Drilling fluid eliminates sag, other weight problems

Doug Oakley, M-I SWACO

A UNIQUELY ENGINEERED fluid technology, comprising chemically treated barite or other weighting agents ground to 1/50th of their original size, has eliminated many of the technical and HSE problems encountered with conventionally weighted drilling and completion fluids.

Compared to traditionally weighted systems, the new fluids technology delivers higher density and less sag at lower rheologies, while demonstrating improved filtration properties and solids separation efficiency in critical drilling, reservoir drill-in and completion fluid applications.

Basically, the ground barite or other weighting agents are applied to oil-base or water-base drilling and completion fluids as a high-density slurry.

Presently limited for use in the North Sea, mainland Europe and Kazakhstan, the technology employs finely ground colloidal weighting agents milled to less than 10 microns in diameter for both drilling and completion fluids. By grinding API barite (with a typical d_{50} of 30microns) to a particle size with a d_{50} of less than two microns in diameter, the problem of barite settlement in drilling and completion fluids are immediately overcome.

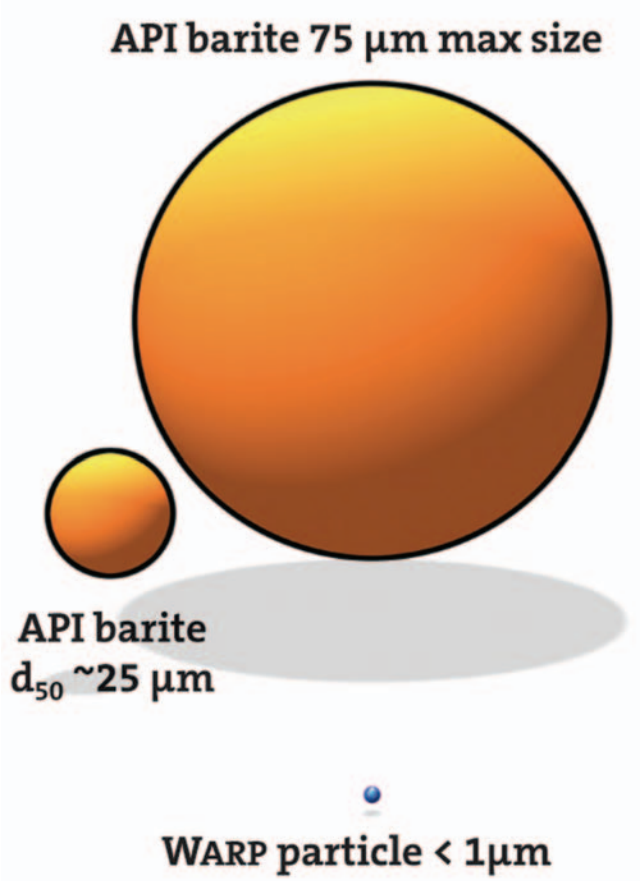
Moreover, drilling fluids can be rheologically optimized to achieve optimal well hydraulics and equivalent circulating density (ECD) management for the most complex well geometry without fear of barite sag and settlement.

A patented polymer is added during the grinding process to ensure the fluids remain stable.

The so-called WARP Fluids Technology can be applied to all water- and oil-base drilling and completion fluids. The fluids are specially engineered for ERD, horizontal, HTHP and other critical drilling applications and as replacements for conventional high-density brine completion fluids.

WEIGHTING AGENTS

Field trials in both the North Sea and the Caspian Sea off Kazhakstan have validated the technology as the answer to a host of technical and HSE problems that have beset the drilling fluids industry over the four decades since the introduction of barite as a weighting agent.



The micron-size weighting materials developed for WARP Fluids Technology are much smaller than standard API barite, allowing them to flow easily through 300-mesh shaker screens, so that virtually 100% of drilled cuttings can be removed on the first pass.

Owing to their capacity for controlling downhole pressure and avoiding wellbore collapse, weighting agents are critical to the building of any drilling fluid. However, thickeners, viscosifying agents, gelants and other products are required to keep all the weight material suspended, which, particularly in long reach and extended reach wells, limits the hydraulics and the ECD capability of the drilling fluid.

If these additives were removed, weight material would settle in a drilling fluid resulting in an uneven fluid density in the wellbore. High-density WARP Fluids Technology overcomes sag and all the other deficiencies of conventionally weighted drilling fluid systems, and some of the shortcomings of salts, brines and other soluble weighting agents.

These fluids also have been shown to provide safer and more secure well control and requires less dilution, thereby reducing discharge to the environment. Further, they deliver comparably faster ROP during the drilling phase and are non-damaging to the formations.

The use of these fluids also allows solids-control equipment to be run much more aggressively than they ever could with conventionally-weighted fluids.

The problem with the normal grade of API barite is that the particle size is very close to that of the drilled solids that invariably become incorporated into the drilling fluid system.

With shaker screens of 250-mesh or finer, the barite and low-gravity drilled solids customarily are removed on the screens, resulting in damage to the screen and higher costs.

With its particle sizes a magnitude of order smaller than conventional API barite, a WARP fluid system can be run through extremely fine mesh screens on the primary shaker. Screens as fine as 325 and 270 mesh have been routinely used successfully with WARP fluid systems.

Consequently, most of the drill solids are removed on the first pass. Further, the very thin viscosity of these fluids not only aid screening, but also reduces environmental impact and the volume lost over the shakers, which in turn results in dilution rates as much as 35% lower than conventionally weighted systems.

TRIALS VALIDATE TECHNOLOGY

The new fluids technology has been used successfully in the North Sea and elsewhere.

In one application off Norway, a 13.7 lb/gal oil-base fluid using the new tech-

nology was used to drill a 4,222-ft 8 ½-in. section at 60° inclination with 19 offset wells providing a benchmark. At the end of the section, ECDs were reduced by 0.3 lb/gal compared to the offset wells by adjusting the rheology so that the 6 and 3 rpm Fann readings were only 4 and 3 respectively.

No evidence of barite sag was observed and the rheologically thin fluids combined with small particle size of 1/50th of the original, meant that aggressive solids control equipment could be configured.

Also in the Norwegian North Sea, a linear paraffin-base drilling fluid system incorporating newly engineered technology were used together for the first time to successfully drill a high-temperature, high-pressure well in the Norwegian North Sea.

The combination was used in a 9474-ft 12 ¼-in. section with bottomhole temperatures of 329°F (165°C). In this environment, absolute control of wellbore pressure is critical while managing ECD without compromising barite sag and settlement are critical.

The ECD's were predicted accurately using a proprietary hydraulics monitoring software package and was within 0.008 lb/bbl (0.001 sg) of actual pressure measured from the PWD tool. This allowed for absolute control of subsurface pressures and ECD management.

Further, there were no significant losses while drilling, running casing or cementing. Casing was run to TD faster and with fewer losses than on all previous wells drilled in the field.

At this writing, the technology already has been used successfully on 13 projects for several operators in the Caspian Sea off Kazakhstan.

On one development in the environmentally sensitive northern Caspian area, an oil-base WARP system was designed as packer fluid, ranging in density from 11 ½ lb/gal to 15 ½ lb/gal.

Since the fluid was to remain in the wellbores for up to five years, the system proved to be the only viable alternative.

The risk of particle settlement on the packer in conventionally weighted fluids was high, while the environmental risks and costs of clear brines at this density range were prohibitively high.

One of the wells was re-entered after three months static at 250°F and the 14-lb/gal fluid was successfully displaced out of the well showing no signs of any density variation.

Onshore Kazakhstan, a 17.5 lb/gal (2.1 sg) kill pill formulated with the technology was spotted across a perforated zone through a 2 7/8-in tubing, where it was to remain prior to pulling the tubing and plugging and abandoning the well.

After two months static under downhole conditions in an H_2S environment, no sag or settlement was observed. The slurry also remained stable after nine months in storage.

In another well drilled in 1,171 ft of water in the North Sea, a water-base WARP fluid system delivered 50% lower torque than anticipated on a 1,870-m, 17 ½-in extended reach section of a well with 73° inclination.

In addition, no barite sag observed and the section was completed 24 hours ahead of schedule.

This technology also has been applied to high-density completion fluids where expensive or hazardous brines are normally used.