SOLTEX® ADDITIVE

Drilling Specialties Company
a division of Chevron Phillips Chemical Company LP

www.drillingspecialties.com

Main Office: 832-813-1866

Customer Service: 800-423-3985

Technical Service: 800-221-1956

SOLTEX® ADDITIVE IN OIL BASED DRILLING FLUIDS

Soltex® Additive is a sodium asphalt sulfonate made water dispersible by a unique sulfonation process. It is a versatile, total mud conditioner that stabilizes shale formations, significantly increases lubricity, lowers HTHP water loss and enhances filter cake properties in both oil and water – based drilling fluids. The product can be mixed in most water – based and all oil – based and synthetic drilling fluids. Soltex® Additive has been used in water – based drilling fluids for over 45 years but only in the last 15 years has it been widely used in oil – based drilling fluids. This paper will examine the use of Soltex® Additive in oil – based drilling fluids and the benefits gained from using it. Special thanks to Allan Cameron Sr. Technical Sales Rep. and Mike Murty E.H. Director of Product Development in the UK for their work in compiling this data.

THE MAJOR BENEFITS OF TREATING OIL – BASED AND SYNTHETIC SYSTEMS WITH SOLTEX® ADDITIVE

- Improves Lubricity – Laboratory measurements of lubricity under simulated down hole condition of temperature and pressure show reductions in frictional forces of up to 30% at low levels of Soltex® Additive treatment. This applies to metal to formation and metal to metal contact.
- Increases temperature stability (safely lowers HTHP fluid loss)
- Improves return permeability
- Provides Superior hole stability
- Improves filter cake quality and reduces wall cake thickness
- Reduces torque and drag (stick/slip)
- Improves ROP (rate of penetration)
- Meets toxicity regulation for offshore discharge in the North Sea

SOLTEX® ADDITIVE IN A SYNTHETIC OIL BASE MUD

A 90:10 oil/water ratio synthetic based drilling fluid was tested to determine the metal to metal and metal to sandstone coefficient of friction reduction gained after being treated with four pounds per barrel Soltex® Additive.

A sample of synthetic base oil mud made of Saraline 185 base oil was tested by an independent lab to determine if adding Soltex® Additive would reduce the metal-to-metal and metal to sandstone coefficient of friction. The fluid used in the test was a 90:10 oil/water ratio sample made in the laboratory. The fluid sample was tested for properties before and after the addition of four pounds per barrel (ppb) of Soltex® Additive. The lubricity tests were run at 150 rpm, 125 lbf, at 75°F. Rheological properties and fluid loss properties were measure using API standard test procedures.

Test Results

The base fluid had a coefficient of friction (C.F.) of 0.22 for metal-to-metal contact and a C.F. of 0.33 for metal to sandstone. The coefficient of friction for the base mud containing 4 ppb of Soltex® Additive for metal-to-metal was 0.16 (a 27.2 % reduction) and for metal to sandstone was 0.26 (a 21.2% reduction).

Fluid Properties

Sample	Base Fluid	Base Fluid w/ 4 ppb of Soltex® Additive
600 rpm @ 120 ° F	34	42
300	19	22
200	14	15
100	8	9
6	3	3
3	3	3
Plastic Viscosity, cP	15	20
Yield Point, #/100 ft^2	4	2
Gels, 10 sec/ 10 min	9/14	7/18
Electrical Stability, volts	807	1227
HTHP @ 300 ° F, ml	4.2	6.0
Lubricity Tests (Avg. C.F)		
Metal to Metal Contact	0.22	0.16
Metal to Sandstone Contact	0.33	0.26
Note: The sample containing Soltex® Additive was hot rolled for 16 hrs @ 150° F before being tested.		

SOLTEX® ADDITIVE REDUCES HTHP FLUID LOSS IN OIL BASE MUDS

TABLE I

Properties	Base mud	4 ppb Soltex® Additive	6 ppb Soltex® Additive	8 ppb Soltex® Additive
Weight ppg	15.5	Same	Same	Same
600 rpm	73	80	80	82
300 rpm	41	44	44	45
200 rpm	30	32	32	32
100 rpm	19	20	21	20
60 rpm	15	15	15	15
30 rpm	10	11	11	11
6 rpm	7	7	7	6
3 rpm	6	6	6	5
Plastic Vis	32	36	36	37
Yield Point	9	8	8	8
Oil/water Ratio	80/20	80/20	80/20	80/20
Gel Strengths	07/11	09/12	09/13	08/12
Electrical Stability (ES)	787	795	772	757
HTHP 500psi@ 250°F	4.6 cc	2.0cc	1.4cc	1.0cc

Note: Oil used was a low tox mineral oil.

With Soltex® Additive in the drilling fluid, the HTHP filtrate will be low, even at temperatures in excess of 400° F where conventional filtrate control additives will be struggling and in need of high maintenance treatments. More important than the filtrate volume is the filter cake itself.

SOLTEX® ADDITIVE REDUCES HTHP FLUID LOSS IN OIL BASE MUDS

TABLE II

Properties	Base	Before Heat Aging Base + 6ppb Soltex® Additive	After Heat Aging @ 300°F Base + 6ppb Soltex® Additive	Before Heat Aging Base + 6 ppb Amine lignite	After Heat Aging @ 300°F Base + 6 ppb Amine lignite
Mud weight	9.4	Same	Same	Same	Same
600 rpm	44	47	44	50	47
300 rpm	28	29	24	31	28
200 rpm	21	22	18	24	20
100 rpm	14	15	10	17	13
60 rpm	10	11	8	13	10
30 rpm	9	9	5	10	7
6 rpm	6	6	3	7	5
3 rpm	5	5	2	6	3
PV	16	18	20	19	19
YP	12	1	4	12	9
O/W Ratio	70/30	70/30	70/30	70/30	70/30
Gel Strengths	07/12	07/13	02/05	08/15	02/09
ES	337	285	238	305	297
HTHP 500 psi@ 250°F	6.8cc	3.6cc	2.2cc	5.2cc	5.8cc ($1.0H_2O$)*

*** Of the 5.8 cc HTHP fluid loss, 1.0 cc was water**

Note: Oil mud used was a low tox mineral oil.

CASE HISTORIES

Case Number 1 (low tox mineral oil)

A Platform well in the Northern North Sea drilling approximately 14, 000 ft. made an addition of 4 ppb of Soltex® Additive with the following results:

	Before	After
Mud Weight	12.2 PPG	12.2 PPG
Oil/ water ratio	64/36	65/35
PV/YP	36/14	38/13
Gels	10/18	10/19
HTHP (250°F)	3.6cc	1.6cc
Electrical stability	359v	385v

Case Number 2 (low tox mineral oil)

A jack-up rig in the Central North Sea drilling at 12,500 ft. made an addition of 6.0 ppb Soltex® Additive with the following results:

	Before	After
Mud Weight	15.6 PPG	15.6 PPG
Oil/ water ratio	79/21	79/21
PV/YP	35/13	37/13
Gels	10/17	9/18
HTHP (250°F)	5.0cc	2.0cc
Electrical stability	560v	545v

Case Number 3 (low tox mineral oil)

A jack-up rig in the Southern North Sea drilling at 12,000 ft. made an addition of 2 ppb of Soltex® Additive with the following results.

	Before	After
Mud Weight	10.6 PPG	10.6 PPG
Oil/ water ratio	75/25	75/25
PV/YP	24/14	23/12
Gels	5/14	6/12
HTHP (250°F)	4.8cc	3.6cc
Electrical stability	515v	550v

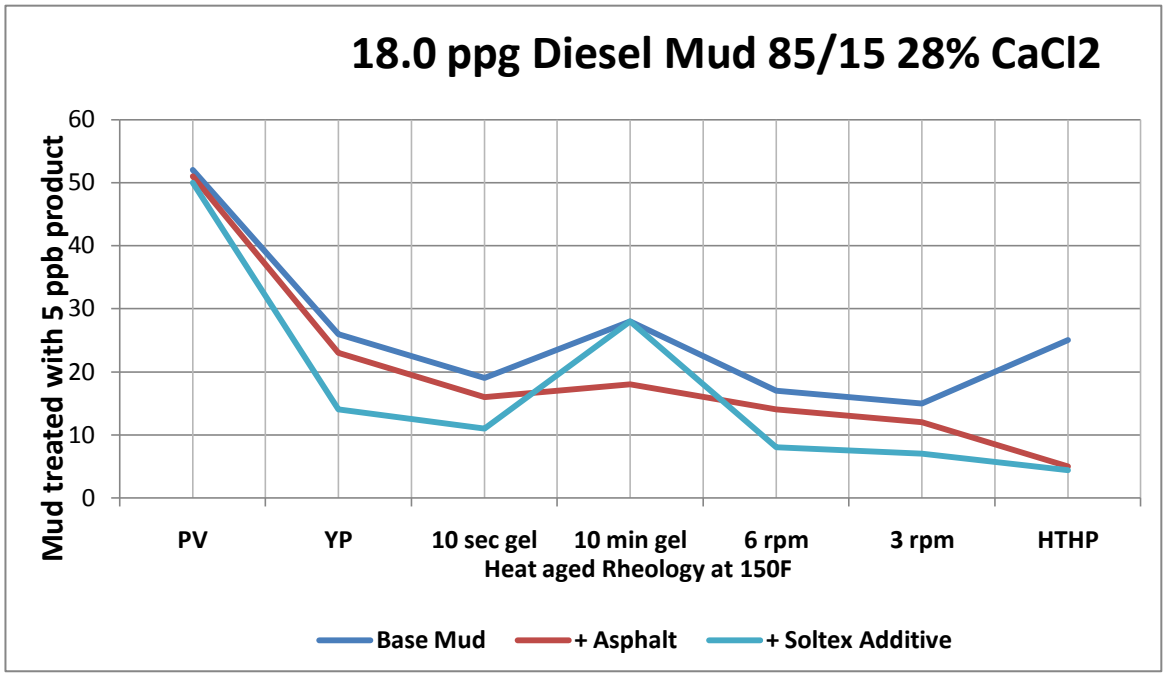
RHEOLOGICAL, ELECTRICAL STABILITY, HTHP @ 300° F AND LUBRICITY TEST RESULTS

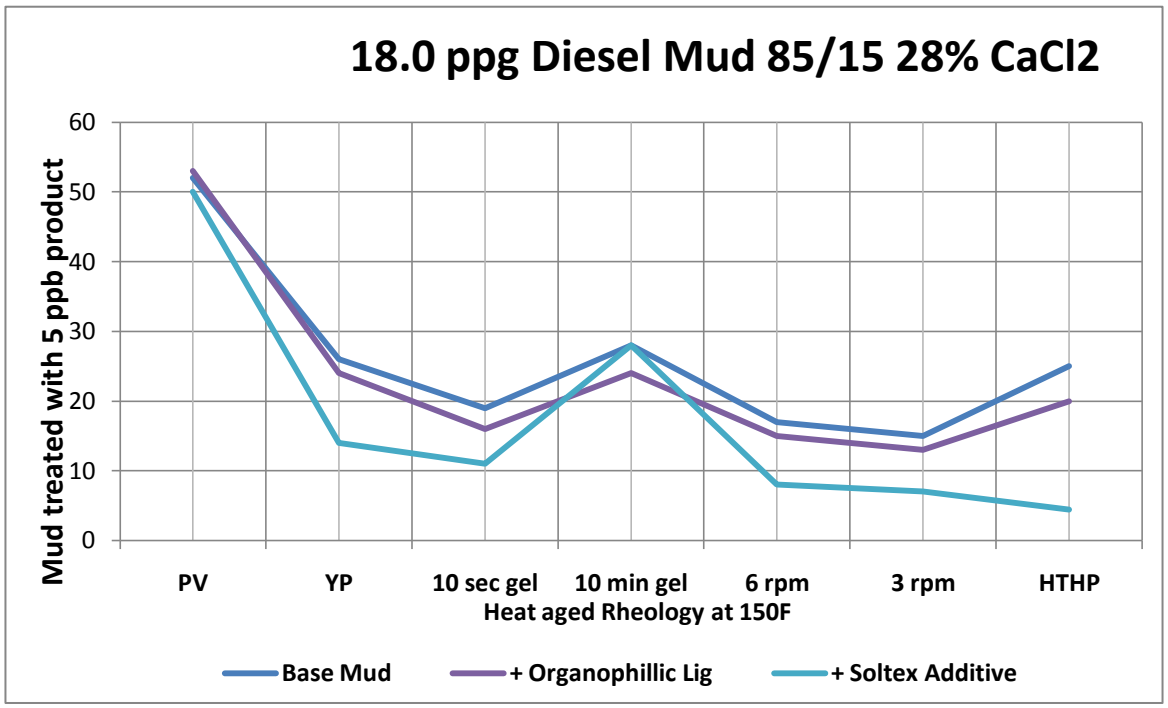
TABLE III

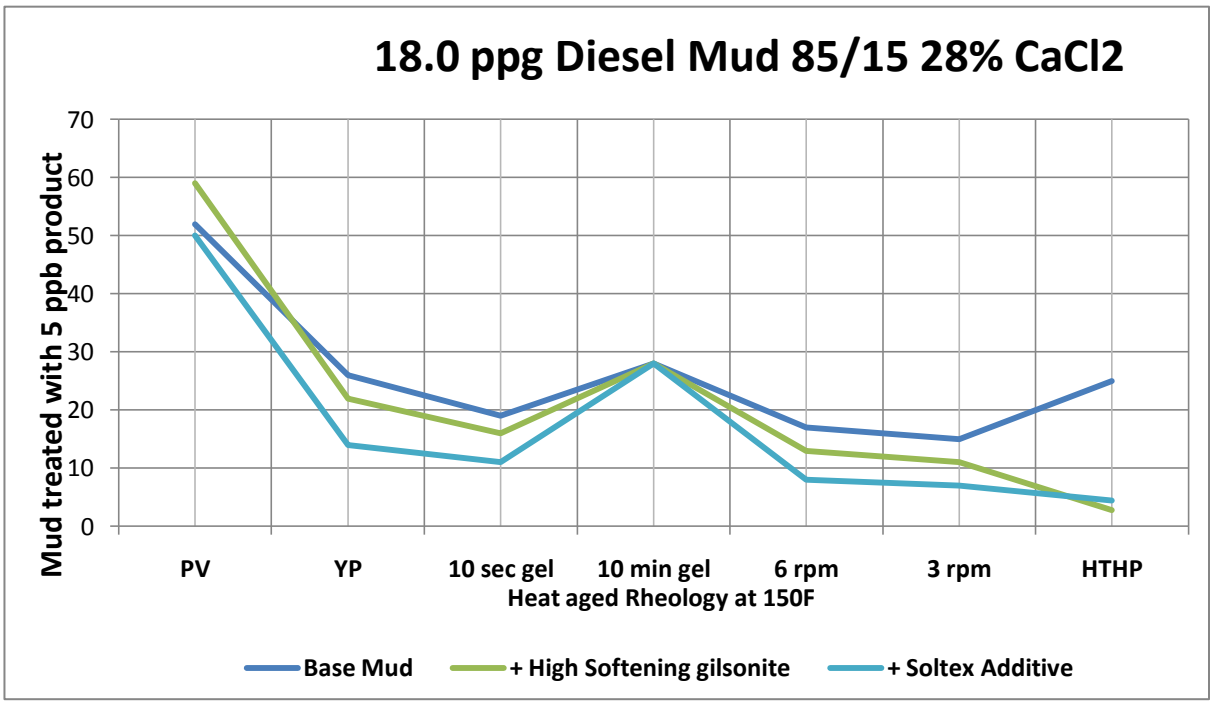
Properties	Base Fluid*	Base + 4 ppg Soltex® Additive
Mud weight	11.1 ppg	11.0 ppg
600 rpm	59	64
300 rpm	35	35
200 rpm	26	24
100 rpm	17	14
6 rpm	6	3
3 rpm	5	2
PV	24	29
YP	11	6
Gel Strengths	8/12	4/10
ES	350	303
HTHP 500 psi@ 300°F	4.2	2.8
Lubricity Tests (Avg. C.F.)		
Metal to metal Contact	0.2979	0.2437 (18% Reduction)
Metal to Sandstone Contact	0.4207	0.3480 (22% Reduction)

- Note: Base Fluid is a low tox mineral oil

SOLTEX® ADDITIVE VS OTHER COMMON PRODUCTS USED TO CONTROL HTHP AND THEIR EFFECT ON RHEOLOGY





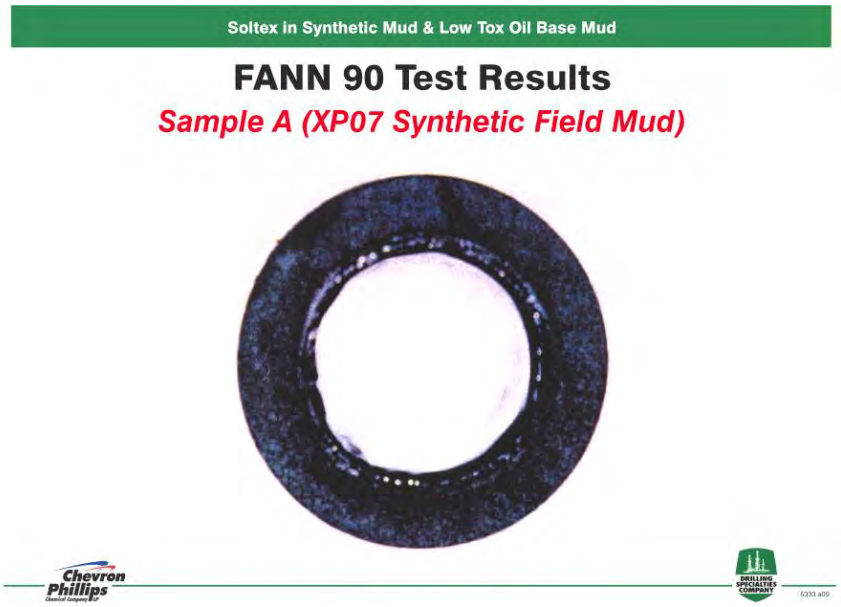


RETURN PERMEABILITY STUDY

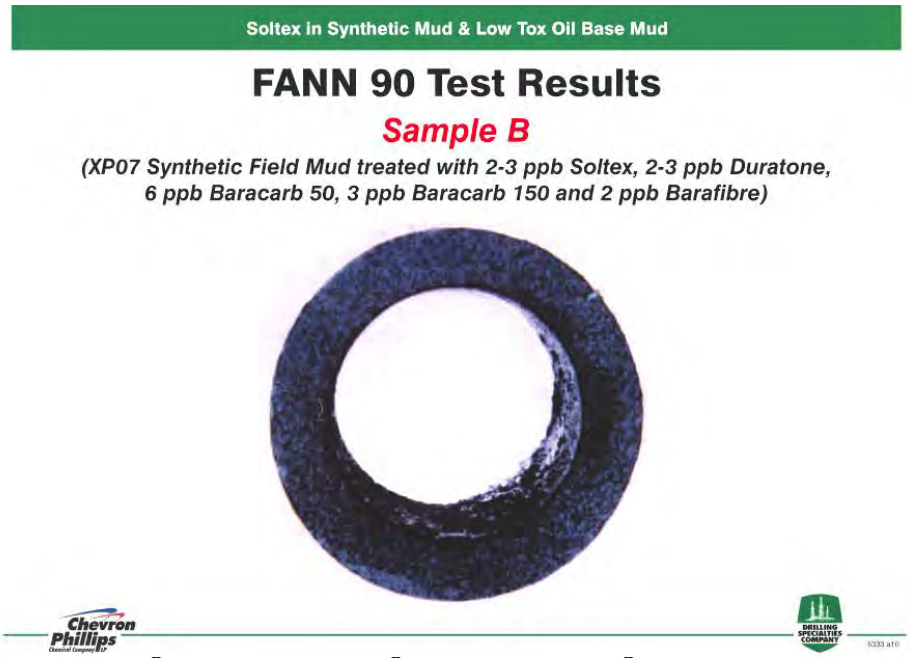
Prior to drilling into the reservoir on one of the North Sea field trials, a formation damage study was carried out to determine what effect Soltex® Additive – treated OBM would have on the formation. The objective was to compare the return permeability values of sandstone cores after exposure to oil base muds with and without Soltex® Additive under simulated reservoir pressure and temperature. Also, the cores were subjected to both static and dynamic conditions as part of this permeability study. After the cores underwent a simulated cleanup, they were then subjected to Scanning Electron Microscope (SEM) analysis to determine the presence of any fine solids invasion. Additionally, Cryogenic SEM was conducted to determine the possible presence of emulsions or colloidal suspensions. It was concluded that the Soltex® Additive – treated OBM sample gave much higher return permeability values (62% versus 27%) over the OBM sample containing conventional fluid loss additives. Both SEM analyses also indicated a better filter cake cleanup with the Soltex® Additive – treated mud sample. It is concluded from this study that the addition of Soltex® Additive to an oil base mud does not have a negative effect on the formation permeability. It appears that by lowering the fluid loss with Soltex® Additive under dynamic conditions, the fluid loss and filter cake integrity are greatly improved thereby reducing the invasion of solids into the formation.

REDUCTION IN FILTER CAKE THICKNESS

PICTURE #1 BEFORE ADDITION OF SOLTEX® ADDITIVE



PICTURE #2 AFTER ADDITON OF 2 – 3 PPB SOLTEX® ADDITIVE



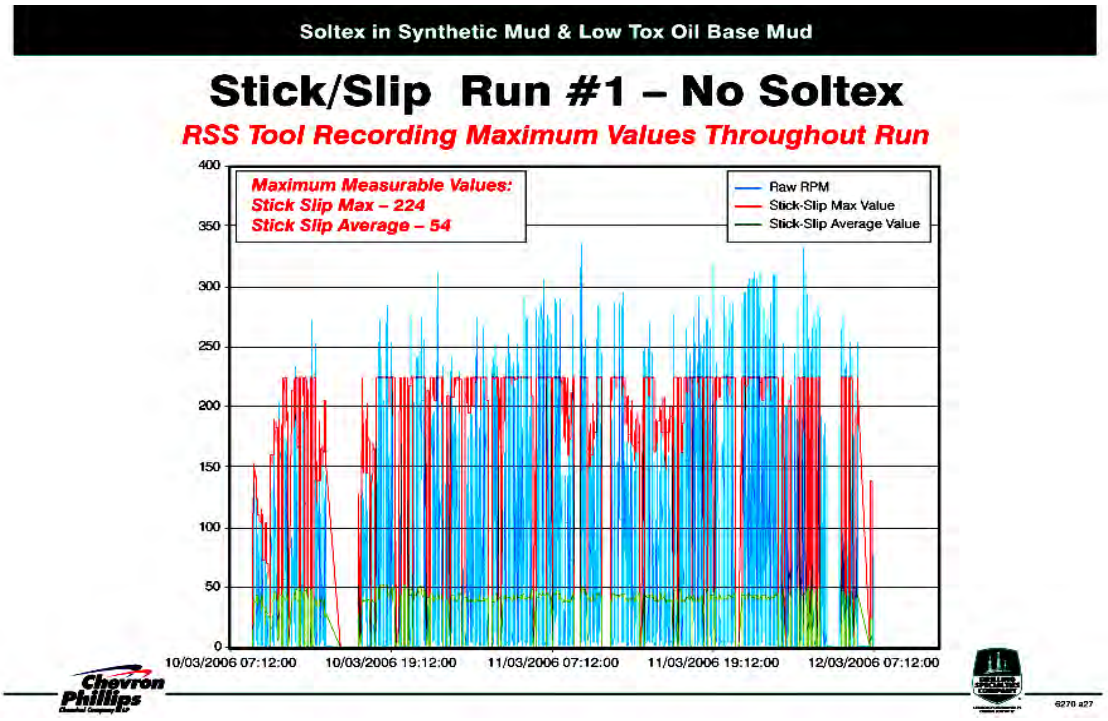
NOTE: Duratone® HT, Baracarb® 50, Baracarb® 150, and Barafiber® are trademarks of Halliburton Energy Services/Baroid

NOTE: The above FANN 90 tests on two field muds from a Major North Sea Oil Operator were conducted using 20 micron cores at 300°F and 500 psi differential. The test results and core photographs show substantial filter cake build up on sample A and very little filter cake builds on sample B.

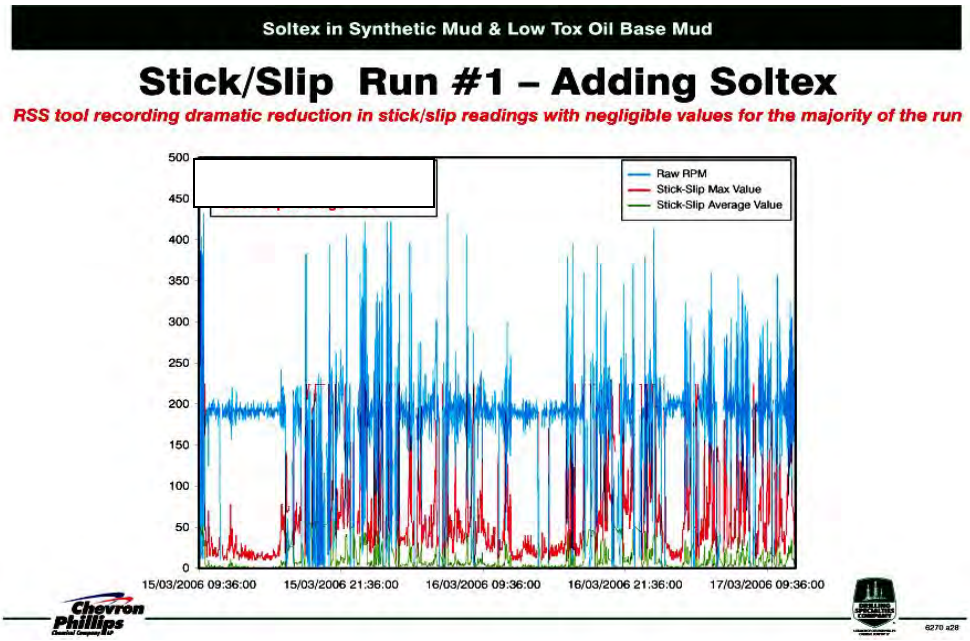
SOLTEX® ADDITIVE REDUCES STICK/SLIP PROBLEMS

Stick/slip is a condition were the drill string momentarily sticks and torques up and then breaks free causing the drill string to wildly spin. This in turn causes borehole instability and other problems. Soltex® Additive reduces stick/slip by reducing excess wall cake as evidenced in Picture #2, and making the wall cake more compressible. Below are graphs showing stick/slip before treatment with Soltex® Additive and after.

STICK/SLIP BASE NUMBERS BEFORE ADDITION OF SOLTEX® ADDITIVE

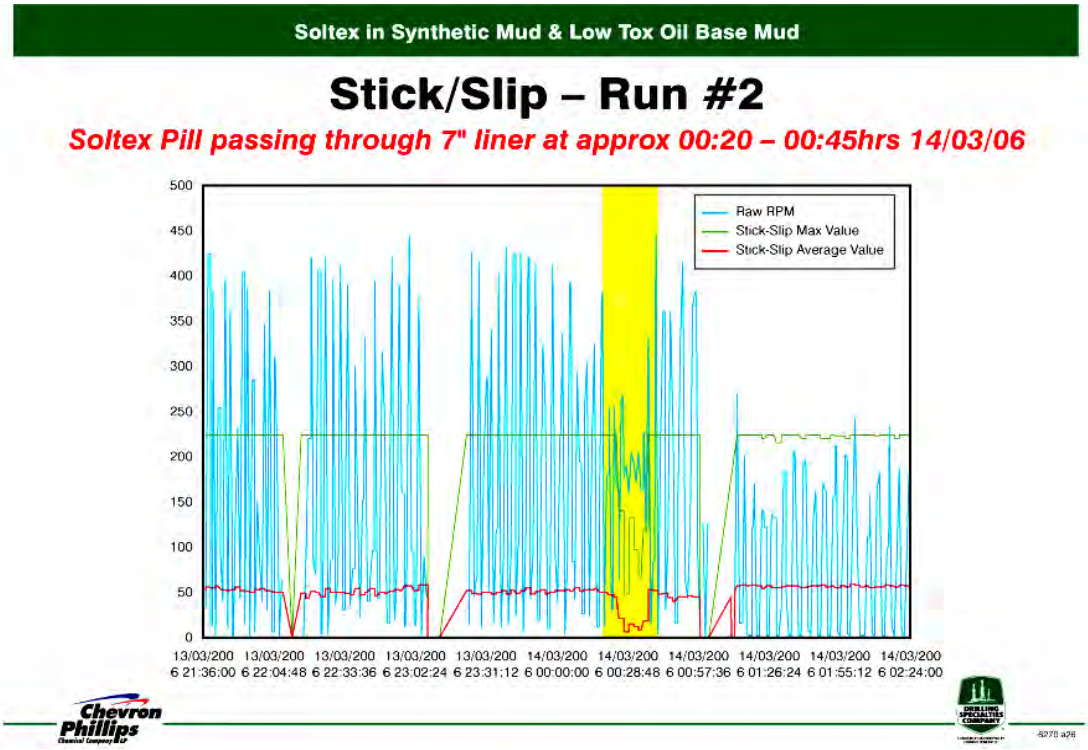


MASSIVE REDUCTION IN STICK/SLIP AFTER TREATING MUD WITH SOLTEX® ADDITIVE



REDUCTION IN STICK-SLIP PROBLEMS

YELLOW MARKED AREA DENOTES THE PASSAGE OF SOLTEX® ADDITIVE PILL, ALL NUMBERS INCLUDING RAW RPM, STICK-SLIP MAX AND STICK-SLIP AVERAGE VALUES DROP DRAMATICLY

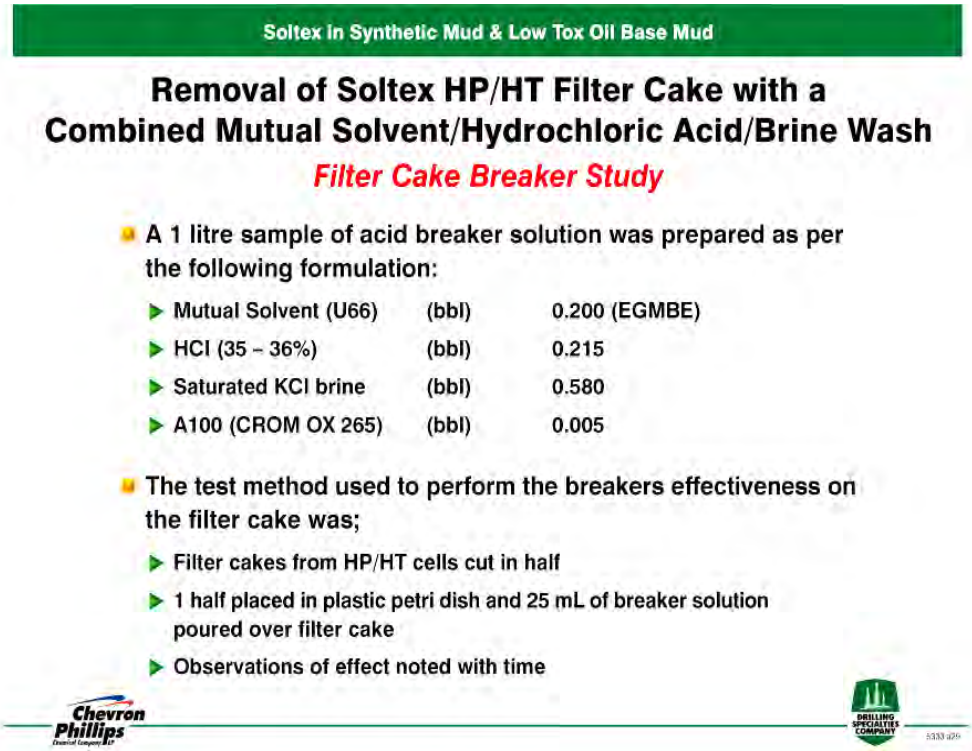


SOLTEX™ ADDITIVE IMPROVES REMOVAL OF FILTER CAKES

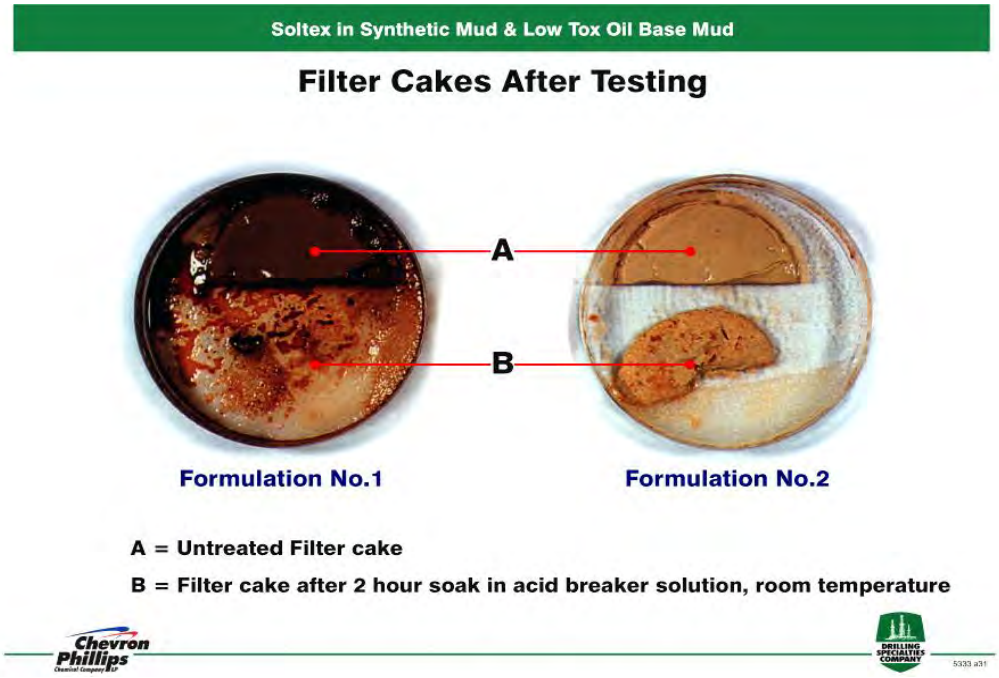
The filter cake of oil – base muds can be your best friend when drilling through permeable formations especially when the well is deviated, has high temperatures, depleted zones, or formation damage potential and your filter cake properties can be the difference between success and failure. Oil – base muds are often the optimum fluid to use in drilling a reservoir despite the claims attached to the "new" customized drill – in fluids. Using Soltex® Additive in oil – base drilling fluids not only minimizes damaging fines migration, but the filter cakes formed are easily removed. Many slotted liners and pre packed screen completions have been run with impressive success.

The following work demonstrates the ease of filter cake clean up with a standard acid breaker solution when Soltex® Additive is incorporated into the oil – based mud or synthetic mud system. Five synthetic muds were formulated. They were all hot rolled at 220° F for 16 hours. All had the same density of 13.65 ppb with 85/15 oil/water ratio. The filter cakes produced from the fluid loss tests were retained, and then used to observe their reaction when immersed in a common acid breaker solution (comprised of Ethylene Glycol, monobu Tyl ether [E.G.M.B.E], HCl [35%] and saturated KCl brine). Test results demonstrate that when Soltex® Additive was incorporated in formulation #1, it produced a filter cake that was easily dissolved through the use of a simple breaker solution.

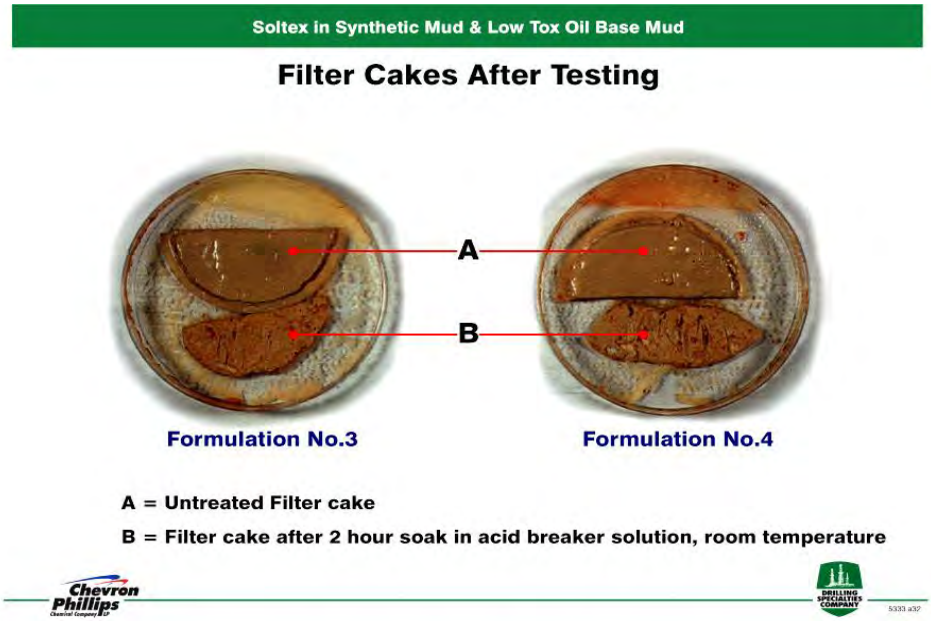
SOLTEX® ADDITIVE IN LOW TOX OIL BASE MUD



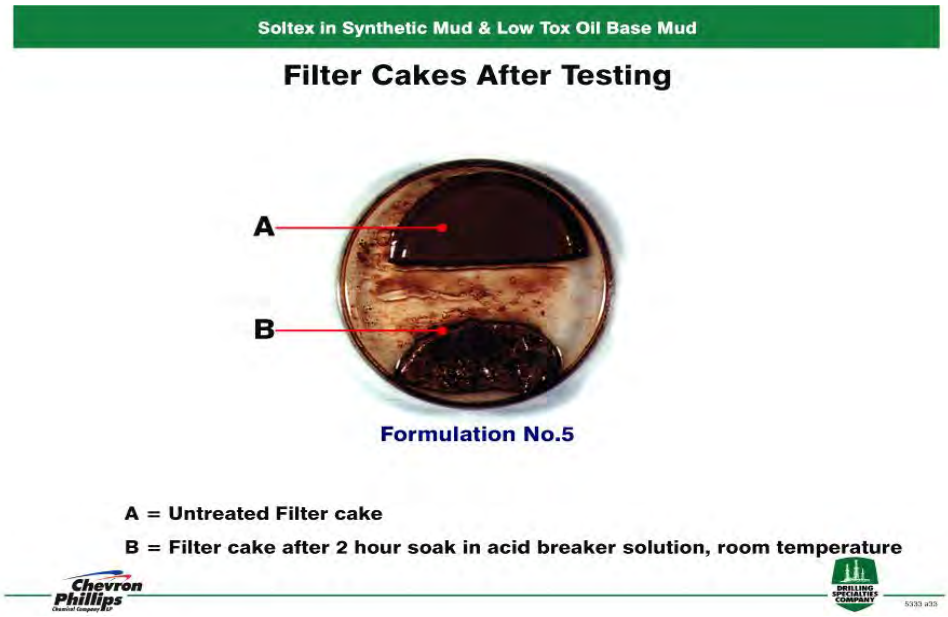
SOLTEX® ADDITIVE AIDS IN THE REMOVAL OF FILTER CAKES (#1 CONTAINS 5 PPB OF SOLTEX® ADDITIVE, #2 CONTAINS 1.5 PPB OF POLYMERIC FLUID)



OTHER FLUID LOSS ADDITIVES DO NOT AID IN THE REMOVAL OF FILTER CAKE (#3 TREATED WITH 2.5 PPB OF POLYMERIC FLUID LOSS ADDITIVE, #4 TREATED WITH EMULSION PACKAGE



FILTER CAKE #5 CONTAINS 5.0 PPB OF GILSONITE
(NOTICE HOW LITTLE OF THE FILTER CAKE WAS DISSOLVED)



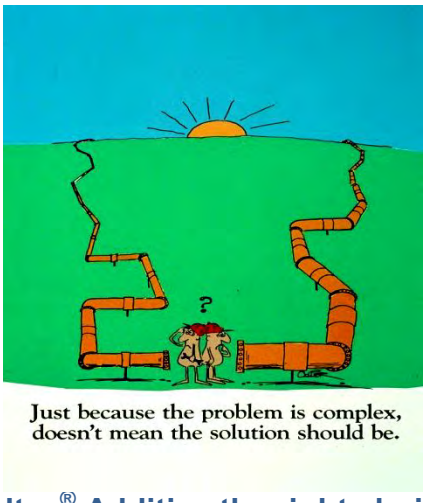
Note: If Soltex® Additive is incorporated in your synthetic or oil – based system, this same breaker solution can be utilized as a spotting fluid to destroy wall cake build – up in areas prone to differential sticking.

CONCLUSION

These tests show that the addition of Soltex® Additive in oil-based drilling fluids aids in the removal of filter cake when compared to other oil mud additives. Soltex® Additive is a drilling fluid additive that has been recognized worldwide for its excellent compatibility with the environment. Soltex® Additive is a highly modified product which contains no polynuclear aromatic hydrocarbons. Also, under luminescence spectrometer scanning, the addition of Soltex® Additive to low toxicity oil base fluids does not alter the hydrocarbon profile of the fluid. In addition Soltex® Additive meets all PARCOM and U.S. Gulf Coast environmental toxicity requirements.

The unique chemistry of Soltex® Additive means that the same product which has performed so well in water – base muds for years can be applied in oil – based and synthetic drilling fluids with extraordinary results. The fact is, if you're committed to cutting back on drilling fluid costs, reducing trips and avoiding reworking efforts – and if success is critical to your drilling project – it's time to consider Soltex® Additive. It can mean the difference between success and failure.

Soltex® Additive is a trade mark product from Drilling Specialties Company, a division of the Chevron Phillips Chemical Company. Soltex® Additive is produced by the sulfonation of asphalt. This sulfonation process produces a product which is highly anionic and is typically over 70% to 80% water soluble. Asphalt is neither anionic nor water soluble. Therefore, after sulfonation, Soltex® Additive no longer has the chemical or physical properties of an, asphalt. In the same way, it is chemically different from gilsonite and blown asphalts which are not sulfonated but are sometimes mistakenly characterized as "Soltex® Additive substitutes". For more information on Soltex® Additive or case studies of its use in oil – based or synthetic oil – base fluid systems, please visit us at our web site at www.drillingspecialties.com.



Soltex® Additive the right choice