APPLICATION INFORMATION

THINNERS FOR OIL-BASED DRILLING FLUIDS

Contents

The use of BYK additives to control yield point and gel strength in oil-based drilling fluids

During the drilling process, fine drilling solids accumulate and disperse in the drilling fluid. Excess solids can quickly lead to an unfavorable increase in rheological properties such as plastic viscosity, yield point, and gel strength.

The use of thinners is a cost-effective way to counteract the increase in rheological properties. As drilling solids accumulate, thinners allow the mud to be used for extended periods without dilution. Reducing the rheological properties of the mud should also improve the efficiency of the solids control equipment.

Since there is no one-size-fits-all solution, BYK offers a range of additives to meet performance and economic goals.

BYK's range of non-aqueous thinner additives includes:

BYK-GO 8700 – Liquid solution of sodium linear alkylbenzene sulfonate.

BYK-GO 8701 – Polar, acidic ester of long chain alcohols.

BYK-GO 8702 – Copolymer with solids affinic groups.

BYK-A-GS 446 – Concentrated mixture of alkoxylated resin and naphtalene sulfonic acids.

Performance test of BYK thinners for drilling fluids

The performance of four BYK thinners for oil-based drilling fluids were tested at lab scale.

The drilling fluids were formulated with 10 % OCMA clay to simulate low-gravity solids. BYK-GO 8700, BYK-GO 8701 and BYK-A-GS 446 were added at 1.0 lb/bbl and BYK-GO 8702 at 0.5 lb/bbl.

The equivalent of 14.2 laboratory barrels was prepared in a 2-gallon bucket. The lb/bbl equivalents and order of addition are listed below. The muds were aliquoted from the bucket into a mixing beaker – one mud for each temperature. On a multimixer (11,000 rpm), each mud was treated with one of the thinners and mixed for 5 minutes. The drilling fluids were then sheered at 6,000 rpm in a Silverson mixer until they reached a temperature of 150 °F. The performance of the four BYK thinners was benchmarked against lecithin.

Rheological data were measured with a viscometer at 150 °F. All systems were measured before hot rolling and after hot rolling at 250 °F for 16 hours. The muds were then hot rolled again at 350 °F for 16 hours.

In addition, a 3-day static sag test was performed to determine that none of the thinners adversely affected the barite sag.

Diesel 11.4 ppg, 75/25

Component	Amount (lb/bbl)
Diesel #2	170.0
CLAYTONE II	9.0
Lime	10.0
Emulsifier	8.0
25 % $CaCl_2$ brine	90.0
API barite 4.1	127.0
OCMA clay	70.0

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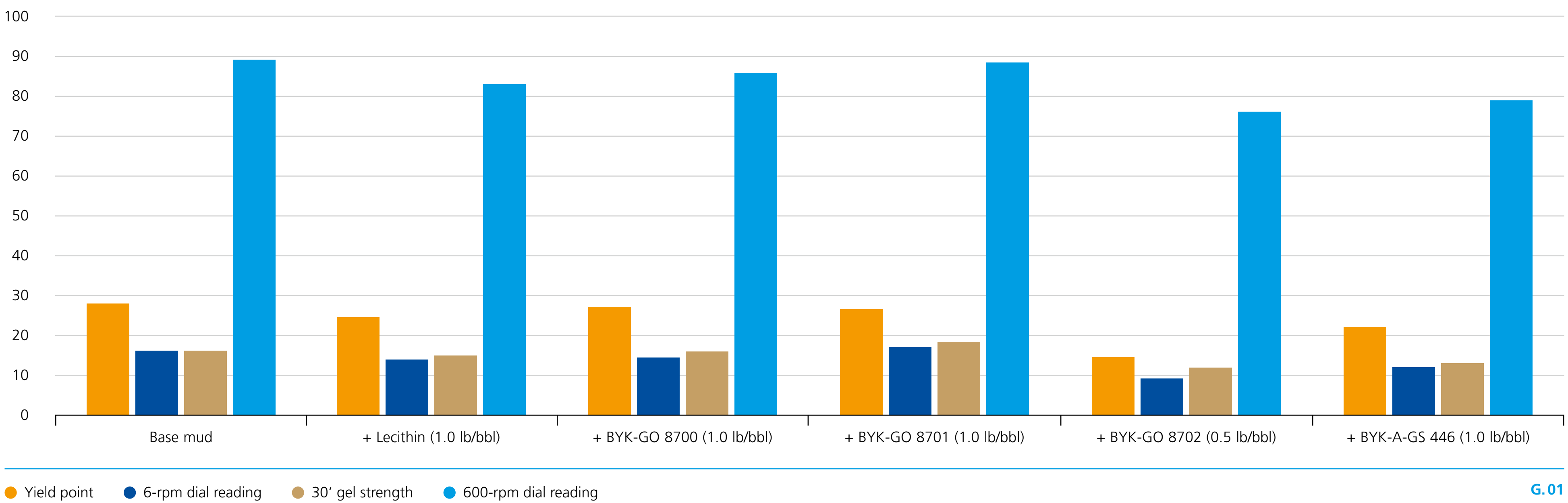
Rheological results

The influence of the four BYK thinners on the rheological properties of the drilling fluids was evaluated. A summary of yield point, 6-rpm dial reading, and 30-minute gel strength measured prior to heat aging is shown below. At the test temperature of 150 °F, BYK-GO 8702 and BYK-A-GS 446 had an immediate effect on conditioning the mud within the optimum rheological parameters.

Before heat aging, lecithin, BYK-GO 8700, and BYK-GO 8701 all had a moderate effect on the 600-rpm rheology. BYK-GO 8702 and BYK-A-GS 446 both had an immediate positive effect on high-end rheology.

Rheological data before hot rolling (BHR) at 150 °F



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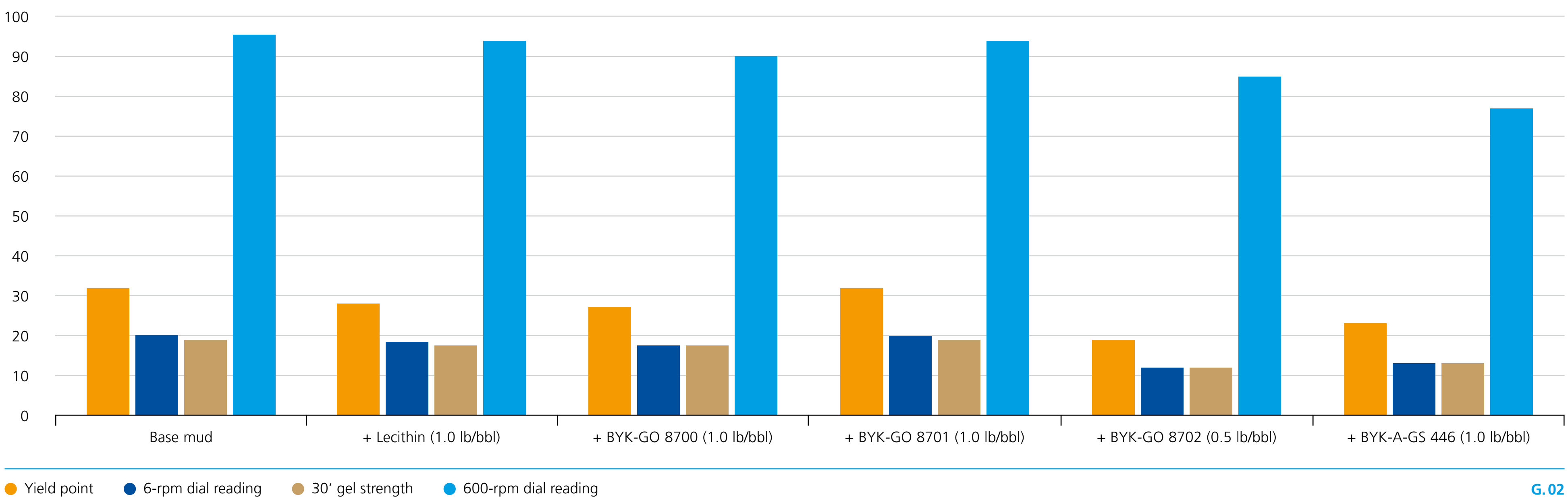
The muds were hot rolled at 250 °F for 16 hours and tested again at 150 °F. BYK-GO 8700 and BYK-GO 8701 both performed equally as well as lecithin. At 250 °F, BYK-GO 8702 and BYK-A-GS 446 again conditioned the mud to optimal rheological ranges.

After heat aging at 250 °F, lecithin, BYK-GO 8700, and BYK-GO 8701 again all had moderate effects on 600-rpm rheology. BYK-GO 8702 reduced the fluids 600-rpm dial reading by 11 units, while BYK-A-GS 446 reduced the fluids 600-rpm dial reading by 18 units..

Rheological data after hot rolling (AHR) at 250 °F



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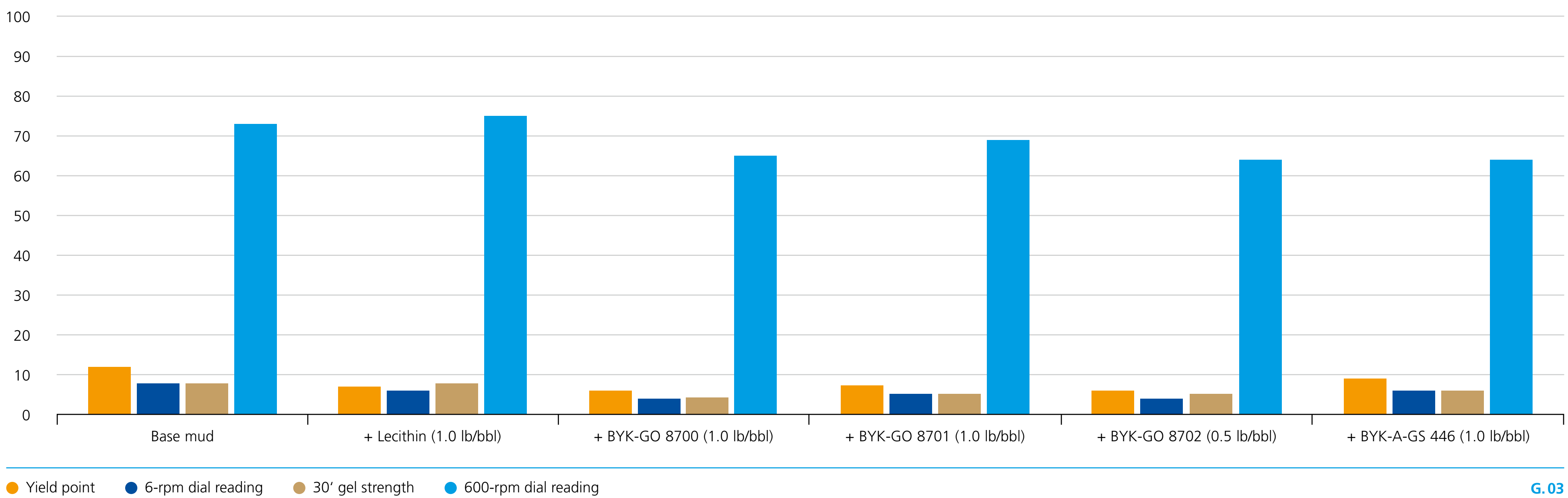
The drilling fluids were additionally heat-aged at 350 °F for 16 hours. Following the same procedure, rheological data were collected at 150 °F. After heat aging at this temperature, BYK-GO 8700, BYK-GO 8701, BYK-GO 8702 and BYK-A-GS 446 were found to be efficient thinners, each exhibiting temperature stability at 350 °F. The yield point, 6-rpm rheology, and 30-minute gel strength were consistent for each of the products.

The results of the 600-rpm dial reading were different at 350 °F. Lecithin had no positive effect on rheology, while all four BYK thinners reduced high-end rheology. Most notably, BYK-GO 8700, BYK-GO 8702, and BYK-A-GS-446 reduced rheology by over 11 % compared to the base mud.

Rheological data after hot rolling (AHR) at 350 °F



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Static sag

Weight material settling (sag) potential is an important parameter to consider in any product that reduces rheology. To get a complete picture of how these thinners influence sag, a 3-day static sag evaluation was performed.

Each of the fluids was transferred to aging cells and hot rolled at 150 °F for 16 hours in a roller oven. The next day, the cells were cooled and multi-mixed for 15 minutes. After mixing, each mud was placed in aging cells and pressurized. The ovens were preheated to 250 °F and 350 °F.

The cells were placed in a vertical position in the two ovens. The cells were aged at the respective temperatures for 72 hours. After static aging, the cells were removed from the oven and cooled with a fan undisturbed. After cooling, the cells were depressurized and opened.

The free oil was collected with a pipette and its volume was measured. This free oil was then poured into a beaker that was scored for 233 ml. The upper layer of the mud was removed from the aging cell with a spatula and transferred to the beaker until it reached 233 ml. The remaining bottom layer in the aging cell was mixed with a spatula and a slow speed stirrer for 10 minutes. The density of the mixed fluid was measured using a BYK-Gardener pycnometer.

The total combined fluid was mixed and the density was measured again. The sag resistance is measured by comparing the bottom layer with the total mixed fluid using the following equation.

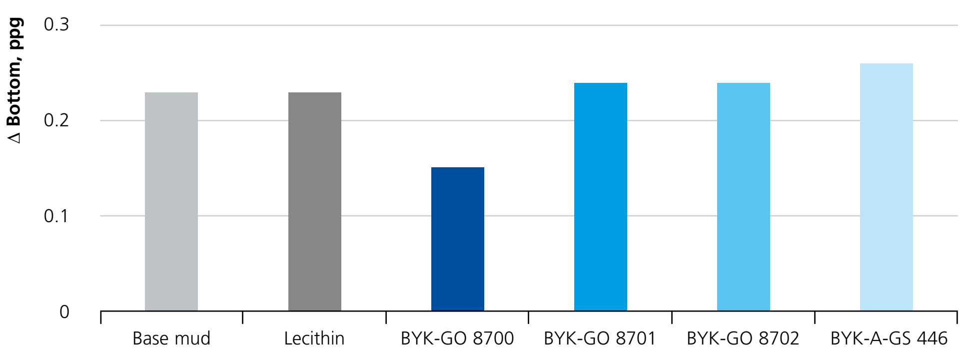
Δ Bottom, ppg = density of the bottom – density of the full mud

The smaller Δ Bottom is, the greater the sag resistance of the fluid.

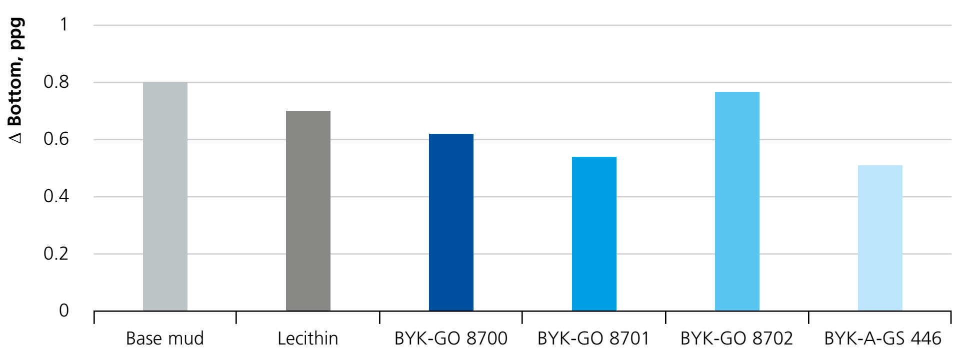
The graphs below show the sag resistance for the 3 days at 250 °F and 350 °F. Based on these results, at 250 °F BYK-GO 8700 improved the static sag performance of the base mud and lecithin by 35 %. At 350 °F BYK-A-GS 446 was the best performing product reducing static sag by 35 %.

Sag resistance for 3 days

250 °F



350 °F



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Conclusions

BYK's thinners were effective up to 350 °F. Each of them reduced the yield point and gel strength of the muds. Although the 6-rpm scale reading was reduced, they had less barite sag than the base mud. BYK-GO 8702 and BYK-A-GS 446 both lowered the 600-rpm reading immediately and it remained reduced after both hot-rolling cycles.

Since all drilling systems are different, BYK recommends testing the product triad to find the optimum balance between economy, performance, and treatment level. Our experts and our application labs are here for your support.

Please visit us at
Additives for Drilling for Oilfield – BYK

OG-A 2 06/2022

BYK-Chemie GmbH
Abelstraße 45
46483 Wesel
Germany
Tel +49 281 670-0
Fax +49 281 65735

info@byk.com
www.byk.com

A member of ALTANA