New Nanoparticle Fluid System Improves Drilling and Cementing Efficiency for Difficult Intermediate Section

FIRST APPLICATION OF BARAFLC® NANO-1 WELLBORE SEALANT PROVIDED HIGH ROP, AND OPTIMUM HOLE CONDITIONS FOR TRIPS

COLOMBIA

CHALLENGE

- Deliver inhibitive fluid with environmentally-accepted components and without salts
- Stabilize dispersive shales and plastic clays
- Enable higher ROP
- Reduce filtrate invasion
- Improve hole conditions for trips

SOLUTION

- Customized polymer-based WBF with BaraFLC Nano-1 nanoparticle sealant
- Extensive laboratory testing to optimize the fluid formulation and develop KPIs
- Optimal filtration control to minimize invasion and pore pressure transmission

RESULTS

- Achieved 40% faster ROP (with less WOB) early into the section
- Met all KPIs for filtrate values
- Experienced minimal overpull with trip speeds above average for the area
- Delivered wellbore near-gauge, allowing for reduced cement volume and time savings

OVERVIEW

An operator drilling development wells inland Colombia sought a more inhibitive, freshwater-based fluid alternative to its current dispersed fluid system. Although overall performance was adequate, the time required to drill the intermediate section was longer than desired and hindered by the recurrence of sticking and overpull issues while tripping.

Halliburton Baroid was approached to help increase the rate of penetration (ROP), reduce fluid invasion, and stabilize the wellbore for faster trip speeds. Discussions centered on the addition of BaraFLC® Nano-1 sealant to the existing fluid to examine how it could contribute to improved drilling efficiency. This product was previously shown to provide very low filtration rates and a reduction of pressure transmission in shales similar to that of oil-based fluids. After numerous laboratory tests by Baroid Colombia to optimize the nanoparticle fluid and qualify the new recipe in a third-party lab, the operator agreed to a series of trial wells.

In planning the first trial well, the team developed key performance indicators (KPIs) for benchmarking purposes, i.e. to measure how the new fluid met increased efficiency goals versus previous wells. Materials were shipped for timely execution and local personnel prepared a detailed Design of Service (DOS) plan suited for the region. The fluid solution was successfully trialed under the supervision of a Baroid global technical field advisor.

CHALLENGE

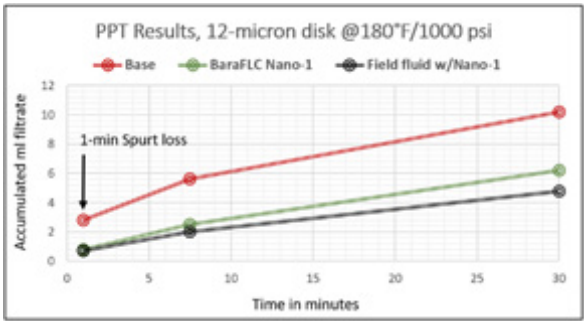
The operator's ongoing experience with a dispersed polymeric fluid system indicated opportunities for improvement, especially when drilling a potentially unstable intermediate section of shales and plastic clays. Complications while tripping were slowing down the progress, sometimes requiring time-consuming wash and ream interventions or multiple passes when tripping out of hole from the target depth. These delays meant reduced operational efficiency and higher well construction costs.

SOLUTION

In early laboratory testing, numerous fluid loss studies focused on reaching the lowest spurt and total filtrate possible on particle plugging tests (PPTs). Since BaraSeal™ W-1040 had been used in the past for other fields, it was also tested to help benchmark performance of the new BaraFLC Nano-1 material.

The spurt and total filtrate volumes from pilot tests with equal additions of these products indicated that BaraFLC Nano-1 was more effective – reaching 71% lower spurt loss than the base mud, while BaraSeal W-1040 achieved a 38% reduction. The treatment with BaraFLC Nano-1 also lowered the total filtrate collected by the end of a 30-minute test. With the incorporation of drill solids during well development, the fluid treated with BaraFLC Nano-1

showed even lower filtrate than the laboratory-tested fluids.
Different PPT disk sizes were used to simulate a variety of microfractures and permeable sands existing throughout the intersected formations. These simulations indicated that BaraFLC Nano-1 could help effectively seal disks with porosity ratings over 100 microns. Based on test outcomes, the operator approved the first-time use of the fluid solution, and additional steps were taken to prepare for the actual field trial. Baroid fluids personnel followed a detailed process to service this new technology application, with added oversight to ensure high levels of proficiency in risk mitigation, systems reliability, and data capture.



Laboratory PPT results.

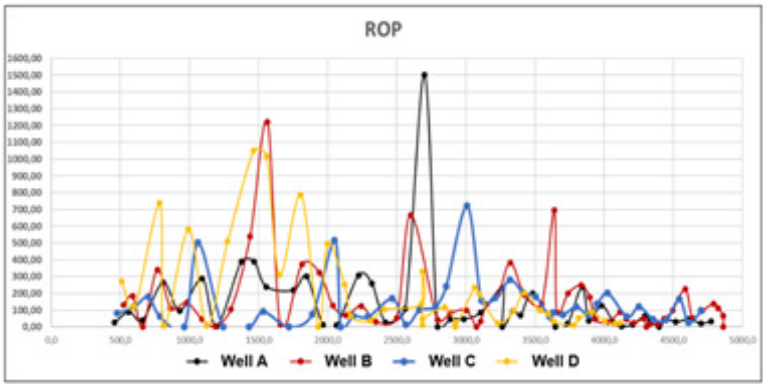
FIELD TRIAL DETAILS

As the surface hole was being drilled, mixing began for the intermediate section fluid system. Additions of BaraFLC Nano-1 were made according to plan, and quality checks showed that fluid properties were in range. The new inhibitive, polymer-based fluid system was displaced into the well and the intermediate section drilling proceeded (see Well D in the Figure below). A high ROP was sustained with less weight on bit (WOB), with several instantaneous rates higher than previous wells in the area. On the first day of drilling, the team exceeded plan by 700 ft. Unfortunately, by about the middle of the interval, cuttings accumulated in the flowline and header box, and auxiliary flowline jetting equipment was not operational to assist with the cleanout. This limited the ROP pace for the remaining portion of the interval.

Drilling was suspended due to a strike in the local area, yet the wellbore remained stable and and slick after nearly 48 hours of static conditions. As the section was drilled to casing point, hole conditions remained ideal for several wiper trips and the final trip out of hole for the casing run.

RESULTS

The average tripping velocity had been 860 ft/hr with the legacy dispersed fluid system. The new polymer-based fluid system with BaraFLC Nano-1 exhibited an increase of 24% for an average velocity of 1,070 ft/hr. Overpull on the final trip out was reported as minimal (max 30 klb), compared to several events observed in offset wells with up to 80-klb overpull during the same activity.
Casing was run to setting depth without any issues, and circulation before the cement job indicated an in-gauge wellbore. As a result, the excess cement volume could be reduced while achieving good returns.
Additional trials with BaraFLC Nano-1 are planned in the near future. Halliburton looks to fully commercialize this drilling fluid under the BaraShale® Max fluid name this year.



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