MICRONAIRE™

Generic System Name: Natural Gel – MMH with surfactant

Introduction:

Category: The system is a water based fluid for preventing formation impairment and lost circulation. It is based on a bentonite-inorganic polymer crosslink complex for LSRV and a surfactant to entrain air bubbles. It may be inhibitive with the addition of a potassium source. (eg. K_2SO_4).

Application: Drilling depleted horizontal wells where a near-balance fluid is required, in low density drill-in fluid applications for hydrocarbon pay-zones and for use in lost circulation zones in surface or downhole applications. The system prevents invasion into lost circulation and pay zones by placing a "micro-bubble bridge" across porous formations. It is commonly run between 7.5 – 7.9 ppg (900 - 950 kg/m^3) although densities as low as 5.4 ppg (650 kg/m^3) are possible. Weighting agent additions allow for use in higher pressure wells.

Replacement for: Solids based bridging systems (carbonates, celluloses, resins and salts), low weight loss circulation fluids and low damaging drill-in systems.

Key aspects

- Can be used with N_2 additions
- Watch for mud pumps cavitation
- Excellent option for depleted formations
- It can be used with potassium salts

Components: MICRONAIRE system

QMax Product	Function
Water	Continuous phase
**Bentonite Premium*	Viscosifier
**MICROVIS*	Crosslinking agent
**MUDLITE*	Surfactant
**QSTAR ENV*	Fluid loss control
Caustic Soda	Alkalinity control
**QSTOP FINE*	Fiber for seepage loss, sweeps
**T-352*	Bactericide

* Proprietary or brand name product

Key aspects

- Order of addition of materials is critical
- Use non-peptized bentonite
- Maintain alkaline environment
- Add Mudlite as required for density

Typical System Properties

MicronAire™		
Property	**Range**	**Min/Max Recommended**
Mud Weight, ppg (kg/m^3)	6.7 – 7.9 (800 – 950)	>6.7 (> 800)
Plastic Viscosity, cP	5 - 35	< 40
Yield Point, $lb/100ft^2$ (Pa)	12 - 24 (6 – 12)	<60 (< 30)
Gels, $lb/100ft^2$ (Pa)	80 / 200 (40 / 100)	As required
pH	8.5 - 10.0	< 10.5
Calcium - mg/l	40 - 100	< 200
MBT, ppb-eq (kg/m^3)	1.5 - 10 (25 – 30)	<10 (< 30)
API Fluid Loss - cc/30min	As required	< 10
LSRV Brookfield @ 0.3 rpm, cP	50,000 - 200,000	>75,000
Inhibition (K_2SO_4) % w/w	3 - 5	> 3%

Key aspects

- Low density drilling fluid
- Keep high rheology
- Higher viscosities than “aphron” systems
- Mud pumps will cavitate if MW < 5.7 ppg

Field Operations

Mixing Procedures

Check make-up water and reduce calcium concentration to below 40 mg/L.Add MICROVIS at the hopper no faster than 20 L per circulation, typically at a concentration of 1.5 to 2.0 kg/m^3. Add QSTAR ENV to 3.5 ppb (10 kg/m^3) initially and adjust the pH to 10.5 with caustic soda after displacement. Allow native clays to build viscosity while drilling ahead. Add pre-hydrated bentonite to build viscosity as required, typically 15-20 kg/m^3 concentration. Dry additions may also be used. Ensure a Brookfield viscosity of at least 80,000 - 100,000 cP at 0.3 rpm. Add the Mudlite only after the fluid has been pumped down hole and achieved a circulation. A standard concentration to begin with is 2 L/m^3. Ideally the Mudlite is added through the hopper, although at the centrifuge discharge is also acceptable.

Maintaining Properties

Add all materials (except for the caustic), if possible, at the hopper. Ensure the hopper remains open as this is the source of the air for the MicronAire system. Adjust the viscosity with either MicroVis alone (if MBT is > 25) or a combination of Bentonite:Microvis (10:1 to 5;1 ratio) to maintain LSRV at a high level (ideally > 75,000).

Control fluid loss with QSTAR ENV as needed. Bentonite in this fluid system does not contribute to lowering of fluid loss.

Fluid Specific Tests and Equipment

- Complete WBM testing kit
- Brookfield Viscometer

Contaminants: effect and treatment

Contaminant	Mud Effect	Treatment
Aeration	Foaming	Increase LSRV
Bacteria	Odour	Bactericide
Calcium	Minor flocculation	Reduce with additions of soda ash
Cement	High pH, Calcium	Soda ash, sodium bicarbonate
$CO3^{2-}$/$HCO3^{-}$ /CO2	NA	Caustic soda
H_2S	Surface release	Zinc carbonate
Inhibition	NA	NA
LGS	Excessive PV's	Dilution / solids control
pH	High pH	Sodium bicarbonate
Salt	NA	NA
Water influx	Loss of rheology	Replenish products

Operational Recommendations and “Best Practices”

- Ensure that the rig is equipped with a pre-mix tank and electric chemical mixing barrel. Allow 4-6 hours to mix the MicronAire system prior to displacement. It is critical to have good mixing equipment for preparing the MicronAire system. As an example, a sidewinder hopper with a 6”x8”x14” centrifugal pump has proven effective. The 5”x6”x11” centrifugal pump equipment has proven to be too small on mixing hoppers. Centrifugal discharge lines should be below mud level to prevent unnecessary foaming.

- If the LSRV and gel strengths are inadequate, the MicronAire system will start to foam. Increase low end rheology by adding bentonite and MicroVis at a range of 5:1 to 10:1 as needed. Pilot testing is strongly suggested.

- When the fluid reaches the surface during displacement, slow down the pumps to the point where no fluid is lost over the shaker screens. Start off using screens no coarser than 36 mesh to prevent mud losses over the shaker. Pyramid screens work best for sand sections. Once the system has been sheared 3 or 4 times, exchange screens with the finest possible mesh. Begin with the 84 and two 36's as they have proven effective, and then move to the 110s if needed. Clean screens with a wash gun rather than a 1" hose to avoid creating excess dilution. Do not bypass the shaker screens if displacement occurs in the openhole section.