QMAXVERT M HT

Generic System Name: Oil-based drilling fluid system containing mineral oil as base oil, designed for high temperature conditions.

Introduction:

Category: Mineral Oil-based drilling fluid system.

Application: The QMAXVERT M system is applicable where highly reactive formations are present and there are environmental restrictions for the use of conventional diesel as base oil. QMAXVERT M HT has been formulated to be effective in high temperature conditions (up to 430°F). The QMAXVERT M HT mud system allows drilling through troublesome shale without interfering with the internal structure of the rock provided it has the correct salinity to avoid movement of water from the mud to the shale. It has very good lubrication properties, which makes it ideal for drilling wells with complicated geometries and extended reach. When there are significantly different formation pressures in a single interval, QMAXVERT M HT minimizes the risk of differential sticking. It can be used to drill with a mud density below the water gradient and also it is recommended to be used when high densities and temperatures are expected. Offshore in shallow applications where it is necessary to provide borehole stability across water sensitive shale. The capillary pressures, convex meniscus in capillaries and osmosis are responsible for the shale inhibition resulting in excellent borehole stability and the preservation of cuttings integrity. This, in turn, improves the performance of solids control equipment. The good lubricity exhibited by this system makes it ideal for drilling wells with mono-bore profiles.

Oil-base fluids allow the drilling of reactive formations more efficiently than water-base fluids. Soft shales can be controlled or hardened by exposure to oil-base fluids, which have high-salinity water in the emulsified phase. Transfer of water from the shale to the oil-base fluid is attributed to osmotic forces across the semi-permeable membrane around the emulsified water droplets.

Key aspects

- Used for drilling troublesome shales
- Excellent hole stability
- Stable up to 430°F
- Can be recycled and re-used

Replacement for: HPWBM; other inhibitive water based muds and invert emulsions having conventional diesel as continuous phase.

Components: QMAXVERT M HT

QMax Product	Function
Mineral Oil	Continuous phase
Calcium chloride brine	Internal phase
**MAXVIS HT*	Viscosifier
**MAXMUL HT*	Primary emulsifier
**MAXWET XL*	Secondary emulsifier
Hydrated Lime	Activator, alkalinity agent
**QMAXTROL HT*	Fluid loss control

* Proprietary or brand name products

Key aspects

- Mixing order and shear are critical
- Lime is key for emulsion stability
- Use MAXWET XL when densifying
- When possible, add prehydrated lime

Supplemental Materials	Function
*Soltex	Fluid loss control, shale stabilizer
*SMART SEAL™	Proprietary blend for seepage loss reduction
*QSTOP FINE	Fiber for seepage loss control
Calcium carbonate	Sized solid for seepage loss, particle plugging
Barite	Weighting agent
*MAXMOD	Increase low end rheology
Graphite, Teflon beads	Lubricants

* Proprietary or brand name products

Key aspects

- Soltex will enhance HTHP fluid loss
- SMART SEAL is an effective sealing agent
- Use of MAXMOD will prevent barite sag
- Use QSEAL software for PSD optimization

Typical System Properties

QMAXVERT M HT		
Property	**Range**	**Min/Max Recommended**
Mud Weight, ppg (kg/m^3)	7.1 - 17.5 (860 - 2,100)	<17.5 (< 2,100)
Plastic Viscosity, cP	2 – 40	< 40
Yield Point, $lb/100ft^2$ (Pa)	2 – 60 (1 – 30)	< 70 (< 35)
Gels, $lb/100ft^2$ (Pa)	2/20 – 4/30 (1/10 – 2/15)	As required
Excess Lime, ppb (kg/m^3)	2 – 6 (6 – 18)	>1.75 (>5.0)
Electrical Stability, Volts	300 – 2,000	> 800
HTHP Fluid Loss, cc/30min	2 - 20	< 10
LSRYP, $lb/100ft^2$ (Pa)	8 - 16 (4 – 8)	As required
WPS, mg/L Cl^-	200K – 350K	> 220K
Oil Water Ratio	60:40 – 100:0	> 65:35

Key aspects

- Low temperature will increase rheology
- Alkalinity should be always monitored
- Water in filtrate is a sign weak emulsion
- If possible monitor cuttings activity

Field Operations

Mixing Procedures

For New System: QMAXVERT M HT is normally supplied as a pre-built system at the rig-site. If the supplied fluid's properties are lower than specifications, shear through the bit and addition of extra products will bring properties on line. Mixing QMAXVERT M HT on location is possible. The recommended procedure is listed below:

1. Ensure tanks and lines are clean and free of water.
2. Measure the appropriate amount of base fluid into the mixing tank and circulate the oil through the hopper and fluid guns. Work with the agitators. QMAXVERT M HT stability depends on shear.
3. Add MAXMUL HT and Lime (5-10 min/sk) together through the hopper to the base oil.
4. Prepare the brine in a different tank and add it slowly through the hopper ($CaCl_2$ - 90% purity).
5. Add the MAXVIS HT at 5-10 min/sk. Organophillic clay needs a good deal of shear (preferably through the bit) and time to yield.
6. Add the appropriate amount of QMAXTROL HT through the hopper and allow mixing for a minimum of 45 minutes.
8. Add proper amount of weight material to attain desired fluid weight. To insure proper wetting and dispersion, slow the additions of weight material as fluid weight increases. Periodically during weight-up, check yield point, gels, and emulsion stability to insure proper barite suspension and that a stable emulsion is being formed. Slower additions of weight material may be necessary if inadequate shear exists and emulsion stability is not stable or is decreasing. An addition of wetting agent should be considered.

Note: If the brine water has to be made in the mixing plant by adding sacked salt to water, this would become the first step.

For mix "on the fly": Not recommended

Maintaining Properties

Minimum of two circulations usually required before change in properties noted after product addition. Daily maintenance regime is best option to maintain properties. Concentrated pre-mix addition is alternate option to maintain or manipulate properties.

Maintenance of the system will depend upon the properties desired. Whether density changes, rheological control, emulsion stability, etc are the key to drilling ahead, logging, etc., the properties of the QMAXVERT M HT system can be readily modified as needed.

Additions of wetting agent or secondary emulsifier are very important when adding any solid additive, especially weighting material such as barite or calcium carbonate. Control alkalinity of aqueous phase by adding lime in order to have an excess lime of 5 ppb (15 kg/m^3) to be prepared for a gas kick. The stability of the shale depends greatly on the salinity of the aqueous phase, so it is important to match the salinity of the mud with the salinity of the rock. This can be done by measuring the water activity onsite with a Hygrometer, then, mud engineer can adjust the salinity to the desired value.

When possible, use concentrated brine to increase water phase salinity.

To achieve optimum economics when using emulsifiers and changing oil content, as well as to minimize the plastic viscosity of the fluid, the oil/water ratio is varied with the fluid density. As drilling commences, drill solids accumulation and increases in fluid density requires increased additions of emulsifiers and wetting agents. Water breakout and/or HT/HP increases are direct indicators that additional emulsifiers/wetting agents are required. It is recommended that the HT/HP checks be run every eight hours so that a trend can be developed. Any increases in HT/HP filtrate or detections of water in the filtrate must be treated immediately.

Fluid Specific Tests and Equipment

- Complete OBM testing kit
- May require Hygrometer to test shale activity
- Garrett Gas Train for possible H_2S monitoring
- Flash Point tester

Contaminants: effect and treatment

Contaminant	Mud Effect	Treatment
Aeration	None	
Bacteria	None	
Calcium	None	
Cement	Increase in alkalinity	NA
CO_3^{2-}/HCO_3^-/CO_2	CO_2 may reduce lime	Increase lime additions
H_2S	Gas release on surface	Zinc carbonate, high excess lime, HS 600
LGS	Increasing viscosity	Centrifuge and/or base oil additions, emulsifiers and wetting agent
Salt formations	Possible increase in Cl^-	NA
Water influx	Reduces oil water ratio,decrease WPS, ES, increase in rheology	Base oil additions, chemical thinner may be required. Powdered $CaCl_2$ additions, emulsifiers and wetting agents

Operational Recommendations and "Best Practices"

- For offshore applications, use brine, viscosified brine or viscosified seawater spacer ahead of QMAXVERT M HT for initial and riser displacements. Dyed spacers are easier to distinguish at shakers.
- Screen down after trips due to cold, inactive mud.
- System is easier to maintain with "proactive" measures of daily maintenance or concentrated pre-mix additions.
- Pilot test before additions of thinners and low end rheology modifiers.
- Closely monitor LSRV in deviated sections in case of unexpected extended periods without circulation to reduce effects of barite sag.
- Do not "over-treat" to rapidly acquire target properties.
- Analysis of cuttings shape, size, amount and integrity paramount to wellbore stability, proper inhibition, density and hole cleaning.
- Tanks, lines and pumps cleanliness paramount to successful clean-up before completion operations. Clean-up schedule should include instructions for the cleaning of all mentioned equipment.
- Cuttings segregation for disposal.
- Heated storage for the emulsifiers and wetting agent in the winter is recommended, especially if the concentrated products are used.
- Cover mud pits to avoid the entrance of raining water into the QMAXVERT M HT mud system.
- Recommend to have all the mud tanks area surrounded by ditches to be able to react in case of a spill.
- Have on standby, LCM pills or Kill mud if expected mud losses / high pressures. Reaction time is important in these cases.
- Storage of liquid additives must comply with Operator and local regulations.