



WARP Advanced fluids technology

Treated micronized weighting agents for drilling, completion fluids



WARP Advanced Fluids Technology: Treated micronized weighting agents for drilling, completion fluids

In extended reach, narrow drilling windows and similarly challenging applications, conventionally weighted drilling and completion fluids pose a host of limitations that can increase non-productive time (NPT), environmental risks and costs. In narrow-mud-weight drilling windows, for instance, programming rheological properties sufficiently low to properly manage equivalent circulating densities (ECD), yet high enough to minimize barite sag and still maintain proper hole cleaning, is particularly problematic. The inherent problems with conventional weighting agents also are magnified when formulating high-weight completion brines - a tremendously expensive and environmentally hazardous proposition.

The specially treated micron-size weighting materials unique to WARP⁺ advanced fluids technology from M-I SWACO, a Schlumberger company, are 10 times smaller than drilling-grade barite. Their ultra-small size, combined with their proprietary treatment, ensures that fluids formulated with WARP fluids technology have exceptionally stable rheological properties.

The cost-reducing solution for high densities, low rheologies and minimal sag



Features

- Particles 10 times smaller than conventional barite
- Applicable to all drilling, reservoir drill-in and completion fluids
- Allows for low-viscosity water and oil-base fluids
- Formulated with low plastic and shear rate viscosities with low yield point
- Lower friction factors (10% in cased hole, 35% in open hole)
- Particles pass more efficiently through shaker and open hole-completion screens
- Components can be optimized for reservoir, reservoir fluids and completion hardware
- Thinner filter cake with lower dynamic and static fluid losses
- Lower breakthrough pressures

Benefits

- Reduces risk of static and dynamic sag
- Lowers ECD values
- Reduces swab/surge and pump pressures
- Minimizes risks of completion-screen plugging
- Lowers downhole fluid losses
- Promotes faster pipe-running and tripping speeds
- Optimizes solids-removal efficiency
- Lowers dilution/maintenance requirements

With WARP fluids technology, M-I SWACO went against long-held convention by providing the industry specially treated micron-sized particles that allow fluid densities to be increased with exceptionally low settlement rates. More than 400 sections later, the record-setting and award-winning WARP fluids technology has consistently demonstrated its capacity to uncouple rheology from barite sag, enabling the formulation of cost-effective, low-rheology water and oil-based drilling, reservoir drill-in and completion fluids.

Compared to conventionally weighted drilling fluids, the micron-size particles of WARP fluids technology deliver lower ECD values, which when combined with comparably minimal surface and downhole losses, as well as less product consumption and fluid maintenance, reduces fluid costs appreciably. More importantly, the innovative WARP fluids technology reduces your overall well costs and risks by minimizing NPT and enhancing drilling and solids-removal efficiencies. In addition, WARP fluids technology is the environmental and economic solution of choice for engineering high-density completion brines.

Treated micronized weighting particles: A step-changing concept in drilling fluid design

Traditional drilling-fluid engineering concepts hold that micron-size particles generate excessive fines in the drilling fluid,

thus increasing rheology to detrimental levels. WARP fluids technology has put that conventional thinking to rest.

The field-proven benefits of WARP fluids technology lies in grinding the weighting material to ultra-fine particle sizes — from 0.1 to 10 microns, with the majority measuring 1 micron. Specially treating these extremely fine particles prevents any increase in rheology, verified in field results where fluids formulated with WARP fluids technology routinely mitigate a host of drilling and completion problems, including:

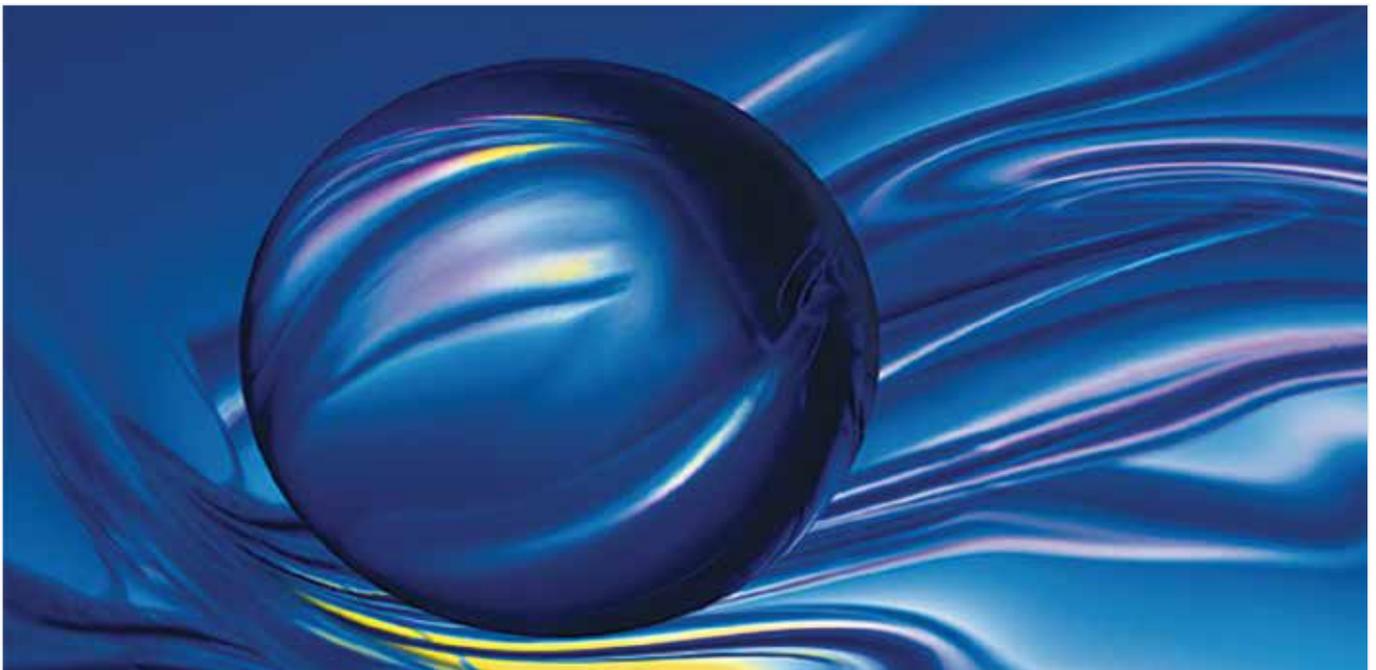
- Low-rheology drilling and completion fluids for extended-reach applications prevent weight materials from settling, despite the low rheologies.
- Improved ECD management and fewer downhole losses while drilling and cementing
- Lower torque and friction factors for long-reach wells
- Ultra-fine shaker screens can be used to enhance solids-removal efficiency without sacrificing premium products, thereby elevating environmental and waste management performance
- Oil-base completion fluids can be safely formulated for water-sensitive hydrocarbon zones.

Compared to conventionally weighted drilling and completion fluids, there is no comparison

When mud systems formulated with WARP fluids technology are evaluated against their conventionally weighted water-base and invert emulsion counterparts, the beneficial results speak for themselves:

- The dramatically reduced particle diameters have been shown to reduce settling velocities by a factor as high as 10,000. The capacity to minimize sag and settlement, therefore, makes WARP fluids technology an excellent option for drilling all lower and intermediate portions of long-reach-horizontal sections, as well as for use in completion and workover fluids.
- Lower plastic viscosity compared to conventionally weighted fluids with the same yield point effectively reduces ECD for drilling narrow mud-weight windows.
- Owing to the comparatively higher allowable pump rates and non-laminar flow regimes, fluids formulated with WARP fluids technology enhance bit hydraulics, thereby improving hole cleaning, with associated increases in ROP and tripping and casing speeds.
- Improved filtration properties delivered by the ultra-fine particle sizes contribute to enhanced filtration control, minimizing the risk of differential sticking.
- Improved solids-separation efficiency requires less dilution, optimizes product performance and reduces associated costs. The fine particle size of the weighting agents in WARP fluids technology allows weight material to easily pass through 500-mesh shaker screens, removing virtually 100% of drilled cuttings on the first pass.
- Reduced torque in open and cased hole by as much as 35% compared to offset wells drilled with conventional weighting agents. Lower friction factors allow for greater horsepower at the bit, more effective drilling rates and less drag while running pipe.
- Non-damaging to production formations, providing all components of the fluid engineered with WARP fluids technology are optimized with respect to the reservoir, reservoir fluids and completion hardware. Of the cumulative sections drilled to date using WARP fluids, 70% are in 8.-in. and smaller sections. With correctly sized bridging materials, WARP fluids are non-damaging to the producing formation and deliver full flow back through completion screens.

The lower fluid viscosities at the shakers also improve screening efficiency while reducing fluid discharge associated with cuttings. As an added bonus, the improved solids-separation efficiency improves the tolerance of the fluid system to low-gravity solids (LGS), while the improved pressure drops in narrow annuli allow greater flexibility for optimizing flow rates and pump pressures.



When the stakes are high, WARP fluids technology keeps a rein on drilling problems

With mud systems using typical API-grade barite, viscosity is tightly controlled to prevent settlement. However, contemporary exploratory and Brownfield extended reach and horizontal wellbores require a more contemporary solution. Wellbore trajectories are more complex and as they continue to extend, operators face an inevitable compromise between the rheological requirements for barite suspension and hydraulics for well control. That is precisely where WARP fluids technology comes into the picture.

The low rheological profile of a WARP fluids technology-enhanced drilling fluid significantly improves hole cleaning by effectively removing any cuttings buildup on the lower side of the hole.

In addition, the low rheologies of the new generation technology clear the way for better control and management of ECD, which is especially critical in extremely narrow margins between the pore and fracture pressure. In fact, WARP fluids technology actually reduce ECD values, while comparatively lower pump pressures also reduce pressure spikes while tripping and running casing. These and other advantages make WARP fluids technology the ultimate choice for reducing drilling risk and well costs for a full gamut of critical drilling applications, including:

- Horizontal and extended-reach wells
- Coiled-tubing and through-tubing rotary drilling
- Managed-pressure drilling (MPD)
- Reservoir drill-in fluids
- Wells with very narrow operating windows
- HTHP wells
- Casing drilling
- Inhibitive fluids
- Wells with risk of barite sag
- Drilling waste management
- Critical cementing operations



Also your best option for safe and cost-effective completion fluids



Formulating a solids-free workover or completion fluid above 13 lb./gal (1.6 SG) offers few choices and the ones typically available are less than attractive. Until now, the options were limited to calcium chloride, calcium bromide, zinc bromide or mixed potassium and cesium formate brines. All of these options are not only very expensive, but also environmentally hazardous and usually requires special corrosion additives to mitigate the increased risks of scaling. The only other alternatives had been specially-formulated barite or calcium carbonate-weighted fluids that are highly prone to sag and settlement.

Those concerns go to the wayside with completion and workover fluids formulated with WARP fluids technology. The micron-sized particles behave as solids-free fluids with minimal settlement and reservoir damage and with complete flow back through gravel-pack and sand-screen completions — all with zero associated

environmental or disposal hazards. In addition, with WARP fluids technology you now have the option of engineering high-density oil-base completion fluids for a complete oil-base drilling and completion fluid train, minimizing the need for spacers as well as reducing the potential for emulsion blocks.

WARP fluids technology keeps your waste management and environmental programs on track, too

WARP fluids technology allows solids control equipment to be run much more aggressively than with conventionally weighted fluids because the weighting-agent particles are so much smaller than the drilled solids. For fluids formulated with conventional API grade barite, the particle size is very close to that of the drilled solids which invariably become incorporated into the drilling-fluid system.

In these instances, reducing the screen size to 250-mesh or finer removes barite as well as unwanted low-gravity drilled solids, resulting in higher fluid costs.

The small particle size of WARP fluids technology ensures that extremely fine-mesh screens may be employed on the primary shaker. Meshes as fine as 500 have been used successfully, removing the majority of the drill solids on the first pass. Not only does the very thin viscosity of these fluids aid screening, it also reduces environmental impact and fluid volumes lost over the shakers, which in turn results in dilution rates as much as 35% lower than conventionally weighted systems.

Put our WARP fluids technology to work for you

To find out more about how our WARP fluids technology and how it's performing for our other customers, contact your local M-I SWACO representative.

WARP fluids technology proves itself in the field

Norway: Oil-based WARP fluids technology lowers ECD in open hole displacement

The Situation

Drilling operations on the reservoir section of the North Sea well were aborted at 12,447 ft (3,794 m) MD due to hole pack off and increases in equivalent circulating density (ECD) and stand pipe pressure (SPP). The operator pulled out of hole (POOH) and placed a cement kick-off plug below the 9 5/8-in. casing shoe to drill a sidetrack. Reducing both ECD and SPP were paramount to successfully drilling the section.

The Solution

The operator decided that displacing with the VERSATEC⁺ oil-base drilling fluid formulated with WARP fluids technology increased the likelihood of reducing ECD values and SPP and successfully drilling the well to TD at 14,934 ft (4,552 m) MD/6,889 ft (2,100 m) TVD

The Results

The WARP fluids technology VERSATEC oil-base drilling fluid, decreased ECD from 12.5 lb/gal (1.50 SG) equivalent mud weight (EMW) to 12.1 lb/gal (1.46 SG) EMW with an identical flow rate of 2,085 lpm. In addition, the SPP was lowered from 230 to 218 bars. The lower ECD and SPP allowed the sidetrack to be drilled to TD trouble-free.

East Canada: WARP fluids technology handles offshore ERD challenges

The Situation

An operator drilling extended-reach (ERD) offshore wells had experienced a number of problems related to the operational limitations of the synthetic-base mud (SBM) used earlier. Low-gravity solids (LGS) in the SBM increased rheology, dramatically reducing flow rates while increasing both ECD and SPP, as well as the dilution rates required to address high colloidal buildup. The operator also had to cope with persistent barite sag.

The Solution

For deeper upcoming wells, M-I SWACO recommended analyzing the performance of a PARADRIL⁺ paraffin-based drilling fluid incorporating WARP fluids technology in the 8 1/2-in. reservoir section.

The Results

The PARADRIL drilling fluid incorporating WARP scored high marks on all counts, with a 10% higher flow rate than SBM, but also with 10% lower ECD and 16% lower pump pressures. Upon displacement, ECD was immediately reduced by 0.35 lb/gal (42 kg/m³), while pump pressures dropped by 1,700 lb/in² at a 528 gal/min (1,999 L/min) flow rate. Rotary torque dropped by 20%. In addition, the operator was able to use shaker screens as fine as 400 mesh, effectively reducing by 50% the waste volumes sent for cuttings re-injection.

Brazil: WARP fluids technology improves MWD signal strength 10-fold

The Situation

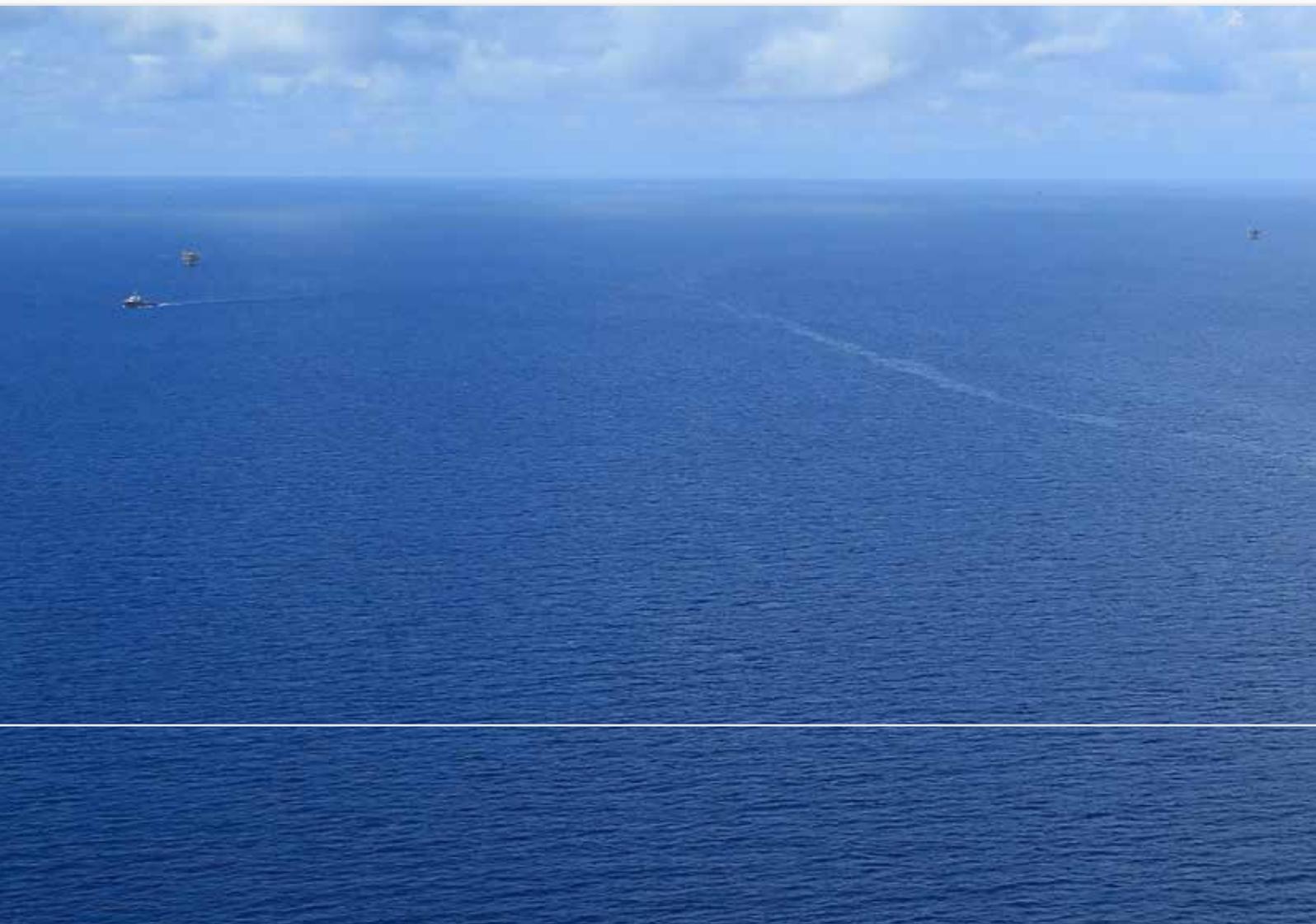
The 8 1/2-in. section of a planned deepwater high-pressure high-temperature (HPHT) well had a narrow operating window of less than 0.65 lb/gal (pore pressure 15.6 lb/gal and LOT 16.3 lb/gal). From a drilling fluids standpoint, the inherent challenges of drilling this exploration well required the utmost technical solution.

The Solution

At BHT of 136°C (277°F) and fluid density of 15.9 lb/gal (1.9 SG), one of the primary objectives was to reduce and preferably eliminate any barite sag issues. M-I SWACO recommended the operator employ an HPHT drilling fluid incorporating the WARP fluids technology. The WARP fluids technology would be run in conjunction with the Schlumberger StethoScope^{*}, TeleScope^{*} and SonicVISION^{*} Drilling and Measurement (D&M) tools.

The Results

The WARP fluids technology drilling fluid system not only drilled the well trouble free, but also enhanced the ability to obtain data from the D&M tools. The improved information elevated the operator's confidence in the data, which was critical given the exploratory nature of the well. Use of the WARP fluid increased the signal strength of the MWD logging tools tenfold. The 7-in. liner was successfully run to the bottom with no sag or losses observed.



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