



BARAHIB

HIGH-PERFORMANCE WATER-BASED DRILLING FLUID

**Design, conserve,
protect the wellbore**


HALLIBURTON

Oil-based fluids are not always an option when drilling shale formations. Conventional water-based fluids may not be enough.

Drilling operators need **high-performance water-based fluids** to maximize their wellbore value. High performance means a system that rivals the results of oil-based fluids – without the environmental and economical limitations.

Halliburton Baroid has engineered an expansive portfolio of high-performance water-based fluids and additives that can be customized to meet your specific challenges. Standardized systems are great, but may not match up with your needs.

Our high-performance water-based systems help reinforce the wellbore. This allows you to reduce torque and drag, increase available open-hole time, push the limits of wellbore geometries, reduce non-productive time, and optimize casing running speeds.



**High-angle, long-reach
wells in
unstable shales
require specially formulated
water-based fluids that can
maximize wellbore value.**

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Achieve measurable wellbore stability

BaraHib™ is Halliburton Baroid's next generation high-performance water-based drilling fluid. The portfolio includes the Gold, Nano and Plus versions, which prevent clay hydration and dispersion, minimize fluid loss and stabilize the wellbore.

Track • Inhibit • Stabilize

BaraHib

Polymer-based system with sustained inhibition through trackable components. Achieves peak efficiency and run life with optimal solids control equipment.

BaraHib Gold


Specially engineered version for environmentally-sensitive areas with reactive shale formations.

BaraHib Nano

Nanoparticle-enhanced version for reduction of invasion and enhanced wellbore stability. Proven to stop pore pressure transmission.

BaraHib Plus

Built with inhibitive additives, synthetic filtration control polymers and stabilizing additives for high temperature service.



BaraHib is engineered to suppress reactive clay hydration allowing operators to drill longer hole sections and eliminate the need to back ream due to clay swelling.

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Track

Product depletion is an unpredictable consequence of any drilling operation. To maximize efficiency in product usage, it is important to know exactly what is in your system. Formations that contain hydratable shale or mixed layers of reactive clay can lead to wellbore instability issues.

Baroid fluid engineers track shale inhibitor concentrations through quantitative measurements instead of the volumetric tracking approach commonly used in the industry. Products in the BaraHib system, such as BaraSure W-674, are trackable in the field.

This innovative tracking method accurately measures amine-based inhibitors. As a result, operators can achieve effective shale inhibition and improve wellbore stability, maximize drilling efficiency, and enhance control over the wellbore.



Inhibit

Depending on the chemistry of the shale, the clays may hydrate, swell or disperse throughout the mud system. This can cause a buildup of solids in the fluid, which can result in accretion issues, decreased hole diameter, and stuck pipe. This requires solutions that inhibit the hydration of clays and minimize reactivity.

Baroid delivers encapsulators, silicates, and amine-containing products that are formulated to mitigate these risks.

Stabilize

Shales with brittle or fractured layering are easily broken apart when exposed to fast-moving fluids or high annular velocities, and increased downhole pressures.

This can lead to some of the most well-known types of wellbore instability. You'll see signs of the wellbore breaking down as cavings come over the shakers and fluid consumption increases. This requires proactive solutions that strengthen and stabilize the wellbore before it receives too much exposure to the degenerative elements of drilling.

Baroid delivers shale stabilizers, bridging agents and nanotechnologies to maximize wellbore stability.

Features and Benefits

- » Quantitative trackable amine inhibitor
- » Quantitative trackable encapsulator
- » Fluid weight up to 17.5 lb/gal
- » Low toxicity
- » Environmental Gold Rated for North Sea
- » Lower well costs
- » Maximize drilling efficiency
- » Customizable fluid system

Which fluid is right for you?

BaraHib systems are optimized for intermediate sections containing shale formations.

	BaraHib	BaraHib Gold	BaraHib Gold+	BaraHib Nano	BaraHib Plus
Solution For	Sustained, trackable inhibition	Environmentally friendly inhibition	Environmentally friendly shale stability	Shale stability	High temperature inhibition (400°F/240°C)
Key Products	Encapsulator/ Amine Combo	BaraSure W-546 BaraSure W-674	BaraFLC Gold	BaraFLC Nano-1	BaraFLC W-950
Existing Areas	Global	North Sea	North Sea	Global	Middle East, Australia
Clay Free	Yes	Yes	Yes	Yes	Yes
Silicates	Available	Yes	Yes	Available	Available
Encapsulators	Yes	Yes	Yes	Yes	Yes
Trackable Inhibitors	Yes	Yes	Yes	Yes	Yes
Nanoparticle Sealing Proven on shale pressure transmission testing	No	No	Yes	Yes	No
Max Temperature	275°F/135°C	275°F/135°C	225°F/107°C	350°F/135°C	400°F/240°C

BaraHib applications and success



High-performance water-based drilling fluid system, such as **BaraHib**, are field-proven in some of the world's most challenging environments.

1 Alaska

Verification of amine tracking test methods in 2020 (BDF-976)

2 Norway

BaraHib Gold system trialed in Barents Sea in 2018.

- Drilled >40 well sections; mainly highly deviated through reactive formations
- BaraSure W-674 tracking and improved fluid maintenance
- Re-used of fluid volumes

3 Qatar

KCI BaraHib fluid Q3 2021

- Vertical and inclined sections drilled through difficult Nahr Umr shales
- Combination of polymeric and amine inhibitors with latex sealing polymer

4 Australia

BaraHib Plus 8.5" and 6.125" slim-hole sections

- BHT >235°F; final section >2,000' lateral
- BaraSure W-988 and Performatrol
- Low T&D drilling; casing runs to TD went easily even with >5 days of OH delay (8.5")

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Tiny solutions for huge problems

Most land drilling applications intersect shale formations that are prone to instability when drilled with water-based fluids. Chemical inhibition only addresses the wellbore surface and drilled cuttings. Mechanical issues can occur within days as the filtrate slowly penetrates the shale matrix, increasing pore pressure in the near wellbore.

This pressure may build to the point where shale breakout or sloughing occurs. Deteriorating hole conditions like these often lead to high costs.

Halliburton's nanocomposite wellbore sealant, **BaraFLC Nano-1**, is formulated to seal depleted, weak formations when drilling reactive shales. The tiny nanoparticles bind tighter together than conventional sealants, preventing filtrate invasion, sealing shales and stabilizing vulnerable formations.

High concentrations of traditional filtration control additives could achieve similar results. But most combinations of starches and synthetic polymers would contribute excessive viscosity to the fluid. BaraFLC Nano-1 delivers tight filtration control with only minor effects on the fluid's rheological profile.

BaraHib

Nano

BaraFLC Nano-1

BaraFLC® Nano-1 wellbore sealant is a nanocomposite suspension that provides enhanced sealing capacity to water-based drilling fluids. The individual nanoparticles fill voids in formations and filter cakes.

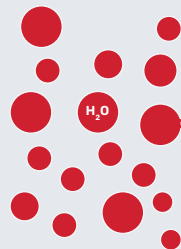
MACROSCALE

Liquid Product



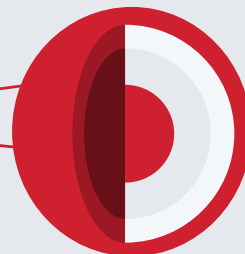
MICROSCALE

Water-in-Oil Emulsion



NANOSCALE

Nanocomposite



Halliburton
Nanotechnology
< 200
nanometers

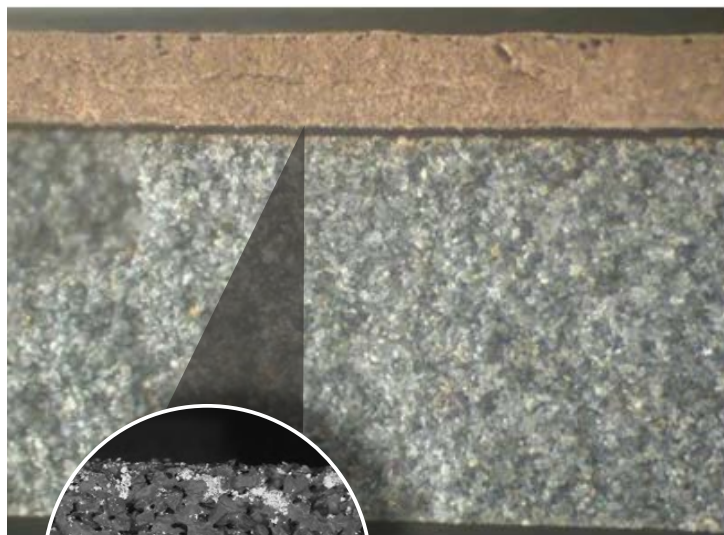
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Lab-proven for filtration control and pressure sealing

BaraFLC Nano-1 sealant outperforms legacy sealant products by delivering ultralow filtration on the full range of permeabilities – from 5 to 120 microns.

Nano in action

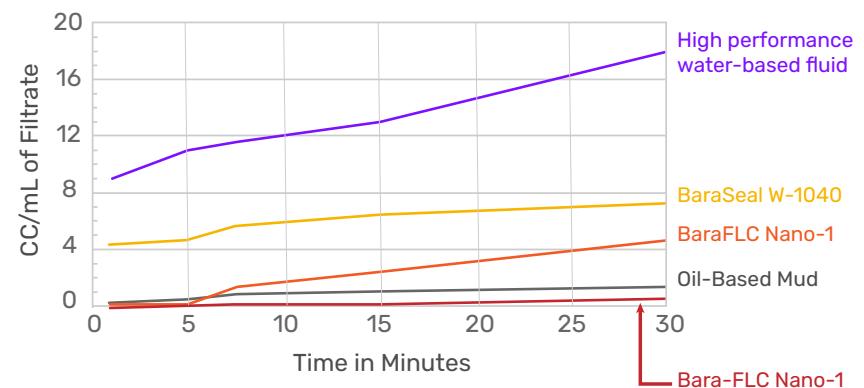
Water-based fluids form a filter cake over time. The images below show an example where nanoparticles actively seal the face of the permeable disc. This results in minimal invasion and increased stabilization.



A cross-section of a ceramic disc with filter cake. It shows BaraFLC Nano-1 sealant under magnification. This shows how the nanoparticles pass through the cake and seal pore space.

BaraFLC Nano-1 versus conventional methods

Particle plugging at 200°F with 1,500 psi, 10-micron disk



120°F	Base HPWBF	BaraSeal W-1040	BaraFLC Nano-1
Rheology	–	10.5 lb/bbl	5.0 lb/bbl
600	67	89	88
300	45	62	61
200	36	49	49
100	25	34	34
6	8	10	10
3	6	8	8
PV	22	27	27
YP	23	35	34
Gels	7/9	9/10	10/12

BaraFLC Nano-1

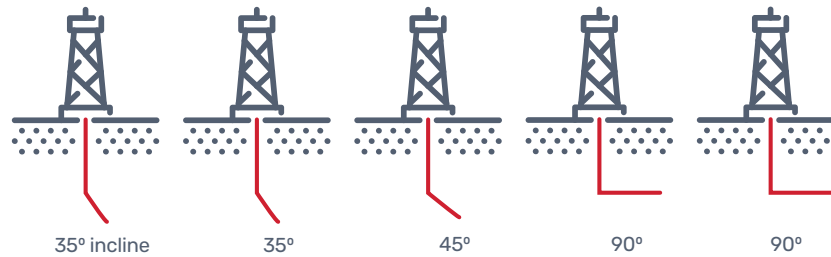
Making a big impact

BaraFLC Nano-1 is in use on problem shales, sticky sands, sandstone, limestone, and reactive clay formations. Here are a few key facts and figures about this next generation additive.

10 for 10

BaraFLC Nano-1 delivered on all objectives – including zero NPT and downtime – on all trialed applications.

Five of 10 wells have been successfully drilled at moderate to high angle using BaraFLC Nano-1. The remaining five were successfully drilled vertically.



Cuttings Inhibited

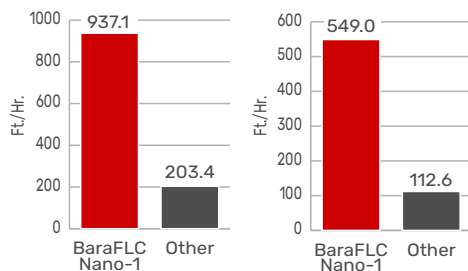


Shaker Status

High clay formation inhibited and not sticking to shaker screens.

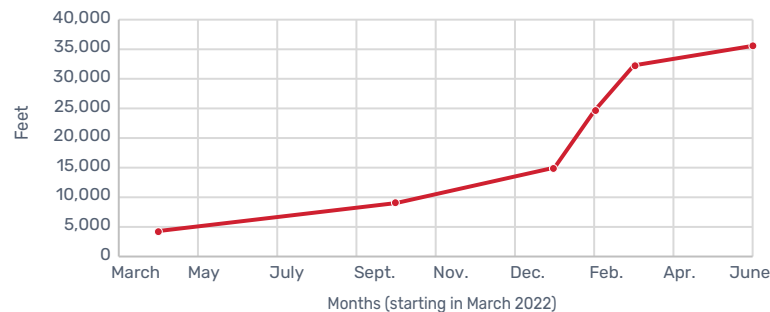
Tripping Speeds

During field trials, BaraFLC Nano-1 helped increase tripping speeds by 360% (left chart) and 387% (right chart) versus inhibited polymeric water-based mud.



Baby Steps for Nano

BaraFLC Nano-1 has been implemented across multiple areas since March 2022. Here is a look at cumulative footage by month where BaraFLC Nano-1 has been injected by operators around the world.



Invasion Evasion

Large formation sample remains dry and intact.

Nano success around the world



965 sacks of conventional chemical eliminated

Oman

Tight filtration control in high temperature application – with less material

An operator drilled multiple wells using a fluid mix, which depended on a high-viscosity synthetic polymer for good control of the high-pressure, high-temperature (HPHT) filtration and particle plugging apparatus (PPA) spurt and filtrate values.

The limitations of this approach were apparent when additions of the polymer to lower the filtration rate caused high viscosity events. This slowed progress in the drilling phase. Lower viscosity and filtrate were desired, but this ideal combination was not possible given the behavior of the conventional system components.

BaraFLC Nano-1 wellbore sealant was implemented to replace the high temperature synthetic fluid loss polymer from the formulation. The nanotechnology-based additive reduced dilution rates, lowered fluid viscosity, and tightened filtration rates during a 22-day interval with maximum downhole temperature >300°F/150°C.



40% faster rate of penetration

Colombia

Nanoparticle fluid system improves drilling and cementing efficiency

The operator's experience with a dispersed polymeric fluid system indicated opportunities for improvement, especially when drilling a potentially unstable intermediate section of shales and plastic clays. Complications while tripping were slowing down the progress, sometimes requiring time-consuming wash and ream interventions or multiple passes when tripping out of hole from the target depth.

These delays meant reduced operational efficiency and higher well construction costs. In laboratory testing, numerous fluid loss studies focused on reaching the lowest spurt and total filtrate possible on particle plugging tests (PPTs). Since Bara-Seal™ W-1040 had been used in the past for other fields, it was also tested to help benchmark performance of the new BaraFLC Nano-1 material. The spurt and total filtrate volumes

from pilot tests with equal additions of these products indicated that BaraFLC Nano-1 was more effective – reaching 71% lower spurt loss than the base mud. After implementing BaraFLC Nano-1, the operator achieved 40% faster rate of penetration (ROP) early into the section. In addition, the operator met all KPIs for filtrate values and experienced minimal overpull with trip speeds above average for the area.

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