SOLTEX® ADDITIVE

Drilling Specialties Company
a division of Chevron Phillips Chemical Company LP

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OVERVIEW OF THE COMPANY

Serving the oil industry for over 65 years, Drilling Specialties Company is a division of Chevron Phillips Chemical Company LP. Our specialized products have been designed to deliver high performance and value to an array of oilfield fluids. From proprietary drilling, cement, and completion fluid additives to an assortment of stimulation and EOR technologies, DSCo products help our customers bring in a better well or restore older ones.

The Drilling Specialties sales and service engineers possess a wealth of applications expertise to help our customers utilize our products. The knowledgeable technical service staff is always ready to provide immediate support from our Drilling Fluids, Cement, Stimulation, and Polymer laboratories. Our experienced customer service group ensures quick product availability from our global distribution system. To meet your operation's needs, Drilling Specialties Company products are never far away.

We are proud to be much more than just a chemical manufacturer and supplier. In addition to our valuable services, we are committed to advancing technology through research and new product development. At Drilling Specialties Company, continuously enhancing fluids performance is our highest priority. Combined, our many activities and products are aimed at maximizing our customers' satisfaction and a return on their investment.

Please review our product information to learn more about Drilling Specialties Company's unique line of products, or call us at 800-423-3985. Discover today how we outperform the rest. Visit us at **www.drilling specialties.com**

PACKAGING

Packaging: 50 pound multi-wall paper bags, 40 bags per pallet

ORDERING

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SOLTEX® ADDITIVE

This paper is a compilation of the writings and thoughts of Wayne Stewart Technical Manager (retired), Bharat Patel Sr. Chemist (retired), Greg Colletti Eastern Hemisphere Sales Manager and Dennis S. Goldwood Dir. of Product Development W.H. Drilling Specialties Company on Soltex® Additive, how it works and how it is genuinely unique as compared to other products.

PRODUCT DESCRIPTION

Soltex® Additive is a sodium asphalt sulfonate made water soluble by a unique sulfonation process. It is a versatile, total mud conditioner that stabilizes shale formations, significantly increases lubricity, lowers high temperature high pressure fluid loss (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 muds.

Soltex® Additive is available in two different forms: Regular and Potassium enhanced. Potassium Soltex® Additive is a specially prepared potassium salt of sulfonated asphalt. In addition to providing the same unique qualities as regular Soltex® Additive, it contributes water – soluble potassium ions at approximately 400ppm/lb of product carried in the mud system. This is beneficial in those areas that require the specific action of potassium to adequately minimize water induced clay swelling. For over 52 years, the unique chemistry of Soltex® Additive has delivered extraordinary results in all types of drilling fluids offering the following advantages:

- Reacts with shale to prevent or stop sloughing and swelling
- Reduces high temperature high pressure fluid loss (HTHP) see case history
- Produces thin compressible filter cakes
- Significantly increases lubricity; either alone or synergistically with small amounts of oils, synthetic oils, or glycol
- Prevents stuck drill pipe
- Extremely temperature stable - does not have the softening point typically associated with un-reacted asphaltic additives
- Minimal and easily distinguishable fluorescence - does not hamper well logging or core analysis
- Will not leave oil slick, sheen or rainbow on water at offshore locations
- No emulsifiers needed to ensure proper mixing
- Do not need to bypass the solids control equipment while mixing
- Reduces high temperature gelation and stabilizes mud properties

GENERAL INFORMATION

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".

While the asphaltic and gilsonite materials have some potential to lodge in micro fractures, they are chemically inert. The fact that Soltex® Additive is highly anionic gives it a distinct advantage in seeking out the charged broken edges of shales at the fracture wellbore interface. It seeks out these sites by the same mechanism that anionic water soluble polymers coat the edges of cuttings and the wellbore. Chemically inactive materials such as blown asphalts and gilsonites are only randomly dispersed in the mud. Thus, they contact the fracture face as the mud filters into the micro facture, leaving solids – including the gilsonite and asphalt at the fracture wellbore interface. Evidence of Soltex® Additive's coating action is seen in the need to replace a significant portion of the material in the first 24 – 36 hours after its initial introduction to the system. The concentration is reduced as anionic molecules satisfy available sights on solids and the wall of the bore hole. These phenomena would not be expected with inert materials such as blown asphalts and gilsonites.

The production of Soltex® Additive also gives it a particle size advantage over gilsonite and asphalt. Gilsonite and blown asphalt are ground to size, giving particles that are relatively coarse and quite narrow in particle size distribution. Soltex® Additive being a sulfonated/reacted material, has a wide range of particle sizes ranging from soluble to colloidal to the size one would expect from ground materials. This wide range of sizes provides a high probability of having the proper particle size to fit into the variety of fracture sites. Virtually all Soltex® Additive particles, regardless of size, are highly anionic. When particle size distribution is combined with the fact that the particles are highly charged and therefore seek out the broken edges of shales, it becomes obvious that Soltex® Additive provides a significant advantage over those inert materials sometimes marked as "Soltex® Additive substitutes".

Should potential damage of producing formations be an issue, Soltex® Additive has an added advantage. It is partially soluble in oil and partially soluble in water. Producing fluids will dissolve Soltex® Additive back out of the formation with time. Gilsonites and asphalts are totally insoluble in water and only partially soluble in hydrocarbons and thus have a lower probability of being removed by the flow of produced fluids.

The clay stabilizing characteristic of Soltex® Additive, its ability to lower the HTHP fluid loss and its ability to reduce torque and drag in the wellbore are also excellent reasons to use Soltex® Additive in all water based and oil based drilling fluids.

CHEMICAL DIFFERENCE BETWEEN SOLTEX® ADDITIVE AND ASPHALT OR GILSONITE

Asphalt: Asphalt is a bituminous substance resulting from petroleum by distillation of lighter hydrocarbons and partial oxidation of the residue. Asphalt comes out as a bottom from distillation of crude oil in refineries and asphalt composition depends on the type of crude oil used and the process for its distillation.
Asphalt is typically a mixture of:

1. Saturates
2. Aromatics
3. Resins
4. Asphaltene

Gilsonite: Gilsonite is a variety of asphalt that occurs naturally. Gilsonite pitch is a complex combination of hydrocarbons obtained as the raffinate in extract from a solvent extraction of gilsonite. It consists predominantly of a complex combination of olefins, naphthalenes, pyroles, pyridines and other hydrocarbons with a softening point of 80 °C to 175 °C (176 °F to 347 °F)

Soltex® Additive: Soltex® Additive is neither asphalt nor gilsonite, it is sulfonated Asphalt, an entirely different product. In the manufacture of Soltex® Additive, specially selected asphalt is use as a raw material.
The sulfonation of asphalt can be simply shown as:

Asphalt + sulfonating agent → Sulfonic acid of asphalt
Sulfonic acid of asphalt + NaOH → Sodium asphalt sulfonate (Soltex® Additive)
Sulfonic acid of asphalt + KOH → Potassium asphalt sulfonate (Potassium Soltex® Additive)

It should be pointed out that all available double bonds from hydrocarbons are eliminated by the sulfonation process used to make Soltex® Additive. An excess amount of sulfonating agent is used to guarantee the complete sulfonation and smooth processing in the plant. This process is routinely monitored by testing the solubility of Soltex® Additive and Potassium Soltex® Additive in water.

COMPARISON OF SOLTEX® ADDITIVE, ASPHALT, AND GILSONITE

Analysis	Soltex® Additive	Asphalt*	Gilsonite
Loss on Ignition, wt %	**36.3**	**72.8**	**99.2**
Softening Point	**None**	**50 °C – 150 °C**	**80 °C – 175 °C**
Carbon, wt %	**49.0**	**87.2**	**86.6**
Hydrogen, wt %	**4.6**	**9.4**	**8.0**
Nitrogen, wt %	**0.5**	**0.8**	**2.6**
Sulfur, wt %	**11.1**	**1.8**	**0.5**
Oxygen, wt %	**34.8**	**0.8**	**2.3**
Solubility in water, %	**>70**	**<1**	**<1**

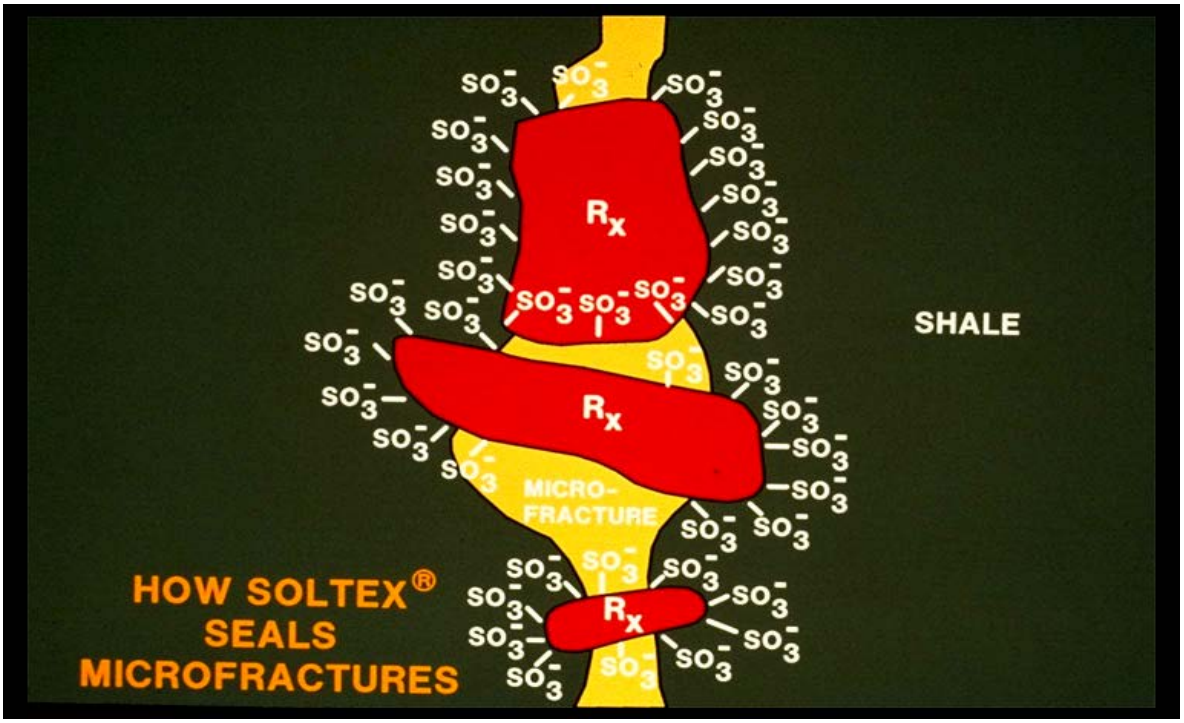
* Analysis of asphalt before sulfonation in the manufacturing of Soltex® Additive.

The above comparison shows that there are two easy tests that anyone can perform that should convince them that Soltex® Additive is neither asphalt nor gilsonite. One is to demonstrate the solubility in water, see photo on page 9. The other is to place about one-gram samples of each on a hot plate side-by-side, and turn the hot plate on maximum for 10-30 minutes. The asphalt and Gilsonite will melt while Soltex® Additive will not. At temperatures above 300 °C (572 °F) Thermal Gravimetric Analysis (TGA) shows that Soltex® Additive partially sublimes and there is a 10% loss of sample weight. Asphalt and Gilsonite will have almost complete weight loss.

SOLTEX® ADDITIVE VS BLOWN ASPHALT

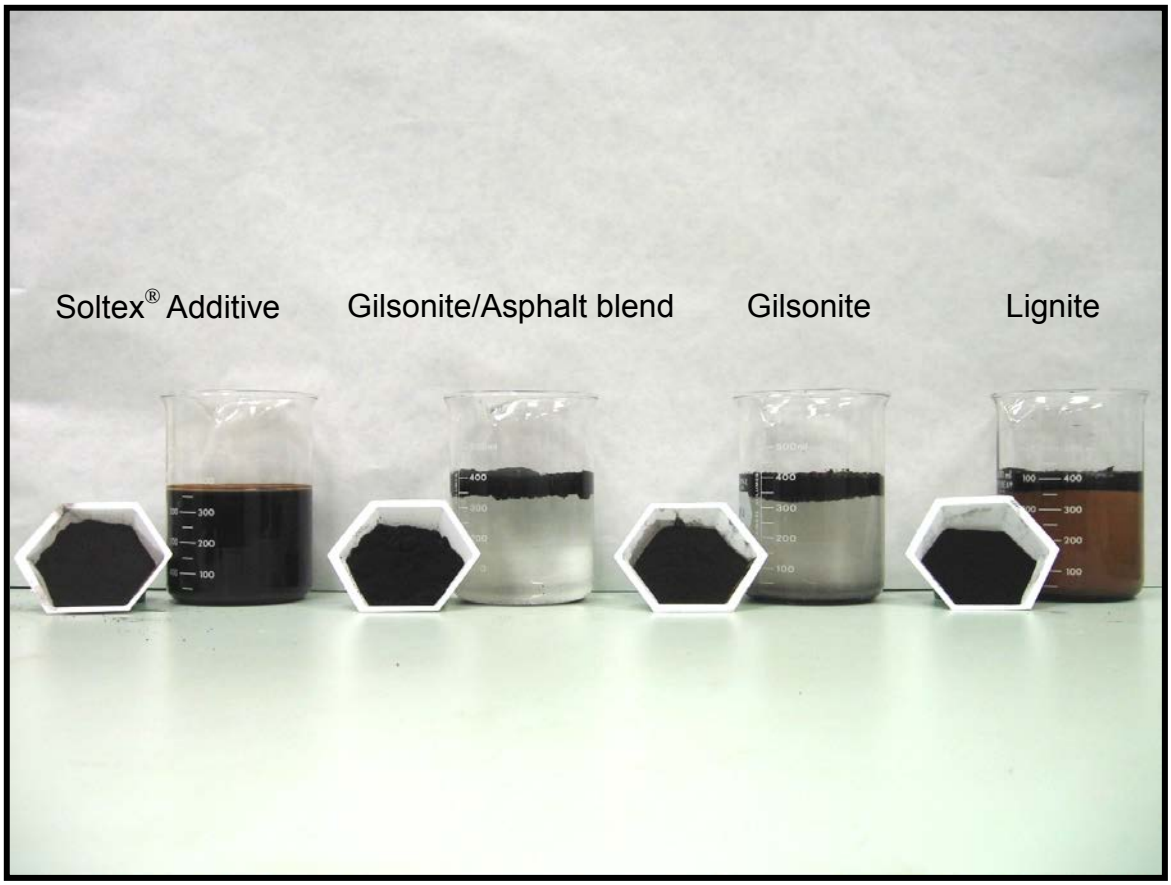
Blown asphalt is made by a process of blowing hot air through melted asphalt. This process oxidizes and purges out low ends (low molecular weight materials). It probably also oxidizes any reactive sites on the higher molecular weight materials. The result is an increase in the softening temperature. Raising the softening temperature makes the material more friable and easier to grind.

Soltex® Additive is produced by reacting asphalt with SO_3. The SO_3 reacts with available double bonds. This creates chemically altered sulfonated material. It is then neutralized with sodium or potassium hydroxide. This process gives a material that is highly anionic (has a negative charge). It is also partially soluble in water. Particle size ranges from very small (about 10 carbon atoms – much too small to see) to very large (highly charged particles large enough to see with the unaided eye). This large variation in particle size range gives a high probability of having particles the correct size to plug holes in both rock and wall cake. The anionic character also gives it an affinity for broken rock and clay edges which are charged sites. See illustration below.



Blown asphalt has no chemical charge. It is not soluble so its particle size is strictly related to how finely it is ground. Typically it is ground to something between 50 – 200 mesh. This would be equivalent to the largest particles in hydrated and dispersed Soltex® Additive. Any “solubility” seen in blown asphalt is not solubility of the blown asphalt, but rather something that is blended with it, usually lignite. Blown asphalt is not soluble in water. In fact it has to have a

surfactant blended with it to keep it from floating out. Blending a sulfonated surfactant with blown asphalt does not create sulfonated asphalt. It just reduces the surface tension of the water enough that the surface of the asphalt is water wet and it does not float out. The photo below shows that asphalt, Gilsonite/Asphalt blends and Gilsonite all float on fresh water. If it floats on water it will float on a drilling mud! Lignite mixes better but mostly floats until you raise the pH. Most look-a-like products have a large lignite component with pH material added to simulate the appearance of being sulfonated. Another reason to add lignite is that it is cheap and readily available.



SOLTEX® ADDITIVE COMPARED TO GILSONITE

There are presently no true substitutes for Soltex® Additive because the chemical modification of asphalt by sulfonation requires special equipment, selected asphalts, and considerable expertise. This sulfonation process produces a product which is highly anionic and is typically 70% to 80% water soluble. Therefore, after sulfonation Soltex® Additive, no longer has the chemical or physical properties of asphalt. The water – soluble portion of Soltex® Additive is comprised of large, electronegative macro molecules. These particles in the filtrate bond themselves to the electropositive edges of clays and shales. This chemical neutralization inhibits the natural tendency of the formation to take on water. Thus, sloughing, swelling and shale disintegration are prevented.

The fact that Soltex® Additive is highly anionic gives it a distinct advantage in seeking out the charged broken edges of shales at the fracture well bore interface. This neutralizes the broken edges and prevents water from entering the formation. Chemically inactive materials such as gilsonite are only randomly dispersed in the mud. Gilsonite contacts the face as the mud filters into the micro fracture, leaving solids, including the gilsonite at the fracture wellbore interface.

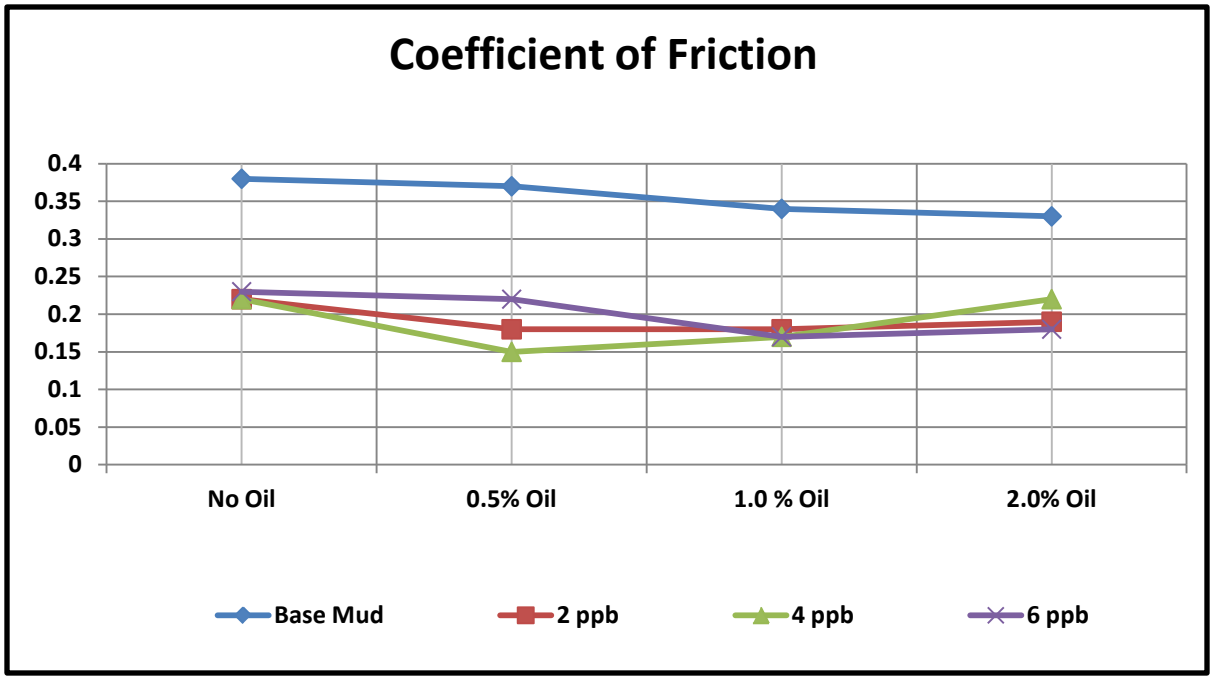
The production of Soltex® Additive also gives it a particle size advantage over gilsonite, which is ground to size, giving particles that are relatively coarse similar to those of ground asphalt mentioned above. Virtually all Soltex® Additive particles, regardless of size, are highly anionic. When particle size distribution is combined with the fact that the particles are highly charged and therefore seek out the broken edges of shales, it becomes obvious that Soltex® Additive provides a significant advantage over products like gilsonite.

Soltex® Additive excels in controlling fluid loss, and especially high temperature high pressure (HTHP) fluid loss. The Soltex® Additive in the filtrate is inhibitive and minimizes damage to water – sensitive shales and drilled cuttings. In lab tests gilsonite appears to be ineffective in reducing HTHP fluid loss of a drilling fluid and in some tests has actually increased the HTHP fluid loss over the control as documented in the "Liquid Soltex® Additive Technical Paper".

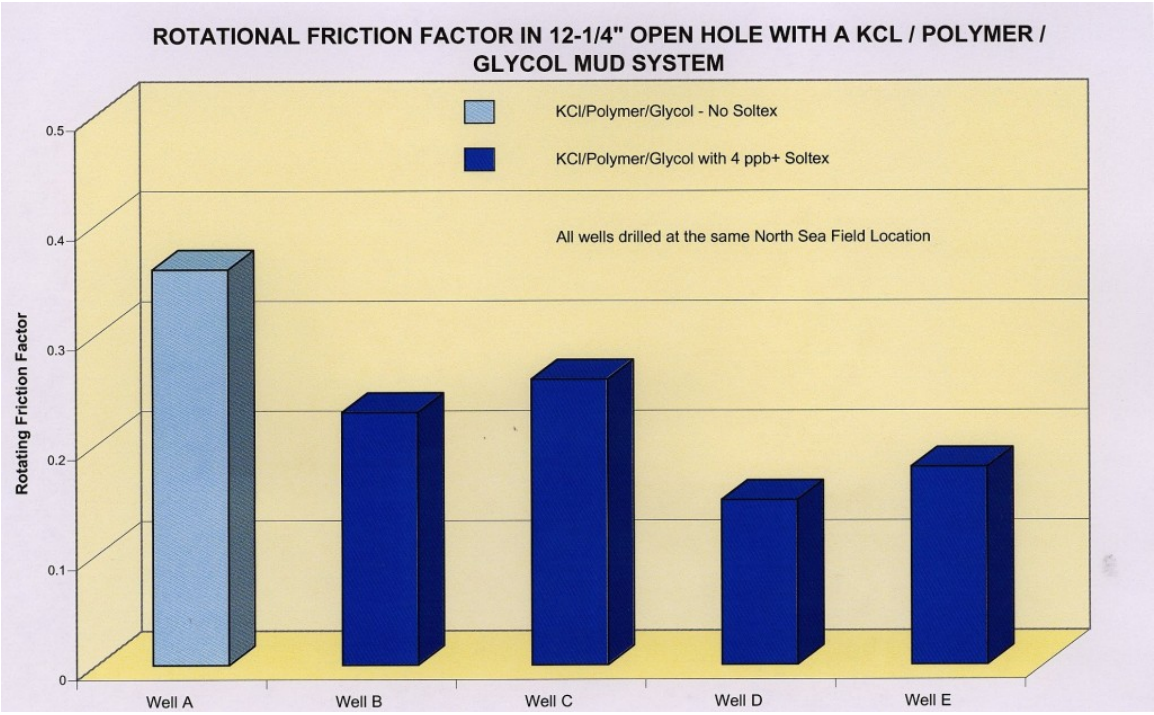
The clay stabilizing characteristic of Soltex® Additive, its ability to lower the HTHP fluid loss, its ability to increase lubricity, prevention of bit balling, reduce torque and drag, and help prevent differential sticking are all reasons to rely on Soltex® Additive. The special combined chemical and physical activity of Soltex® Additive clearly accounts for its superior performance.

Soltex® Additive goes into a drilling fluid and remains stays there because it is sulfonated. Non – reacted competitive materials, such as gilsonite and blown asphalt need a surfactant to keep them from floating out. Further, the non-reacted materials will agglomerate if any oil or hydrocarbon condensate is present in the system, and that will cause them to float out on the surface of the pits or go out over the shaker taking good materials like polymers with them. This costly loss of additives can be avoided when Soltex® Additive is used.

EFFECT OF SOLTEX® ADDITIVE ON LUBRICITY



Mud samples were hot – Rolled 16 hours at 176F. The base mud = 10 ppb bentonite in fresh water, de-sanded with a U.S. standard sieve series No. 200

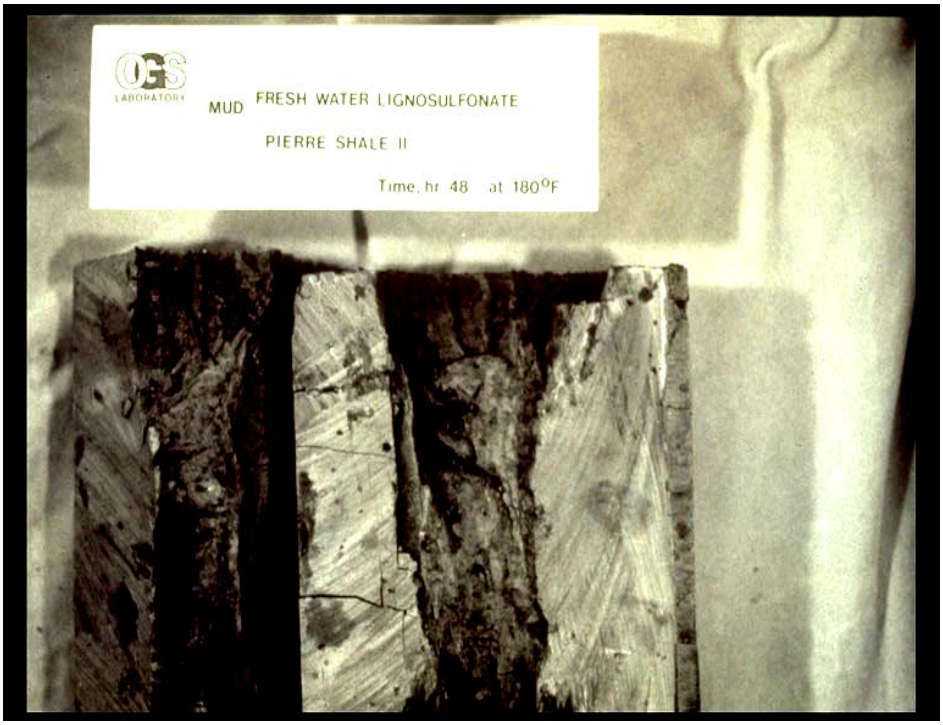


SOLTEX® ADDITIVE AND SHALE STABILIZATION

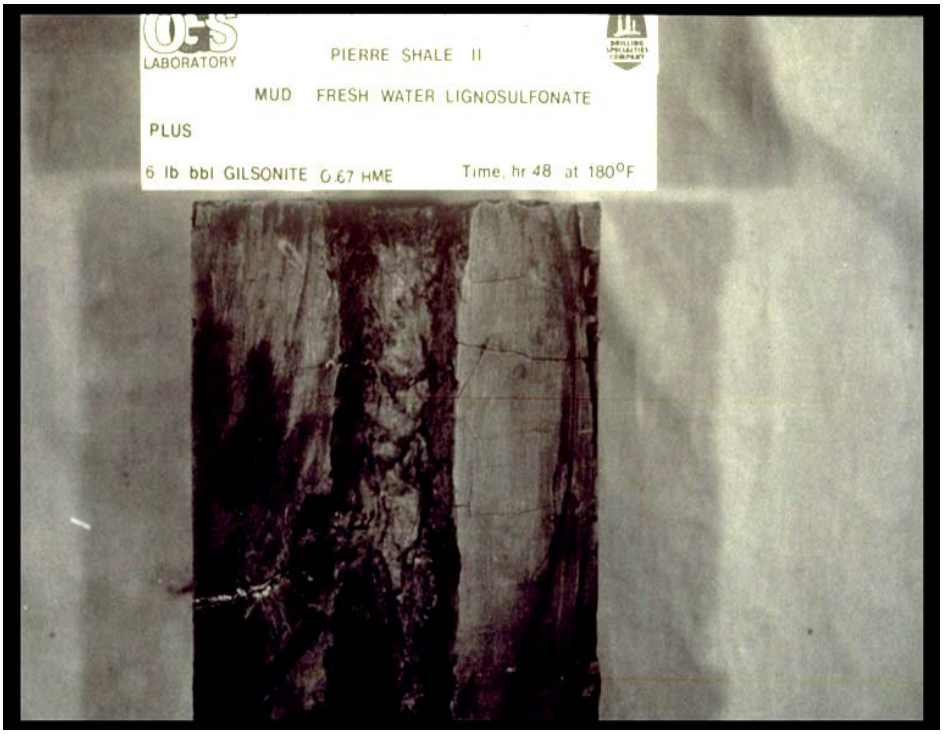
The following pictures were taken from a report commissioned in 1990 to compare Soltex® Additive to gilsonite and determine which was better at shale stabilization. The core test work, conducted by O.G.S. Labs then an independent laboratory sets a new standard in determining borehole stability. This method utilized the "Down-hole Simulation Cell" (DSC) and more nearly simulates down-hole conditions when compared to other test methods. The pictures provide the first laboratory evidence the drilling industry has had, to support almost 50 years of case histories all showing Soltex® Additive to be an excellent shale stabilizer. The mud system used was a fresh water lignosulfonate mud system with test duration of 48 hours and a test temperature of 180 °F. The mud treated with Soltex® Additive had less than 10% hole enlargement, the gilsonite treated mud had 53 % compared to 100 % hole enlargement for the control mud. Both test muds were treated with 6 ppb of product, 0.67 % HME (an oil wetting agent) was added to the gilsonite treated mud to make the gilsonite dispersible and is standard procedure.

MUD PRESSURE:	**3,400 psi**
OVERBURDEN PRESSURE:	3,400 psi
CONFINIG PRESSURE:	3,100 psi
FLOW RATE: CIRCULATING	1.2 GPM
FLOW RATE: DRILLING:	1.7 GPM
ANNULAR VELOCITY:	52.3 FT/MIN - CIRCULATING GAUGE HOLE
ANNULAR SHEAR RATE:	502.1 1/SEC - CIRCULATING GAUGE HOLE
SPECIMEN DIMENSIONS -	
OUTSIDE DIAMETER:	16.2 cm
LENGTH:	20.3 cm
BIT SIZE:	3.2 cm
BIT TYPE:	2 CONE MILLTOOTH
ROTARY SPEED:	60 RPM (DRILLING)

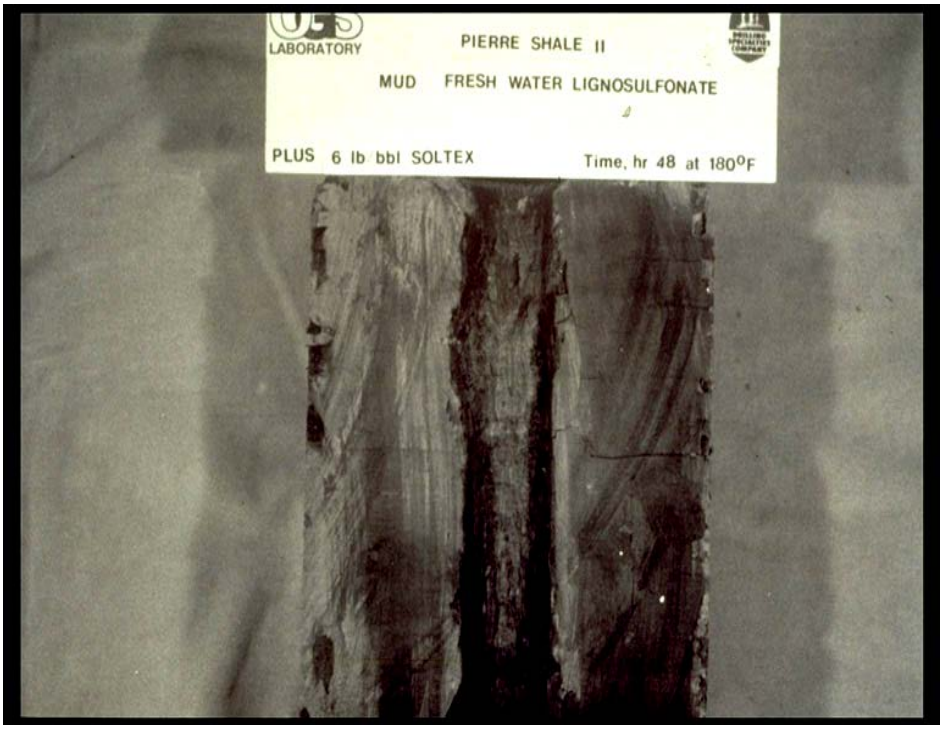
PIERRE SHALE II DRILLED WITH 3.2 cm MICRO BIT WASHED OUT TO 6.4cm 100 % HOLE ENLARGEMENT



PIERRE SHALE II DRILLED WITH 3.2 cm MICRO BIT WASHED OUT TO 4.9cm 53 % HOLE ENLARGEMENT TREATED WITH 6 PPB GILSONITE



PIERRE SHALE II DRILLED WITH A 3.2 cm MICRO BIT WASHED OUT TO 3.5cm, <10 % HOLE ENLARGEMENT TREATED WITH 6 PPB SOLTEX® ADDITIVE



Soltex® Additive was developed for shale control. When shales fracture, the edges are more positive than the faces, thus micro-fractures in shales represent small lines of positive charge. These are bound together by the electro-negative Soltex® Additive in solution, thus inhibiting disintegration of the shale. See photo on page 8.

QUICK REFERENCE GUIDE FOR APPLYING SOLTEX® ADDITIVE

Application	Material Needed
	Soltex® Additive Regular & Potassium
Stabilize shale formations	3 to 6 ppb (9 to 17 kg/m^3)
Impart lubricity	1 to 3 ppb (3 to 9 kg/m^3)
Reduce torque & drag	1 to 3 ppb (3 to 9 kg/m^3)
Control HTHP fluid loss	2 to 6 ppb (6 to 17 kg/m^3)
Thin, strong, compressible wall cakes	2 to 4 ppb (6 to 11 kg/m^3)
Emulsify oil into water-based mud systems	0.5 to 3 ppb (2 to 9 kg/m^3)
General hole conditioning (differential sticking, etc.)	2 to 6 ppb (6 to 17 kg/m^3)

MIXING GUIDELINES

If excessive product losses are being experienced over the shakers, it is recommended to employ coarser screen sizes during initial stages of product addition, and then switching over to finer sizes. It is not uncommon to experience a 10 to 20% loss over shakers during initial stages of additions, and in some areas may be considered normal and within acceptable limits.

Soltex® Additive solubility is much dependent upon temperature, and circulation time. Soltex® Additive will more rapidly mix into the mud system as the fluid temperature increases. If the mud is very cool, it may be best to hold off additions until it has a chance to warm up. An amount of Dilution may also be required during initial additions. Continual additions of Soltex® Additive will be needed to maintain a sufficient concentration in the system if losses occur while drilling. Soltex® Additive is consumed while depositing on drilled solids and on the well bore. It is advisable to add 50% more, one day following the initial treatment, to ensure adequate concentration. Use a conventional hopper when chlorides do not exceed 60,000 ppm. When adding to high salinity systems, pre-wetting the Soltex® Additive with fresh water by adding through a chemical barrel or pre-mix tank will improve results.

PRE-MIXING

Asphalt materials (including Soltex® Additive), may have some preliminary losses over the shaker. Precautionary actions to eliminate or reduce this possibility may be necessary. Pre-mixing is recommended even if the product is not running over the shakers, as the thorough solubility before mixing with whole mud, leads to better hole stability. If Soltex® Additive cannot be added directly to the system through the hopper, it can be added to the system using a chemical barrel or pre-mix arrangement. Add 40-50 ppb of Soltex® Additive to either the base oil or to the base mud and then bleed it into the active system. Agitation, stirring or circulation may possibly be required in the pre-mix tank or chemical barrel to prevent excessive settling. Pre-mixing in freshwater is recommended as the best method, even when adding to an oil base mud system. Make up salt such as calcium chloride can be added to the pre-mix, but this is usually not necessary as the amount of fresh water added to the system via concentrated pre-mix solutions will be negligible.

PRE-MIXING IN FRESHWATER

Mixing in freshwater might be the simplest and cheapest solution. Mix 40-50 ppb of Soltex® Additive in a slug pit of freshwater. There could be some foaming, so if the mixing system requires, a defoamer may be added to prevent surface foam.

PRE-MIXING IN HIGH SALT MUDS RIG SITE MIXING

Soltex® Additive and Potassium Soltex® Additive can usually be mixed into high salt (60,000 ppm chlorides and up), high density drilling muds without problems if some extra steps are followed. If enough time is available, both products may be added gradually over several days to an existing system allowing both time and temperature and shearing at the bit to disperse the product. This slow addition of the product reduces losses at the shale shaker which would be expected under these conditions. However, if hole conditions require large amounts of Soltex® Additive be added quickly, it is best to prewet the Soltex® Additive with fresh water in a separate mixing tank. In fresh water large amounts of either product up to 200 ppb may be mixed to create a slurry that may be added direct to the mud system without much loss at the shale shaker.

PRE-MIXNING IN HIGH SALT MUDS AT THE MUD PLANT

Mixing high salt muds of 60,000 ppm chlorides and higher at a mud plant requires Soltex® Additive products be added first before addition of the salt. Attempts to mix Soltex® Additive after the salt is added in such a low temperature condition will result in the Soltex® Additive floating on the surface. While this looks bad, the Soltex® Additive is not lost but will mix at the rig site over time. Some losses at the shale shaker will occur under this condition. Using premixed brines as above requires that Soltex® Additive products be added at the rig site

instead of at the mud mixing plant. Addition of Soltex® Additive that has been prewet in fresh water may solve the above problems at the mixing plant.

PRE-MIXING IN OIL BASE MUDS

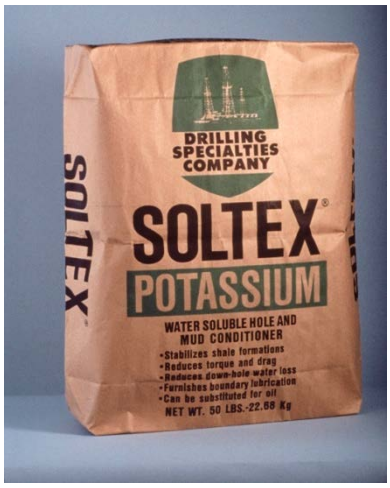
An alternate solution is to solubilize Soltex® Additive in base oil. If this option is desired over freshwater, then premixing 40-50 ppb into the smallest volume of base oil as possible prior to bleeding over into the active system is extremely effective. In most offshore environments the use of diesel is forbidden and can be detected using analytical methods, and if discovered, none of the cuttings can be put overboard. However, in some land operations when permitted, a small amount of diesel can be used to pre-mix Soltex® Additive. If used sparingly, it becomes only slightly detectable after incorporation into the whole system. Of course Soltex® Additive may be mixed in other hydrocarbons such as mineral oil, and synthetic oils.

SOLTEX® ADDITIVE CASE HISTORY HTHP FILTRATE CONTROL JASPER COUNTY TEXAS 2010

Recently a customer drilling in Jasper County Texas near the town of Spurger used Soltex® Additive to reduce the high temperature high pressure (HTHP) filtrate on a very highly treated lignosulfonate drilling mud. Efforts to reduce the HTHP filtrate with other products were unsuccessful and so a decision was made to use Soltex® Additive. The HTHP filtrate was tested at 300 °F and the filtrate was reduced from 12.2 ml to 5.0 ml with the addition of 160 sacks of Soltex® Additive. The volume of drilling fluid treated was 1547 bbl making the treatment roughly 5 ppb. The well had a total vertical depth of 14,000 feet and the mud density was 14.9 ppg. The operator was surprised and very pleased with the results.

SOLTEX® ADDITIVE PLANT

There are presently no true substitutes for Soltex® Additive because the chemical modification of asphalt by sulfonation requires special equipment, selected asphalts, considerable expertise and a plant to make it. There is only one Soltex® Additive plant in the world. The next time someone tells you it is sulfonated asphalt just like Soltex® Additive ask for a trip to their plant or at least a picture of one. The Drilling Specialties Company plant is located just east of Conroe, Texas. To arrange for a tour of the plant call your local Drilling Specialties Co. representative today. Qualified customers only! For more information visit us at our web site at www.drillingspecialties.com.



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 52 years but only in the last 20 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 Senior Technical Sales Rep and Mike Murty Dir. Product Development E.H. Drilling Specialties 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
- Produces thin compressible filter cakes see page 25

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.
The metal-to-metal contact was 0.34. Typical calibration with water averages between 0.32 and 0.35.

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	After Heat Aging @ 300 °F	Before Heat Aging	After Heat Aging @ 300 °F
	Base	**Base + 6ppb Soltex® Additive**	**Base + 6ppb Soltex® Additive**	**Base + 6 ppb Amine lignite**	**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

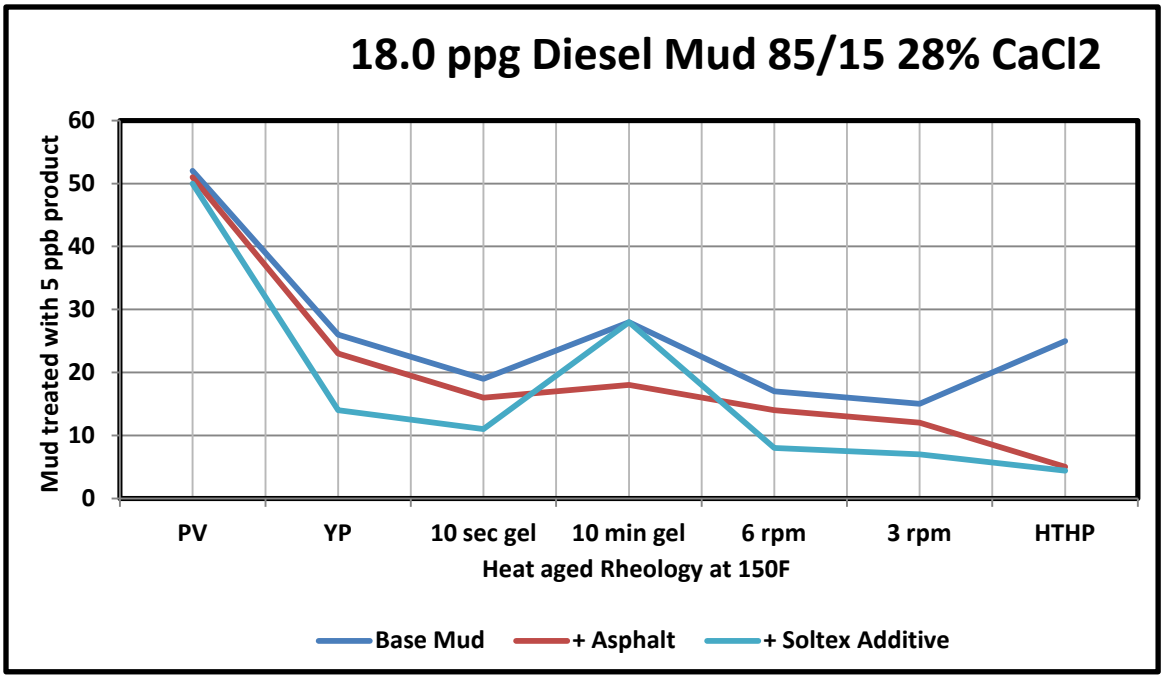
RHEOLOGICAL, ELECTRICAL STABILITY, HTHP @ 300 °F AND LUBRICITY TEST RESULTS

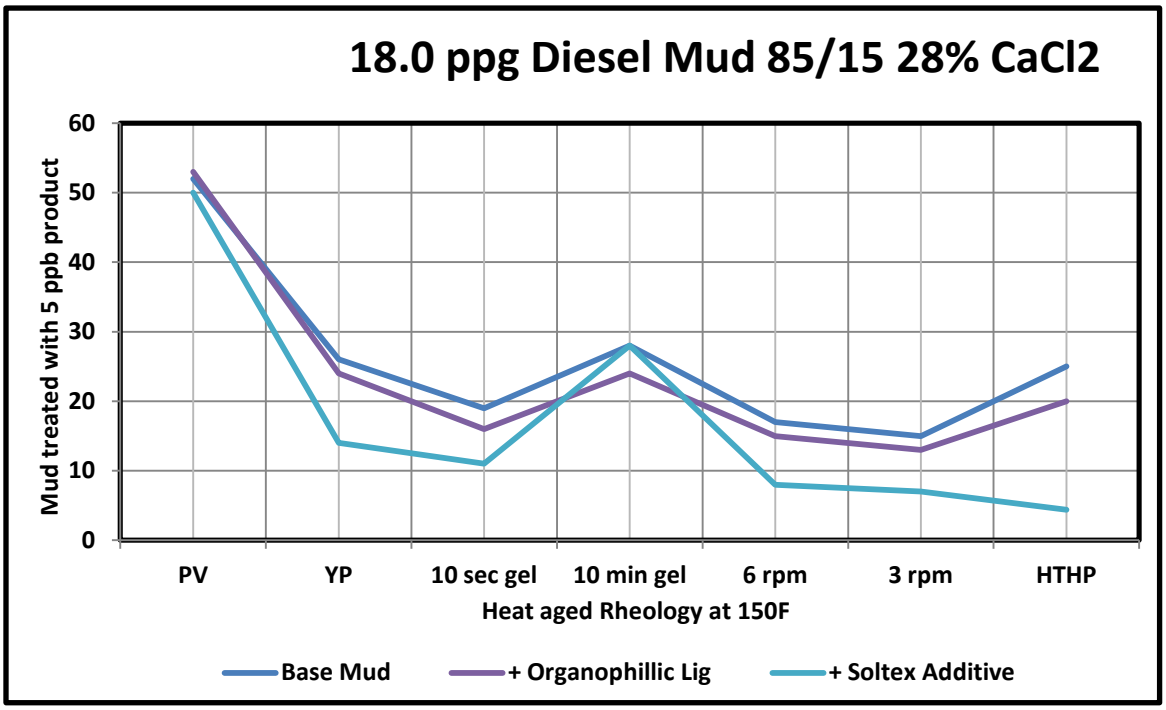
TABLE III

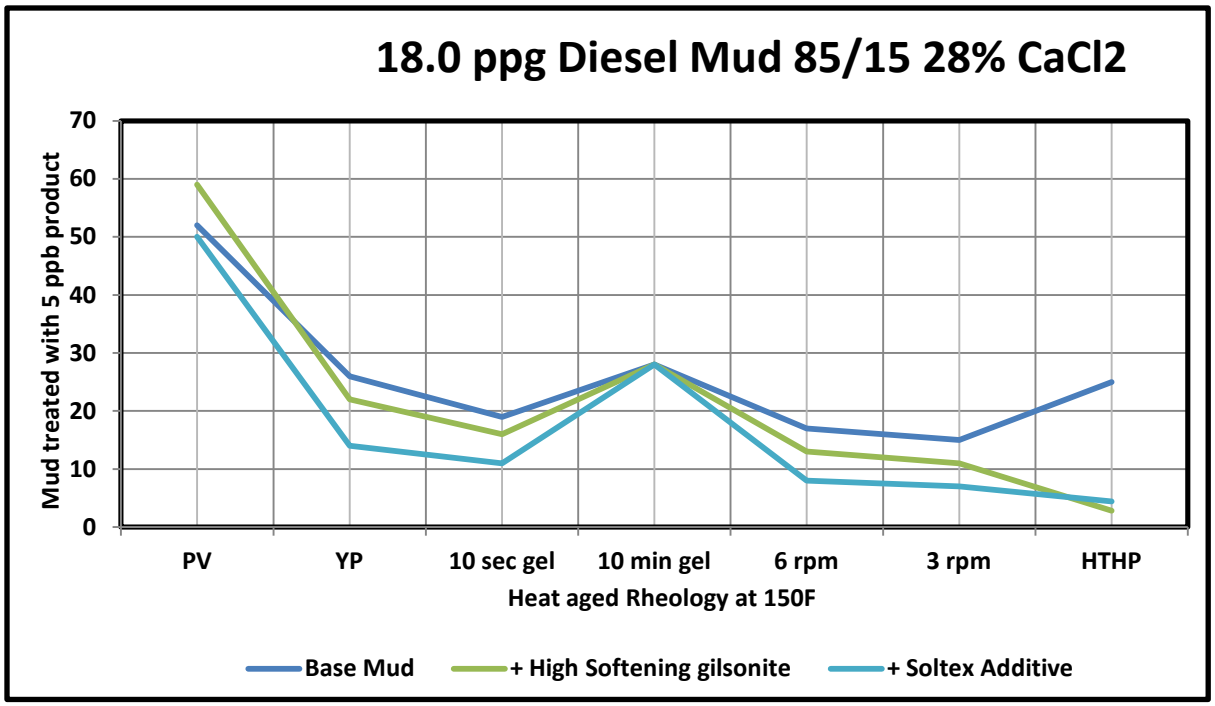
Properties	Base Fluid*	Base + 4 ppg Soltex® Additive
Mud weight	11.1 ppg	11.0 ppg
600 rpm	59	64
300 rpm	35	35
200 rpm	26	24
100 rpm	17	14
6 rpm	6	3
3 rpm	5	2
PV	24	29
YP	11	6
Gel Strengths	8/12	4/10
ES	350	303
HTHP 500 psi@ 300 °F	4.2	2.8
Lubricity Tests (Avg. C.F.)		
Metal to metal Contact	0.2979	0.2437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







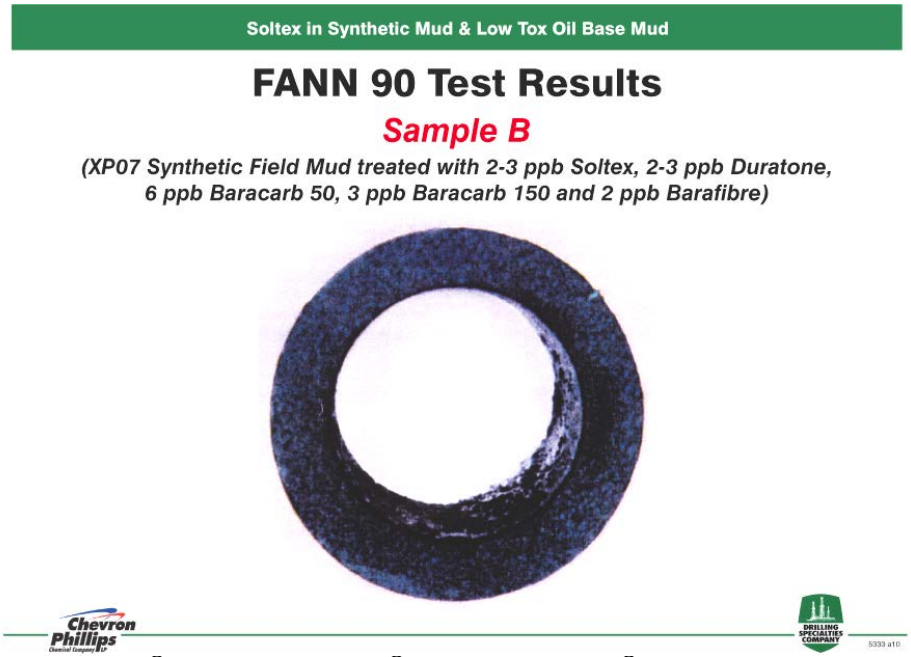
RETURN PERMEABILITY STUDY

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



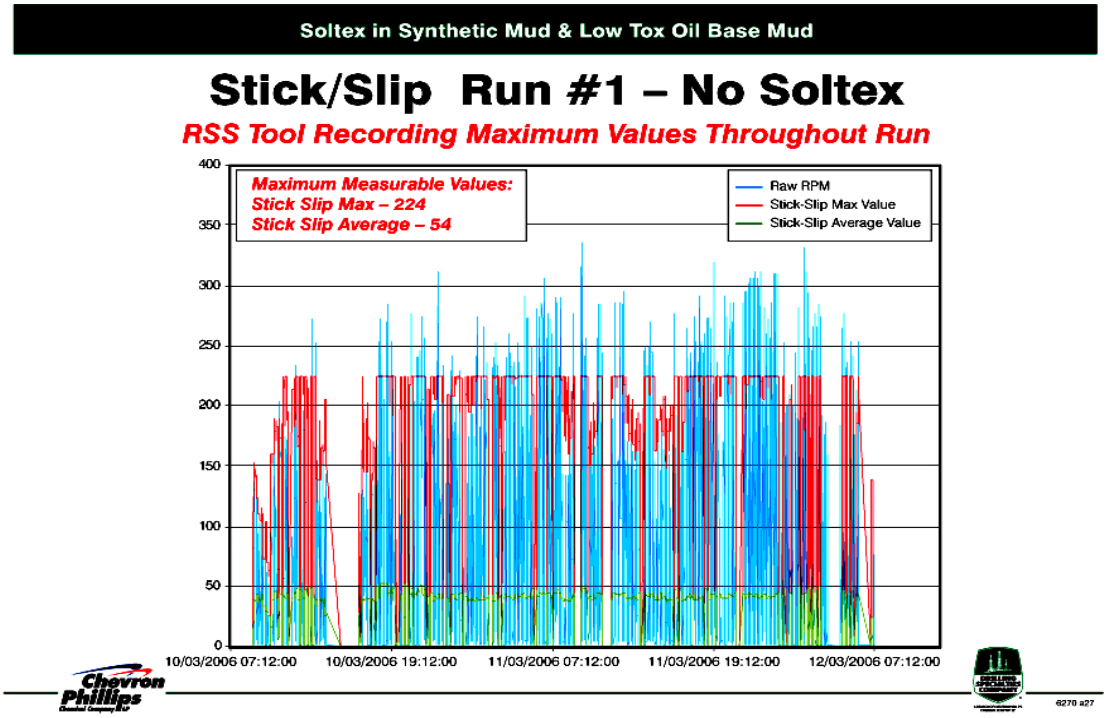
NOTE: Duratone® HT, Baracarb® 50, Baracarb® 150, and Barafiber® are trademarks of Halliburton Energy Services/Baroid

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.

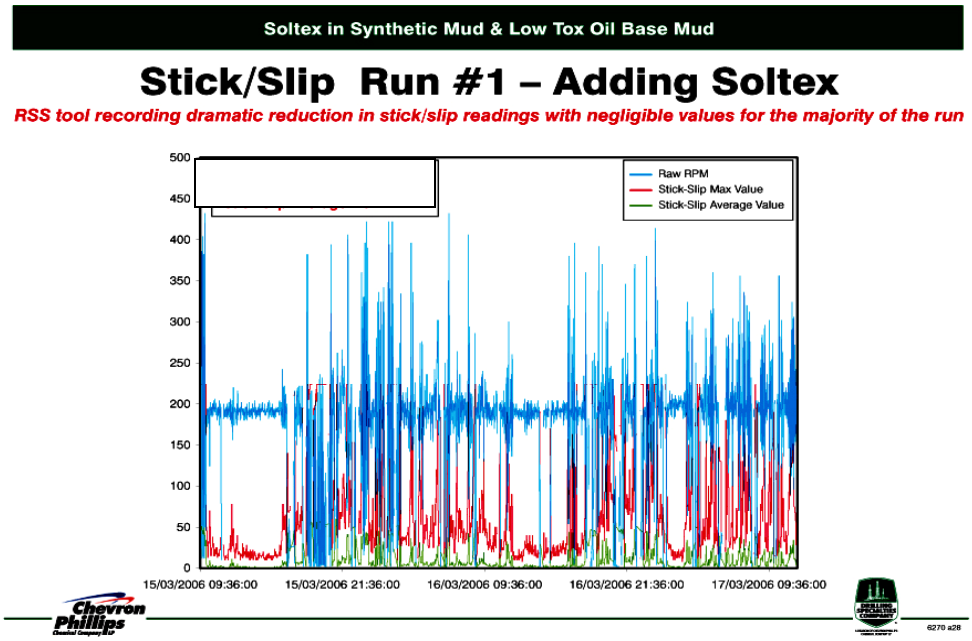
STICK/SLIP BASE NUMBERS BEFORE ADDITION OF SOLTEX® ADDITIVE



SOLTEX® ADDITIVE OBM Case History in South Texas by Tim Burrell

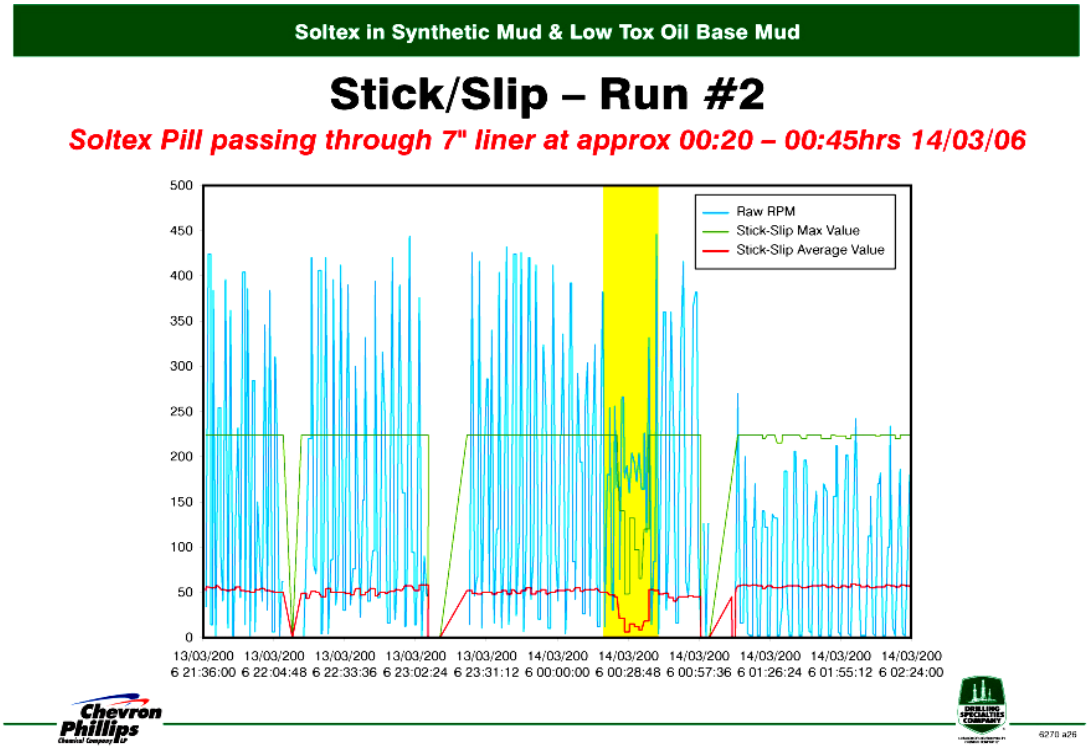
A major mud company was working for an operator in the Eagle Ford shale and was having trouble with a formation that was causing the well bore to pack off and become stuck. Several options were discussed and it was decided that we would add Soltex® Additive to the mud system. We started out using 1.5 ppb in the system and maintained this amount for the duration on the well. If we encountered the packing off problem we increased the concentration of Soltex® Additive to 4.0 ppb. We have had very little problem with packing off problems since we started adding Soltex® Additive to the system. An added benefit has been the increased ability to slide has improved. All of these things together have helped decrease the drilling days on this project.

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 in Synthetic Mud & Low Tox Oil Base Mud

Removal of Soltex HP/HT Filter Cake with a Combined Mutual Solvent/Hydrochloric Acid/Brine Wash

Filter Cake Breaker Study

- A 1 litre sample of acid breaker solution was prepared as per the following formulation:
  - Mutual Solvent (U66) (bbl) 0.200 (EGMBE)
  - HCl (35 – 36%) (bbl) 0.215
  - Saturated KCl brine (bbl) 0.580
  - A100 (CROM OX 265) (bbl) 0.005
- The test method used to perform the breakers effectiveness on the filter cake was;
  - Filter cakes from HP/HT cells cut in half
  - 1 half placed in plastic petri dish and 25 mL of breaker solution poured over filter cake
  - Observations of effect noted with time

Chevron Phillips Chemical Company LP

DRILLING SPECIALTIES COMPANY

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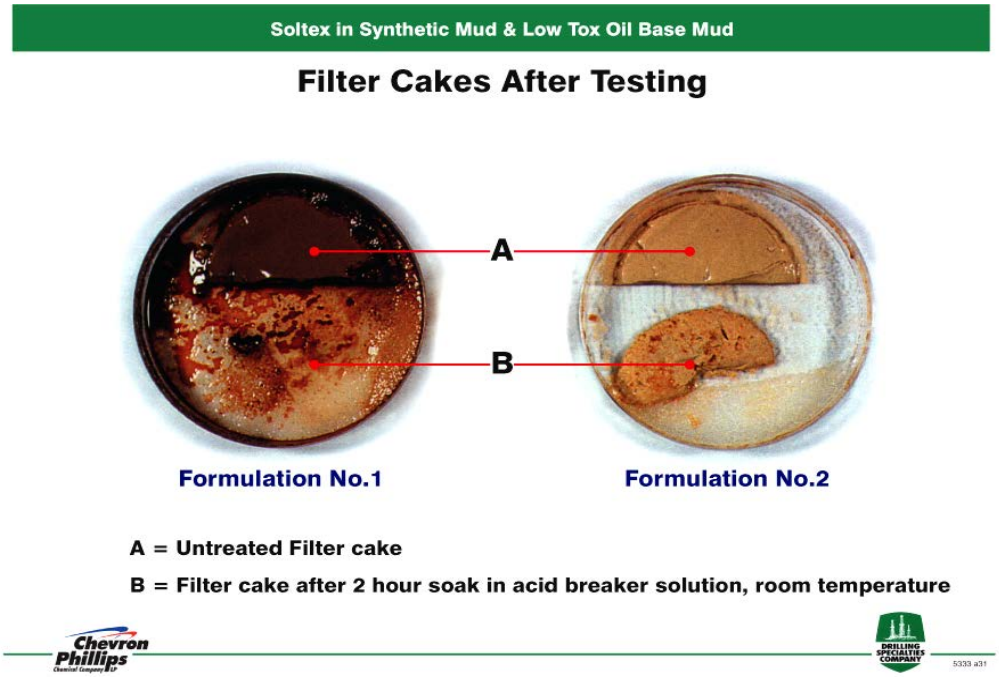
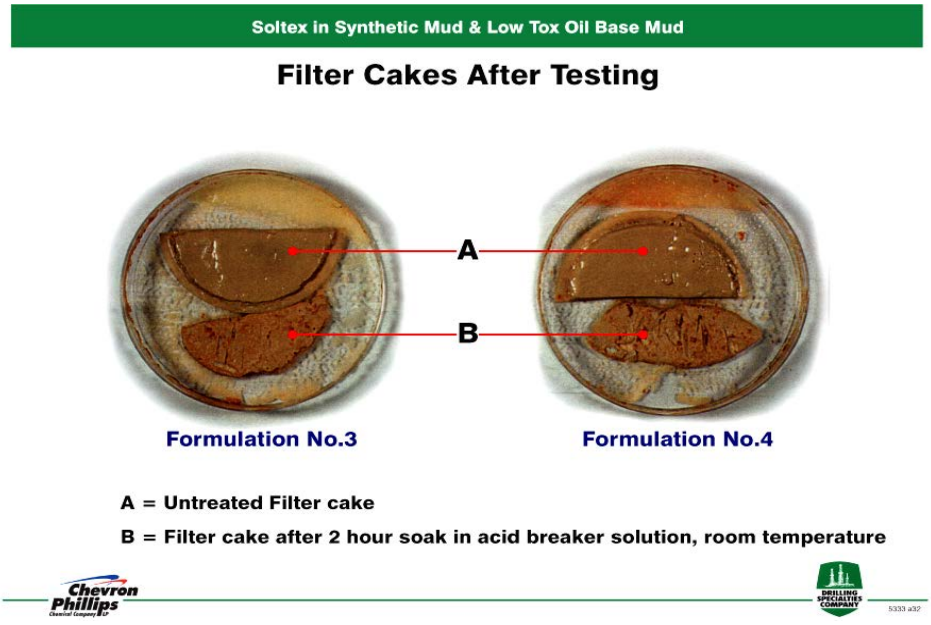
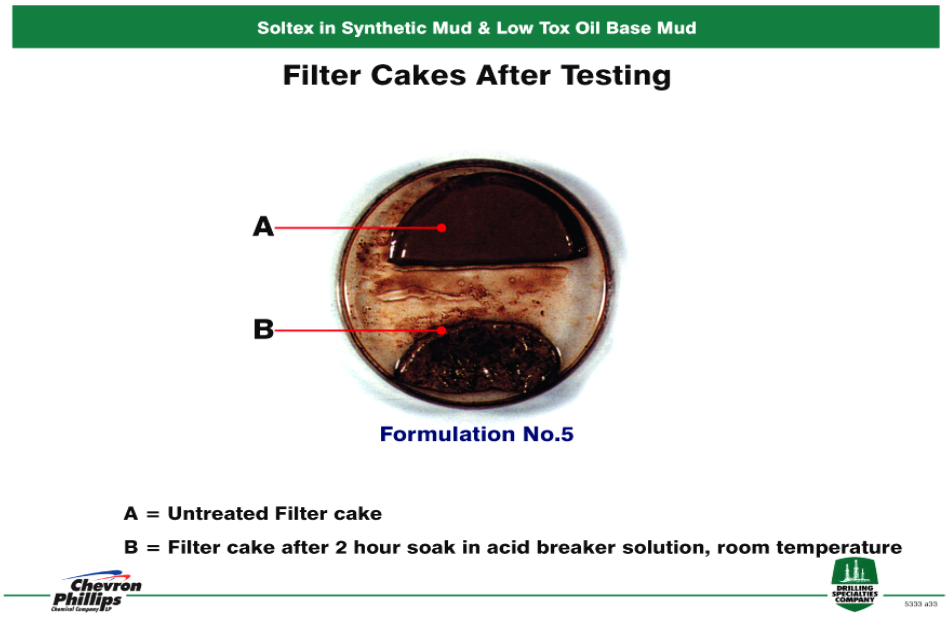
SOLTEX® ADDITIVE AIDS IN THE REMOVAL OF FILTER CAKES (#1 CONTAINS 5 PPB OF SOLTEX® ADDITIVE, #2 CONTAINS 1.5 PPB OF POLYMERIC FLUID)



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)



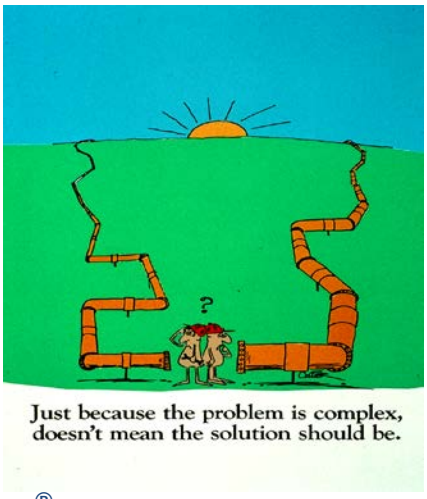
Note: If Soltex® Additive is incorporated in your synthetic or oil – based system, this same breaker solution can be utilized as a spotting fluid to destroy wall cake build – up in areas prone to differential sticking.

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