MI SWACO
A Schlumberger Company

RHADIANT

Ultra-high-temperature non-aqueous drilling fluid

RHADIANT components engineered to take the heat

The components of the RHADIANT† fluid system are specially engineered to work synergistically to maintain stability throughout the drilling phase and evaluation of an ultra-high temperature well. The RHADIANT fluid system performs equally well with various synthetic and mineral oil base fluid chemistries, providing the flexibility to formulate a system tailored to meet specific downhole and environmental demands.

The RHADIANT non-aqueous fluid system is both easy to build and maintain with only three specifically-engineered components:

- **MUL† XT** emulsifier is the primary emulsifier for the RHADIANT fluid package and is the principal reason this evolutionary system is able to withstand ultra-high bottom hole temperatures. The MUL XT emulsifier also contributes to the system's extremely low HPHT fluid loss values and contains no nitrogen-base compounds that can break down at elevated temperatures and release harmful ammonia.
- The **ONETROL† HT** component functions as the primary fluid loss control agent. ONETROL HT fluid loss agent maintains stability at 500°F (260°C) BHST with minimal effect on the rheological properties of the drilling fluid.
- The **ECOTROL† HT** component is the secondary fluid loss control agent that, like its primary counterpart, retains stability in extreme temperature environments.

RHADIANT knocks down barriers to accelerate the safe delivery of ultra-high temperature wells

Features

- Proprietary, novel emulsifier technology
- Flexible non-aqueous-base fluid formulation
- Lower, non-progressive gel strengths
- Lower surge and swab pressures
- Ultra-thin, highly compressive, slick filter cake
- Superb high-temperature filtration control
- Zero ammonia-forming nitrogen compounds

Benefits

- Maintains thermal stability greater than 500°F (260°C) BHST
- Resists acid gas contamination
- Effectively controls equivalent circulating densities (ECDs)
- Improves tripping
- Reduces mud loss and stuck pipe incidents
- Reduces torque and drag
- Provides ideal logging, casing and cementing operations
- Eliminates fluid-related non-productive time (NPT)
- Minimizes HSE risks
- Accelerates production
- Maximizes asset value
- Minimized potential for high temperature gelation

As an ever-increasing number of wellbores approach the 500°F (260°C) threshold, the need has arisen for a drilling fluid that can remain stable and deliver consistent performance throughout the processes of the drilling phase and open hole logging.

RHADIANT non-aqueous drilling fluid system from M-I SWACO, a Schlumberger company, meets the challenge with its novel and proprietary emulsifier technology. Whether circulating or static, the uniquely engineered RHADIANT fluid system is the industry's only non-aqueous drilling fluid with the field-proven capacity to maintain stable rheological properties at up to and above 500°F (260°C) bottom hole static temperatures (BHST).

The RHADIANT fluid system minimizes lost circulation, excessive equivalent circulating densities (ECDs), stuck pipe, ballooning, well control and other issues typically associated with drilling deep and ultra-high temperature wellbores. It also resists acid gas contamination and maintains stability during prolonged static periods of tripping, logging and cementing.

The low, non-progressive gel structure, excellent HPHT filtration control and superb filter cake quality of the RHADIANT fluid system combine to deliver a wellbore ideally conditioned for open hole logging and prospect evaluation.

The uniquely engineered RHADIANT non-aqueous drilling fluid is ideally suited for ultra-high temperature, highly deviated and slim-hole wells, especially in environments where H_2S and CO_2 contamination are significant concerns. The RHADIANT fluid system also eliminates the HSE risks associated with the build-up and release of ammonia at elevated temperatures.

All of this translates into an ultra-high temperature well that is drilled safely, evaluated efficiently and put into production sooner.

The new standard in ultra-HT drilling

This novel ultra-high temperature non aqueous emulsion drilling fluid is specially formulated to maintain a stable rheological profile and do so with little maintenance required. The RHADIANT drilling fluid system consistently produces all the characteristics needed to deliver cost-effective drilling rates in hostile downhole environments.

First and foremost, the system has shown its capacity to remain stable and highly effective at temperatures greater than 500°F (260°C) BHST and over a wide range of densities, from low density to densities in excess of 17.0 lb/gal (2.04 sg). But, that's not the only thing that distinguishes the RHADIANT fluid system:

- **Lower, non-progressive gels:** The low gel structure of the RHADIANT system remains non-progressive even when low-gravity solids (LGS) are included in the mix. Even in formidable downhole temperatures, the RHADIANT fluid system consistently exhibits 10 sec, 10 min and 30 min gels considerably lower in viscosity than any competitive non-aqueous drilling fluid system. The RHADIANT system is extremely resistent to high temperature gelation tendencies.
- **Excellent filtration control, high-quality filter cake:** Any drilling fluid considered for a well with 500°F (260°C) BHST must meet two key criteria: Exhibit extremely low HPHT fluid loss and deposit a high quality filter cake with very low permeability. The RHADIANT fluid system consistently generates extremely low HPHT fluid-loss values, not only when measured on filter paper at 350°F (177°C) but also on dynalloy disk at 425°F (218°C). Its capacity to keep an exceptionally tight lid on fluid loss enables the RHADIANT system to deposit a very thin, and slick filter cake with extremely low permeability.
- **Exceptional ECD management:** The RHADIANT non-aqueous drilling fluid will provide lower ECD, effectively reducing hydraulic pressure cycling. By utilizing the VIRTUAL HYDRAULICS or PRESSPRO RT software, this allows for strict control of ECD values. In fact, the RHADIANT fluid system is so effective at reducing surge and swab pressures that when the pumps are re-started after a trip, ECD spikes have been shown to be lower than those recorded when reaming the stand just prior to the connection.
- **Superior hole cleaning:** Maintaining control over ECD translates into outstanding hole cleaning while minimizing the possibility of barite sag, allowing the RHADIANT fluid system to produce cost-effective drilling rates in highly deviated well paths.
- **Extraordinary acid gas resistance:** The RHADIANT ultra-high temperature non-aqueous drilling fluid demonstrates its resistance to the serious impact of the H_2S and CO_2 gases that, in extreme bottom hole temperatures, typically destroy drilling fluid systems. In contrast to the norm, the RHADIANT system has consistently shown extraordinary gas tolerance, even in the presence of up to 60 ppm H_2S and with as much as 80% CO_2 concentrations.

RHADIANT stands out with improved well deliverability

Perhaps the real impact of the RHADIANT system becomes apparent when you're ready to assess the cost of producing your ultra-high temperature asset. Unlike conventional non-aqueous drilling fluids, the RHADIANT fluid system maintains extreme-temperature stability even during prolonged static conditions. Stable rheologies in tandem with the ultra-thin and slick filter cake it deposits, clear the path for highly efficient logging, casing and cementing operations.

The non-aqueous RHADIANT system routinely demonstrates its capacity to protect downhole tools while optimizing wireline operations, effectively opening the door for accurate perforation placement, optimized completions, and the highest quality reservoir characterization.

As an added bonus, with the RHADIANT fluid system it is no longer necessary to spend excessive time and money conditioning the well for cementing. The RHADIANT system improves the quality of the cement job and does so with less time needed to prep the well beforehand.

At the end of the day, the ease you will experience while logging, running casing and cementing means your ultra-high temperature well is drilled safely, evaluated efficiently and put into production sooner.

With RHADIANT, high BHT does not mean higher risks

Dramatically reduced mud losses, the highest quality cement jobs, minimal pressure spikes, and improved logging conditions are but some of the reasons the RHADIANT drilling fluid system is the best solution for delivering an ultra-high temperature well faster and safer.

The non-aqueous RHADIANT fluid system reduces the risks of well control issues, which studies have shown increase exponentially as the temperature rises. The higher the temperature, the more the fluid degrades and the less effective it becomes in helping to keep the well under control. The RHADIANT fluid system maintains control, effectively removing yet another obstacle to the efficient and fast delivery of an ultra-high temperature well.

And, since there are no risks of the high temperatures releasing ammonia, the potential shut-downs and the expense of additional safety equipment is eliminated.

To learn more about how the RHADIANT ultra-high temperature non-aqueous drilling fluid is performing for our customers worldwide, contact your nearest M-I SWACO representative.

It's all about bringing an ultra-high temperature well into production faster.

Success story: Gulf of Thailand

‘Ring of Fire’ well no match for RHADIANT

The situation

The operator requested a drilling fluid formulation that would allow it to efficiently drill and log an ultra-high temperature exploration well in what had become widely known as the ‘Ring of Fire’. Owing to the temperature gradients of other Gulf of Thailand wells, the operator expected up to 453°F (234°C) BHST. In addition, the well was programmed with a maximum inclination of 51.94° and a 6 1/8 in. production zone. Despite the difficult drilling environment, the operator’s primary concern was achieving acceptable logging performance.

The solution

After examining the well parameters, M-I SWACO specialists recommended the operator use the uniquely engineered RHADIANT non-aqueous drilling fluid. Past experience with the novel ultra-high temperature drilling fluid in the Gulf of Thailand increased confidence that the system could meet and exceed the client’s twofold drilling and evaluation objectives.

The results

The 10.5 lb/gal (1.25 sg) RHADIANT drilling fluid came through on all counts. With actual BHST of 432°F (222°C) as recorded on wireline logging tools, the RHADIANT fluid system met all drilling expectations, and delivered superior filtration control and filter cake quality with stable rheological properties while drilling the 6 1/8 in. interval with zero lost circulation or other problems. That same efficiency extended to the logging operation. Trips were smooth, and a total of seven open-hole wireline logging runs were performed successfully with minimal issues, despite the fluid remaining in a static condition for more than 90 hrs.

ONLINE RESOURCES

RHADIANT
www.miswaco.com/rhadiant

HPHT
www.slb.com/hpht

TECHNOLOGY CENTERS

M-I SWACO
Houston, Texas
Tel: 281·561·1300
Fax: 281·561·1441

M-I SWACO
Aberdeen, Scotland
Tel: 44·1224·334634
Fax: 44·1224·334650

M-I SWACO
Stavanger, Norway
Tel: 47·51·577300
Fax: 47·51·576503

M-I SWACO
A Schlumberger Company

P.O. Box 42842
Houston, Texas 77242-2842
www.miswaco.slb.com
Email: questions@miswaco.slb.com

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