Fluids face the heat

A drilling fluid from Halliburton’s Baroid business combines new emulsion chemistries with polymers to extend the operating environment of a drilling fluid for high-pressure, high-temperature conditions. Jennifer Pallanich reports.

Baroid introduced BaraECD in 2012 for use in narrow margin drilling operations in the Gulf of Mexico. The fluid was intended to provide stability over a range of elevated temperatures and pressures.

“Over a period of two and a half years, BaraECD has gone through an extensive engineering phase where we’ve designed fluids for very high temperatures and very high pressures, where the solids content can become a challenge to suspend,” Luis Mota, Baroid’s global technical sales and marketing manager, says. “In the last year, we delivered a high-performance system operating with those increased capabilities.”

Baroid aimed at developing a stable rheology profile that worked across a range of elevated temperatures. BaraECD can function at temperatures reaching 400°F Fahrenheit.

“You want to have a fluid behave in a predictable way, whether it’s at 150°F Fahrenheit or 400°F Fahrenheit,” Mota says.

Julian Coward, strategic business manager for the fluids division, says the company has recently discovered polymers that give “excellent” return permeability results.

“On the reservoir fluids side, we’ve extended our portfolio capability to 400°F Fahrenheit for water-based fluids. On the oil-based mud side, it’s even hotter, and we’ve designed our fluid sets to reach 450°F Fahrenheit consistently,” Coward says. “Not only do we have to provide a fluid that’s resistant to the...
extreme temperatures, but it also has to have other physical characteristics that allow us to drill the wells. Minimising equivalent circulating density (ECD) allows operators to drill in high-pressure, high-temperature (HPHT) environments that maybe conventional systems don’t allow.

As operators look at more challenging well environments, they need fluids that can resist extreme conditions, yet still function. “You just can’t use traditional technology for these applications and expect to get good results,” Coward says. “Conventional technology wisdom and thinking doesn’t get you where you want to be. You need to consider a more novel approach, such as using synthesised polymers.”

As such, Baroid focused its R&D efforts on a fluid rheology profile that controls pressure in HPHT operations but would not be troubled by barite sag. “The challenge to us is not what we call static sag,” Mota says. “It’s more what we call dynamic sag, where we circulate the well at low rates, where the low shear conditions can induce the sag.”

Baroid’s scientists found that traditional emulsion systems could not keep the weighting material suspended in low rheology fluids in extreme HPHT environments. “We redesigned the rheological profile,” says Mota, who joined Baroid as a fluids engineer. Baroid moved to a novel chemistry to suspend the solids in a “uniquely different” way and make it possible to drill HPHT wells, he says.

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system and the new BaraECD system delivers an enhanced suspension package.”

The clay-free system provides greater rates of penetration and fewer losses in the wellbore, Coward says. One of the problems Baroid found was that conventional fluids containing organoclays required higher rheological properties to suspend weighting material. The solids-laden fluids were often too viscous.

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Field deployment

Baroid used the BaraECD formulation in the North Sea for a well where the operator needed a low ECD fluid for a narrow-margin HPHT well. The operator had significant efficiency challenges with competitor fluids and had concerns about formation damage. The solution came by delivering one fluid for drilling and completion operations. Multiple wells have been drilled...
and completed with BaraECD and production and drilling efficiency have come in at or above expectations, according to the company.

The reservoir temperature for the three wells, drilled in July, October and December 2014, ranged from 275°F to 340°F Fahrenheit.

“The challenge with this well wasn’t just efficiency or risk of formation damage, but that it was also drilling at a critical angle, and more crucially, we knew they would be circulating at low flow rates, due to the geometry constraints of the well,” Mota says. “The geometry of this well was known and prone to produce barite sag.”

Baroid carried out 18 months of lab work and worked with the operator to define and design a system that would meet four objectives — to provide a low ECD fluid with minimal sag risk, to maximise drilling performance through the reservoir, to avoid production damage and to be compatible with the standalone wire-wrapped sand control screens the operator was going to run.

“The reservoir sections were drilled with this fluid, and it had excellent drilling performance across all three wells,” Mota says. “No additional time was required for fluid clean-up before running the screens.”

According to Baroid, the first two wells were producing at or above the expected rate. The third well was not yet onstream as of early January.

“We combined the drilling fluid and completion fluid into one step, so that allowed us to reduce the time spent on the well and resulted in about a $5 million fluid cost saving per well,” Mota says.

BaraECD “qualified itself for this application in a way that no drilling fluid had ever done before. It qualified itself as a completion fluid as well. The key was about being able to flow that fluid through the screens.

“Secondly, and just as important, when you’re drilling the reservoir, you need to make sure that any fluid invasion into the reservoir doesn’t damage the reservoir.”

While BaraECD has been deployed in the field, ongoing testing is aimed at “delivering the same system across the globe where we have the same challenges” in terms of narrow margin drilling, Mota says.

Global demand
HPHT and narrow margin capabilities “are two of the core attributes that most majors, international oil companies and national oil companies need from their fluid providers. I feel Baroid, certainly in the last two or three years, has positioned itself to be able to provide that technology,” Coward says. “These well challenges are now within our capability to solve. Most of the extreme HPHT prospects are still in the planning and development stage, where in my opinion other technology will fail before the fluids.

“We are currently looking at specific areas where customers are considering hot wells up to 600°F Fahrenheit. There are a few of those, but they are not what I would consider mainstream requirements.”

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IN CONDITION: Halliburton’s Baroid product service line uses a hydraulic shear unit at mud plants or on-site for fluid preconditioning.

LAB WORK: Baroid’s Technology Centre in Houston.