 days it remained in the wellbore at almost static conditions with only occasional circulations and minor treatments. The key rheological indicators remained stable throughout: density of the fluid was shown to be unchanged despite the challenging conditions, indicating no solids settlement that could jeopardize further operations and cause nonproductive time (NPT). Further corroboration of fluid stability was inferred by the ease of unsetting the ST packer and visual inspection of the bottomhole assembly (BHA) at the surface as reported by the rig and operator.

The BaraDrilN X fluid was recovered and stored at a local liquid mud plant (LMP) facility for re-use in the next HPHT well, and required minimal reconditioning and product treatment. This practice would allow the customer further savings in subsequent well applications.

Considerable cost savings were realized in the form of a 45 percent saving of the rental cost of the original high-density monovalent brine.

HALLIBURTON