

MI SWACO

A Schlumberger Company



DRILPLEX Drilling Fluid System

**Ultra-versatile, high performance mixed-metal oxide
water-base drilling fluid**



DRILPLEX: The ideal solution for diverse and demanding applications in sensitive ecosystems

One of the most pressing dilemmas operators face is selecting a drilling fluid that effectively addresses demanding drilling applications, while meeting increasingly stringent environmental restrictions. High-angle and long horizontal wells, for instance, may call for the maximum lubricity and hole cleaning efficiency of an oil-based mud, but a combination of environmental regulations and higher waste disposal costs discourage the use of invert emulsion fluid systems.

M-I SWACO, a Schlumberger company, met that quandary head-on with its revolutionary and highly versatile DRILPLEX[†] water-base drilling fluid system. The DRILPLEX drilling fluid system incorporates the latest generation of mixed-metal oxide (MMO) technologies to provide a cost-effective and environmentally acceptable solution for the most challenging applications.

Ultra-versatile, high performance mixed-metal oxide water-base drilling fluid

Features

- Latest-generation mixed-metal oxide (MMO) system
- Highly shear-thinning
- Excellent HSE profile
- Well-understood chemical additives
- Temperature-stable to 300° F (149°C)
- Exceptional rheological properties
- Easily formulated chemical makeup
- Components engineered for hole cleaning and suspension
- Effectively seals high-permeability deepwater formations

Benefits

- Minimizes losses
- Elevates HSE profile
- Delivers high rates of penetration
- Simplifies engineering, maintenance
- Demonstrates efficiency in coiled-tubing applications
- Maintains temperature stability
- Exhibits excellent performance in diverse and demanding applications
- Reduces costs

The water-based chemistry of the DRILPLEX drilling fluid system not only minimizes environmental problems and related costs, but its capacity to reduce torque and drag also reduces the risks of hole erosion by generating flow that is low to zero across the wellbore.

The bentonite/MMO complex of the DRILPLEX drilling fluid system helps deliver an exceptional rheological profile designed to lower costs in a wide variety of drilling applications. The DRILPLEX drilling fluid system, for example, routinely demonstrates unequaled solids suspension, and ultra-efficient screening, even at high flow rates, and effectively controls losses in both hard rock and unconsolidated sedimentary formations.

What's more, the DRILPLEX water-base drilling fluid system is formulated with components that are virtually non-toxic, with a low concentration of organic material. The primary fluid-loss-control additive is a starch derivative that contributes further to the minimal

environmental impact and reduced costs of the DRILPLEX fluid system.

Since its introduction, the DRILPLEX drilling fluid system has recorded an impressive track record of successes in some of the industry's most demanding, diverse and environmentally sensitive drilling applications, including:

- Drilling zones prone to lost-circulation
- Casing-milling operations
- Stabilizing unconsolidated formations
- Coiled-tubing operations
- Deepwater drilling
- High-angle and horizontal wells

It's no surprise why the DRILPLEX drilling fluid system is widely recognized as the drilling fluid of choice for tackling the toughest downhole applications in the most sensitive ecosystems.





Uncomplicated system delivers exceptional results in the most complex wells

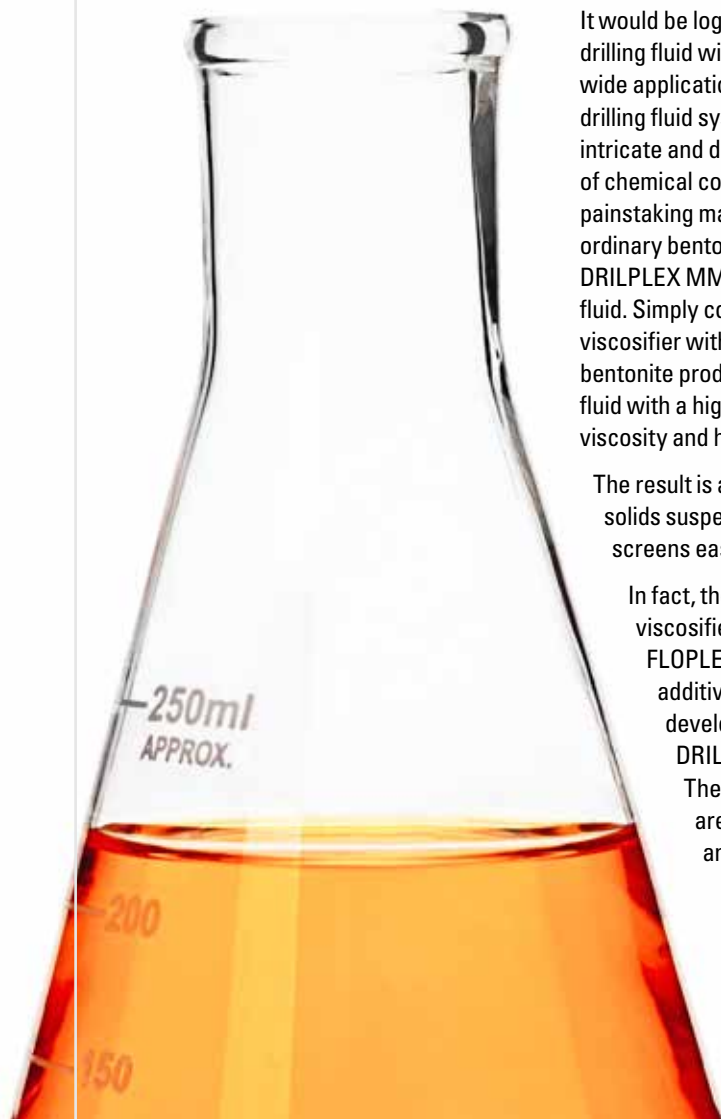
It would be logical to assume that a drilling fluid with the versatility and wide application range of the DRILPLEX drilling fluid system would involve an intricate and difficult-to-engineer maze of chemical compositions, requiring painstaking maintenance. No so, as ordinary bentonite is the heart of a DRILPLEX MMO water-base drilling fluid. Simply combining the DRILPLEX viscosifier with pre-screened, high-quality bentonite produces a highly shear-thinning fluid with a high yield point, low plastic viscosity and high, flat gel strengths.

The result is a fluid system with unequalled solids suspension, but one that still screens easily, even at high flow rates.

In fact, the specially formulated viscosifier and the proprietary FLOPLEX¹ primary fluid-loss-control additive are the only components developed specifically for the DRILPLEX drilling fluid system. The remaining chemicals are relatively common and well understood.

The DRILPLEX drilling fluid system goes with the flow for stability par excellence

Once in the annulus, the unique flow profile of the DRILPLEX drilling fluid system provides the capacity to stabilize mechanically weak and poorly consolidated formations. The high viscosity of the DRILPLEX drilling fluid system at low shear rates results in a stationary layer of fluid on the sides of the wellbore. This protective layer, in turn, shields weak rock formations from flow-induced erosion. The ability of the DRILPLEX MMO water-base mud to stabilize these weak and unconsolidated formations is further enhanced by the lower pump rates used with the system. This tendency also helps explain the lower seepage losses that occurred in a number of wells with highly fractured formations.





The unique mechanism driving the DRILPLEX drilling fluid system

The DRILPLEX AR PLUS drilling fluid system is the most recent variant to M-I SWACO MMO technology. The DRILPLEX AR PLUS drilling fluid system provides anionic tolerance in comparison with the standard version of the DRILPLEX drilling fluid system. This unique feature offers more flexibility and options to drill unconsolidated formations with potential anionic characteristics while still providing the similar unique shear thinning profile, hole cleaning potential and reduced Lost Circulation risks of the DRILPLEX drilling fluid system.

Pre-treatment with a specially selected anionic scavenger will assure protection of the bentonite-MMO complex while drilling in negatively charged formations. Additionally, the system was enhanced with a specially designed fluid loss control additive to provide filtration control and further prevent wellbore instability.

The MMO comprising the core of the DRILPLEX drilling fluid system includes an electron-deficient lattice. When

added to water, the DRILPLEX viscosifier particles bond to the cation exchange sites on bentonite, thereby forming a strong complex that gives the fluid its structure and provides viscosity and gels. This complex also renders the system relatively insensitive to common contaminants.

When the MMO crystals are added to a suspension of bentonite platelets, the cationic crystals displace the naturally "resident" sodium or other cations and form strong associations with the anionic sites on the faces of the clay platelets. The result is a new complex or adduct with characteristics that are fundamentally different from those of a virgin bentonite platelet.

The entire mechanism appears to be electrostatic in nature, which makes it somewhat unusual and accounts for the distinctive characteristics of the DRILPLEX drilling fluid system. For example, an electrostatic-field-based mechanism could explain the elastic or deformable-solid behavior observed in the

absence of shear and could also explain both the dramatic and instantaneous onset of the solid-to-liquid transition and the reversibility of the process.

These exceptional, yet easily engineered features deliver record-setting performances in some of the most challenging applications, including long horizontal wells in the Gulf of Mexico, complex milling operations in the North Sea and ultra-deepwater Brazil where the DRILPLEX drilling fluid system repeatedly drills to TD with zero losses. In West Africa, the highly versatile system effectively drilled a depleted reservoir and unconsolidated formation at a maximum angle of 102°.

Put the DRILPLEX drilling fluid system to work for you

To learn more about the DRILPLEX MMO water-base drilling fluid system and how it's performing for our other customers worldwide, contact the M-I SWACO representative nearest you.



The DRILPLEX drilling fluid system proves itself in the field

Alaska: DRILPLEX AR fluid system meets all drilling, casing installation goals

The Situation

The operator had drilled several wells in the area using spud mud incorporating 35 lb/bbl (100 kg/m³) M-I GEL[†] premium viscosifier. Typically, the operator experienced multiple downhole problems, such as poor hole cleaning, tight hole, severe lost circulation, running gravels and poor cement jobs.

The Solution

M-I SWACO recommended the operator employ its DRILPLEX AR PLUS water-base drilling fluid system. The system has shown its capacity to deliver superior drilling, tripping and cementing performance. The unique chemistry of the DRILPLEX AR PLUS drilling fluid system delivered significantly reduced plastic viscosities, increased yield point and low shear yield point.

The Results

The well was drilled successfully with all client objectives achieved. The uniquely formulated DRILPLEX AR PLUS drilling fluid system provided superior hole cleaning and enhanced wellbore stabilization by “holding back” the unconsolidated gravels. No running gravels and tight hole were observed and tripping time was reduced, allowing the operator to trip out on elevators instead of backreaming. The casing string was run trouble-free and cemented with full returns to surface.

Western Siberia: DRILPLEX fluid system puts the brakes on severe losses in fractured carbonate

The Situation

The Paleozoic deposits of wells drilled in the Tomsk Region comprise cavernous fractured limestones with high hydrocarbon potential. The problem is, the same high permeability reservoirs that allow for high production rates also generate severe lost circulation during drilling. On one well, lost circulation began immediately when drilling started in the Paleozoic deposits, and over the course of trying unsuccessfully to control the losses, the operator lost more than 600 m³ (3774 bbl) of KCL-polymer fluid.

The Solution

M-I SWACO suggested the operator employ the DRILPLEX water-base drilling fluid system for drilling the highly permeable Paleozoic deposits. The system is engineered specially for drilling severe lost-circulation zones. The DRILPLEX drilling fluid system is a cost-effective shear-thinning drilling fluid based on unmodified sodium montmorillonite and mixed metal oxide (MMO) technology.

The Results

The DRILPLEX drilling fluid system was first used to drill 150 m (492 ft) liner intervals in two wells. Drilling mud from the first well was recycled to drill the liner interval of the second well. Total mud loss for both wells was reduced to a cumulative 14 m³ (88 bbl). In addition to the dramatic reduction in losses, the system also delivered exceptional hole cleaning, which contributed to a considerable reduction in interval drilling time. The 150 m (492 ft) intervals on the two wells were each drilled in four days, compared to 24 days for the 157 m (515 ft) liner interval on one offset and eight days for the 38 m (125 ft) liner interval on another well.

UK: DRILPLEX drilling fluid system successfully cures major losses in deepwater well

The Situation

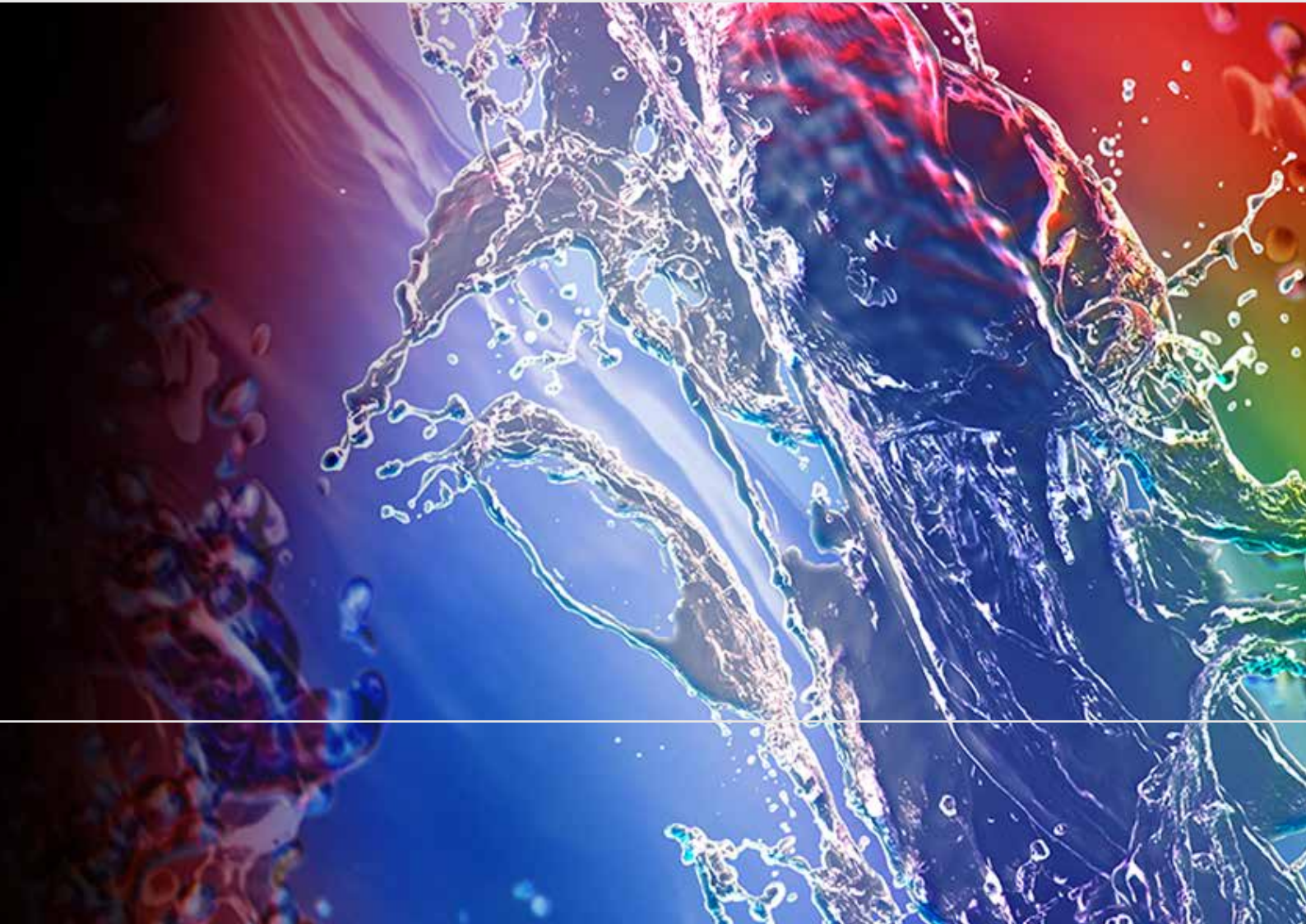
Severe to total losses were being experienced during the drilling of a 12 ¼ in section through a volcanic sequence. A simple mud system comprising 9.4 lb/gal (1.126sg) KCl polymer with carbonate bridging was being used at the time. Various conventional lost circulation material (LCM) pills and cement jobs were tried, all unsuccessfully.

The Solution

M-I SWACO recommended the operator employ the DRILPLEX MMO water-base drilling fluid system in an attempt to reduce or cure the losses to either allow the operator to drill ahead or run and cement casing earlier than planned.

The Results

Shortly after the well was displaced with a 9.4 lb/gal (1.126sg) DRILPLEX drilling fluid system, the well was observed to be stable and drilling recommenced after a delay of several weeks. Severe to total losses were reduced to less than 10 bbl/hr (1.58 m³) with minimal mud treatment, including additional LCM pills, required to treat losses. In addition, the well achieved excellent MWD data transfer.



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