Beyond

ENERGY SERVICES & TECHNOLOGY CORP.

Brine Drilling Fluids

Conventional Brine Drilling

Few technologies have enabled a greater step-change in performance than brine-based drilling. It can drop the overall cost of fluids and reduce AFE days, dropping the total cost of ownership to the operator.

Benefits of Brine Based Drilling

Many of the benefits brought by drilling with brines are due to the fact the fluid itself is solids-free and has no fluid loss control. These two factors allow brine-based drilling fluids to substantially improve the rate of penetration, but other benefits exist.

- Higher specific heat capacity means superior cooling for the bit and downhole tools
- Reduction in solids content leads to proven ROP enhancements [1]
- Reduction in fluid loss control leads to proven ROP enhancements [2]
- Lower cost per m^3 when compared to similar oil-based mud
- Reduced HSE profile

Factors Affecting ROP

Factor	Affect
Solids	Interferes with action of cutters
	Create plastic viscosity which will eventually require staging down pumps
Differential Pressure Between Wellbore and Formation	Chip hold down phenomenon
High Fluid Loss	Allows the drilling fluid to penetrate behind rock chips to equalize pressure

Limitations of Conventional Floc Brine

While full of benefits, conventional floc brine drilling will have some significant limitations.

- Torque and drag may become cost-prohibitive to control
- Clays will be exposed to free water in brine risking wellbore instability
- The low viscosity nature of flocculated brines will magnify the impact of vibrations in the drill string
- Fluids without gels or a filter cake will lead to riskier casing runs

See how Beyond's Brine Drilling Fluids portfolio can mitigate these limitations.

[1] **Hai-Yan Zhu, Qing-You Liu, Teng Wang.** Reducing the bottom-hole differential pressure by vortex and hydraulic jet methods. Journal of Vibroengineering, Vol. 16, Issue 5, 2014.
[2] **B.H. Walker, A.D. Black.** Dynamic spurt-loss beneath an oilfield bit. Amsterdam, Netherlands, 1993.

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B.E.S.T. Brine Drilling Fluids

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See the B.E.S.T options below :

	Highlights	Limitations	Applications
CLEAR Performance	▪ Low-cost flocculated brine solution ▪ The definition of maximizing ROP and reducing fluids related cost ▪ Excellent corrosion results across multiple clients ▪ Backstopped with our proprietary liquid lubricant to substantially enhance lubricity ▪ Beyond's novel chemistry allows for hole cleaning sweeps to be utilized	▪ No fluid loss control ▪ No viscosity	▪ CLEAR Performance applies to most applications where brine can be considered ▪ Ideal replacement for oil-based mud in areas where inhibition is not required ▪ Compatible with monovalent or divalent brines up to 1590 kg/m^3, also compatible with produced waters.
CLEAR Slide	▪ Polymer enhanced flocculated brine solution ▪ Delivers a filter cake where property enhancing materials are embedded ▪ Allows operator to react to real-time wellbore conditions (can tighten fluid loss or increase viscosity) ▪ The system can be converted back and forth from conventional floc brine	▪ Fluid loss control can be tightened to 30 cc/30 min ▪ Yield point from 0 – 3 Pa	▪ CLEAR Slide is a valid choice for most operations ▪ Allows lateral lengths to be extended without increases in cost or ECD ▪ Reduces required treatments of liquid and mechanical lubricants ▪ Provides a greater degree of hole cleaning and inhibition ▪ Compatible with monovalent or divalent brines. Also compatible with produced waters.
CLEAR Slide Plus	▪ Full polymer system optimized for divalent brines ▪ Can provide an invert like filter cake with excellent low shear rate viscosity ▪ Expect enhanced drilling and cooling properties with oil-based inhibition and hole cleaning	▪ The system cannot be flocculated	▪ Ideal for enabling monobores in areas with reactive clays in the upper hole section ▪ Excellent base fluid for building fracture gradient ▪ Will bring some of the benefits of brine-based drilling to areas where only oil based fluids have historically succeeded

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B.E.S.T. Brine Drilling Fluids

CLEAR Performance

CLEAR Slide

CLEAR Slide Plus

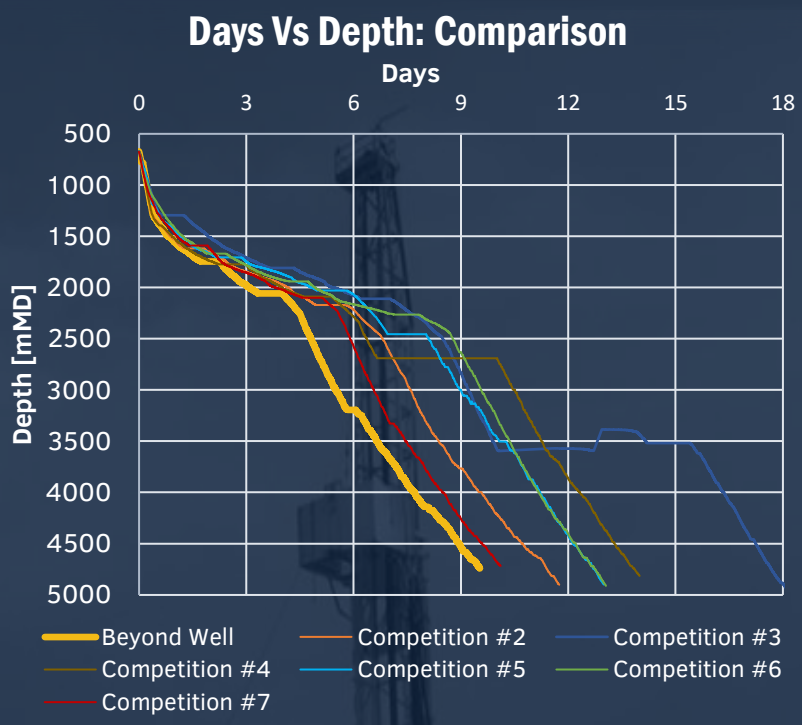
Beyond's Low Cost Flocculated Brine Package

Description

CLEAR Performance is a high performing solids-free brine package compatible with any brine. Two base packages are available each optimized for either a monovalent or divalent brine. The system requires few products and low supervision to further assist in dropping the cost of service delivery.

Benefits

- Industry-leading corrosion results
- Backstopped with our proprietary liquid lubricant to substantially enhance lubricity
- Vast experience with brines including densities up to 1590 kg/m^3



Product	Usage	Benefit
CLEAR Mono-Corr	Monovalent brine corrosion inhibitor and passivator	Able to reduce the impact of dissolved oxygen
CLEAR Di-Corr	High concentration divalent brine filming amine	Higher concentration means simpler operations and a reduced footprint
CLEAR Scav	Oxygen scavenger	Simple to use, highly efficient
CLEAR Buffer	Liquid additive to provide supplementary pH control	Reduces scaling potential of high salinity brines
CLEAR Glide	Highly dispersive ester-based lubricant	High effectiveness at concentrations of 2 - 3% v/v

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B.E.S.T. Brine Drilling Fluids

CLEAR Performance

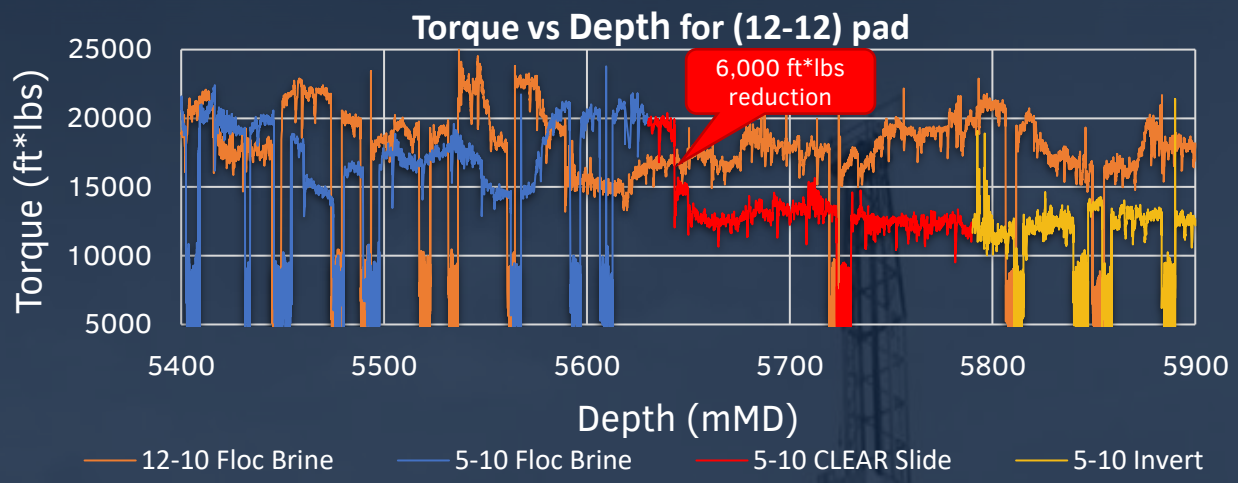
CLEAR Slide

CLEAR Slide Plus

Beyond's Polymer Enhanced Flocculated Brine Solution

Description

CLEAR Slide utilizes novel polymers that work synergistically with friction modifying materials. These polymers build a tight filter cake and trap both liquid and mechanical lubricants exactly where they are needed. Field trials show results on par with oil-based fluids. Moreover, this system can be converted to a conventional floc brine system and back.



Benefits

- Reduces the amount of friction-reducing material required to achieve the same performance
- Provides flexibility as the system can control both viscosity and fluid loss
- Significant improvements when dealing with lost circulation events
- Can suspend LCM to ensure it is placed where it is needed
- Fluid loss control provides elevated inhibition
- ECD reduction compared to oil-based fluids of similar density

Product	Usage	Benefit
CLEAR Glide	Highly dispersive ester-based lubricant	Potent at concentrations of 1% v/v or lower
CLEAR Slide L	Polymer optimized to work in tandem with CLEAR Glide in divalent brines	Novel polymer allows a system to maintain extremely low solids content
Corrosion Package	Uses the same high performing and proven corrosion package	Minimizes logistics and footprint

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B.E.S.T. Brine Drilling Fluids

CLEAR Performance

CLEAR Slide

CLEAR Slide Plus

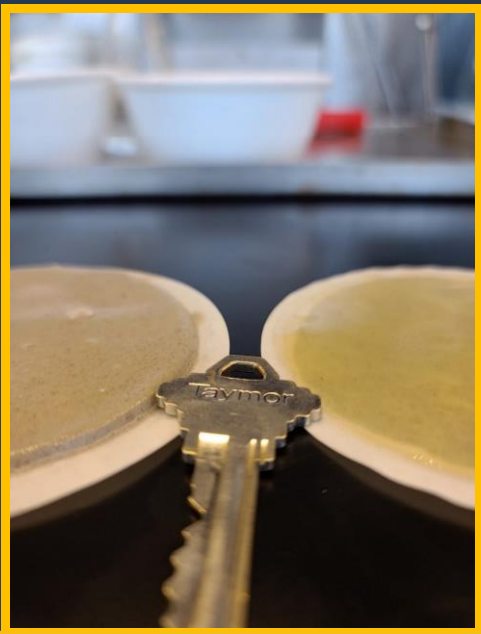
Beyond's Full Polymer Divalent Brine Solution

Description

CLEAR Slide Plus takes it to the next level. With the addition of CLEAR Mod, both the fluid loss and rheology can now be completely customized without restriction. This enables oil-based like property selection with extreme inhibition and excellent low shear rate viscosity.

Benefits

- Minimizes the amount of friction-reducing material required to achieve the same performance
- Provides flexibility as the system can control both viscosity and fluid loss
- Significant improvements when managing lost circulation events
- Can suspend LCM to ensure it is placed where it is needed
- Fluid loss control provides elevated inhibition
- ECD reduction compared to oil- based fluids



The filter cake on the left shows a CLEAR Slide Plus system with 10% solids and highlights the effectiveness of the system while managing drilled solids. On the right shows 1% v/v lubricant embedded into the filter cake itself.

Product	Usage	Benefit
CLEAR Mod	Potent rheological modifier	Very effective at controlling LSRV and gels
CLEAR Slide L	Higher concentrations than in conventional CLEAR Slide allow for efficient fluid loss control	Rapidly disperses in brines reducing the risk of fish eyes and polymer build-up
Corrosion Package	Uses the same high performing and proven corrosion package	Minimizes logistics and footprint

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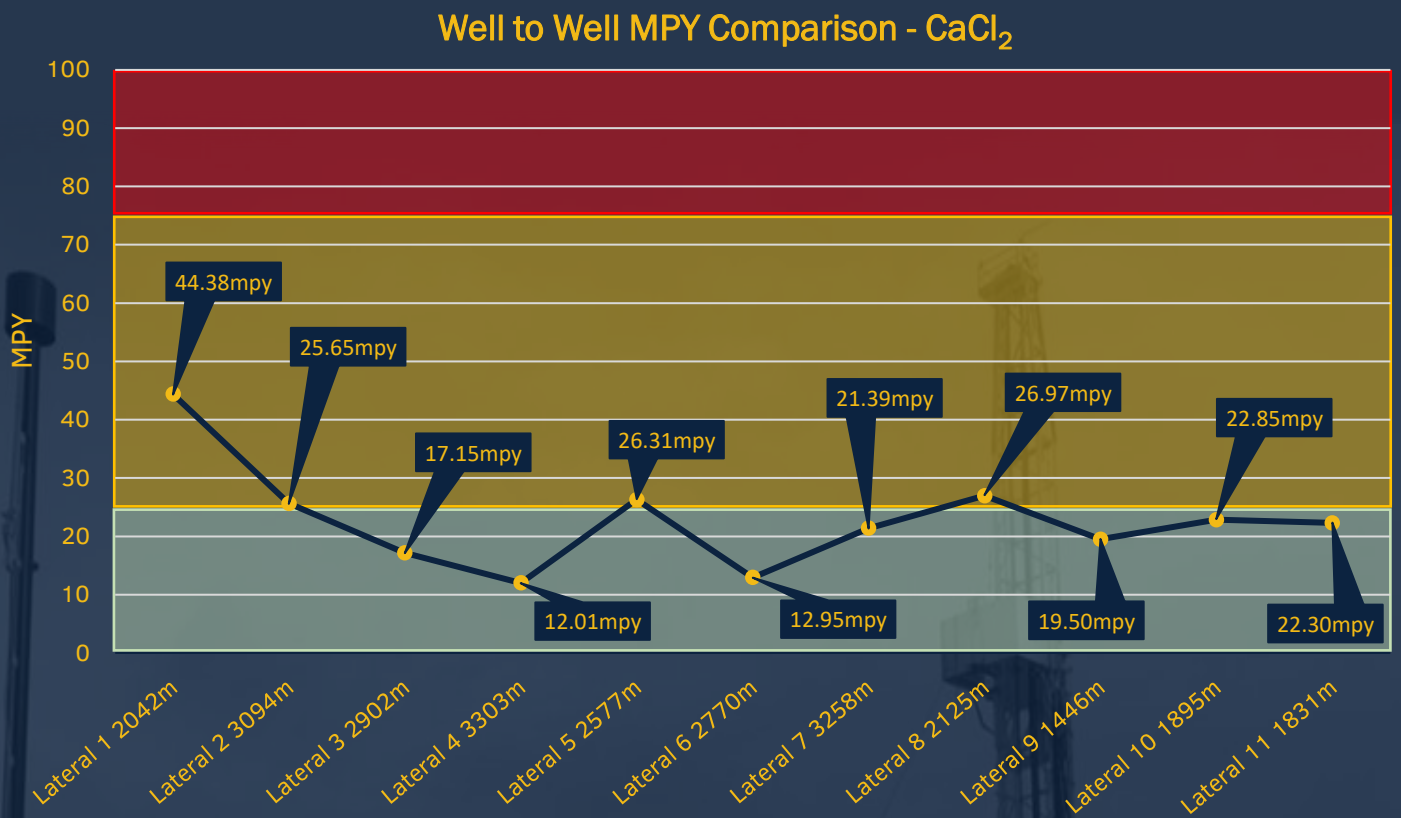
Corrosion Performance

Corrosion is the name of the game in brine-based drilling fluids and failing to control it means failing to control the real cost of brine. Through dedicated research and diligent work in the lab Beyond delivered its first 11 brine wells in an MPY average of 22.86. From here the results have only improved! Reach out to us to see how we can reduce the true cost of brine drilling for your operations.



Beyond Energy's CLEAR Performance Corrosion Package displays impressive results to minimize risk to downhole tools and casing while being conscious of the wells AFE.

Average MPY of 22.86 with no signs of pitting.

Average exposure of 216 hours in BHA

Corrosion rate criteria:

<25 MPY = Low

25-75 MPY = Moderate

75-125 MPY = High

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