



MotorSilk[®] Diesel/Biodiesel Fuel Treatment



The Science of Friction Reduction



Background

The Boron CLS Bond™ line of advanced lubrication formulations (over 20) results from tribological research at Argonne National Laboratories, a U.S. Department of Energy facility. Dr. Ali Erdemir discovered that hydrated boron through a patented process forms an almost permanent and self-replenishing bond to any metal alloy creating a near frictionless surface. The friction coefficient is under 0.01. The result is an 80% reduction in surface friction, a 90% reduction in component wear, the elimination of corrosion as well as a Timken extreme pressure agent.



U.S. Patent #5,431,830
Owned by ARCH Development Corporation, Argonne, Illinois U.S.A.

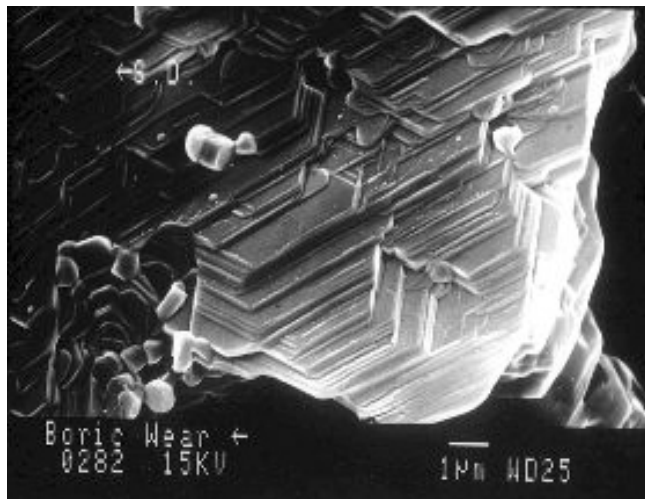


MotorSilk® Diesel/Biodiesel Fuel Treatment is process compliant under ISO 14064 as the only fuel additive to qualify for carbon credits due to less fuel consumption and green house gases.



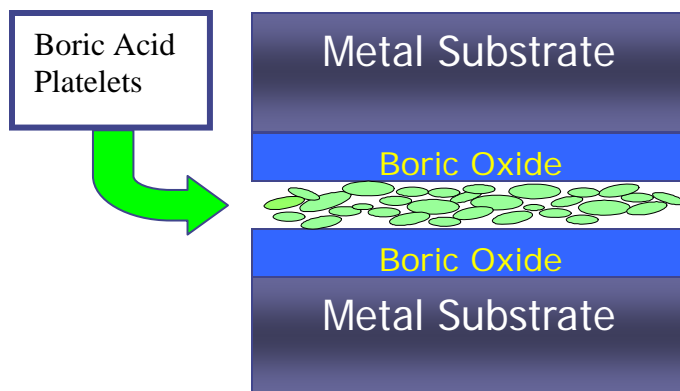
Boron CLS Bond™ Technology in MotorSilk® Diesel Fuel Treatment

Boron CLS Bond® is based on the intricate crystal lattice structure (CLS) of the hydrated boron molecules. That lattice structure allows the layers of hydrated boron particles to slide virtually friction-free over each other, like the playing cards in a fresh deck, while retaining awesome strength. The ultrafine sub-micron particles of hydrated boron reach every metal surface and crevice, lubricating with superior slipperiness as they chemically bond with the host material.



How it Works

- Boric acid is introduced to a metallic substrate in the presence of water vapor. Interaction between the substrate, the water (H_2O) and Boric Acid (H_3BO_3) forms a continuously self-replenishing film of boric oxide (B_2O_3) that bonds to the substrate, forming a corrosion-resistant barrier.
- The boric oxide spontaneously reacts with the air, replenishing the boric acid. The boric acid molecules form into crystal platelets, each of which is a triclinic lattice of molecules strongly bound together by macromolecular covalent bonds (see microscopic photo above).
- Aligned by the mechanical motion of the substrate, the platelets form stacked layers with very small (0.318 nm) spaces between. As a result, the inter-platelet layers are bound by weak "van der Waals" forces, allowing a very low coefficient of friction.





Technology Inventor:
United States Department of Energy,
Argonne National Laboratory



U.S. Patent #5,431,830
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MOTORSILK[®] Diesel & Biodiesel Fuel System Treatment

DESCRIPTION:

MotorSilk[®] Diesel Fuel Treatment is a formulated additive for ULTRA low-sulfur diesel fuels and all biofuels. The technology provides greatly enhanced lubricity to low sulfur diesel fuel because of an active chemical process which creates a micro layer of an extremely low friction coefficient.

The Cetane number in diesel fuel is improved by 8 to 10 numbers; in addition detergency, corrosion protection and fuel stability are improved. Reduced starting time, reduced injector pump wear and lower emissions and fuel consumption are achieved. Designed to protect injectors and pump with a semi-permanent Boric Oxide surface under 0.01 friction coefficient which reduces typical scar width from 460+ to 0.165.

(With a mean fuel lubricity of just under the recommended specification of an HFRR wear scar diameter of 460 microns, fully 50% of the U.S. fuel was found to be above that recommended by equipment manufacturers).

Diesel Fuel Treatment:

Low ultra sulfur fuels (15ppm) and the poor quality of diesel fuel may cause premature pump and injector damage or failure resulting from the lack of lubricity which sulfur provides, also a drop in fuel economy of ½ MPG and power loss has been reported. The active hydrated boron molecules in the diesel fuel treatment protects 100% of the fuel system from the adverse affects of sulfur, biofuels, corrosion and carbon. Any carbon or varnish deposits are permanently removed allowing for the highest injector performance. By increasing the Cetane 8-10 numbers, greater performance is achieved during ignition, easier startups, enhanced driving performance, better fuel combustion and less noise. Today's engines are designed to operated with 50 Cetane fuel, at a level of Cetane 40, delayed ignition, noise, fuel and power losses occur. The average Cetane number at the pump is usually around 42.

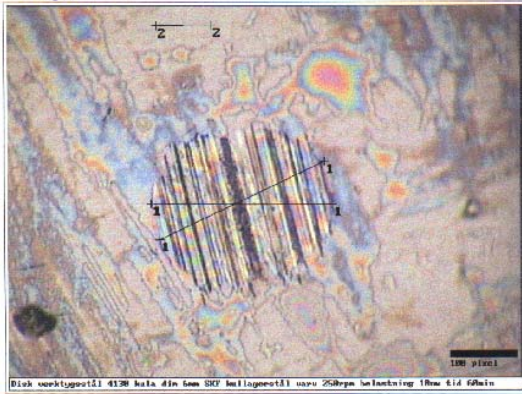


- Eliminate corrosion 100%
- Eliminate deposit formation
- Eliminate any concern for lubricity in fuels
- Eliminate the need for premium diesel fuel

Pin on Disk Test to Measure Scarring

Low sulfur diesel fuel without
Boron CLS Bond™

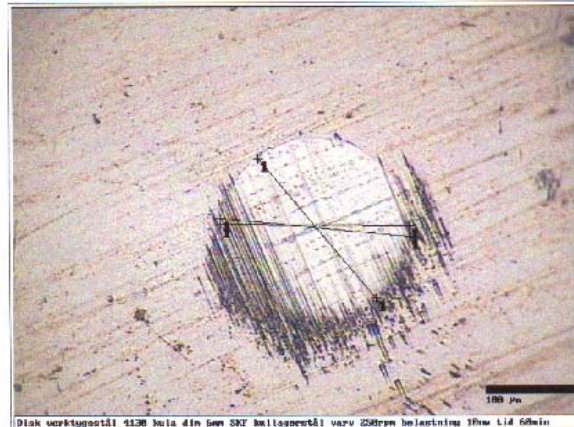
Mitsödiesel



Dokument:	Namnlös - (2002-01-19 15:49:41)
Vitning av:	Avstånd
Kalibrering:	100X
Mättenhet:	µm
Höjdstorlek:	635,39 H x 478,23 V
Bildarea:	303555,67 µm²
Nummer:	Avstånd
1	224,17

Low sulfur diesel fuel
with Boron CLS Bond™

CLS diesel



Dokument:	Namnlös - (2002-01-19 15:46:01)
Nummer:	Avstånd
1	205,70

FEATURES/BENEFITS:

- Eliminate diesel knocks and rough starts
- Easier cold starts at low temperatures
- Maintain the correct pressure rise rate in the combustion chamber
- Permanently remove any deposits of carbon, coke or varnish buildup
- Less emissions produced
- Improved fuel economy of 5% plus as a result of a shortened ignition delay, deposit removal and lubricity
- Metal scarring dramatically reduced to fewer than 300
- Greatest surface lubricity available to ensure the highest performance and component life of the fuel system, will also eliminate seal failure in fuel pump

Protects fuel systems and tanks from the corrosive effects of biofuels

“Deposit control is a crucial part of brand differentiation strategies designed to enhance diesel engine performance and reduce emissions. Efficient operation of diesel engines depends on proper operation of the fuel injectors, so control of deposits in this critical area is necessary to ensure optimum performance, minimize fuel consumption and control engine smoke”.
–Chevron



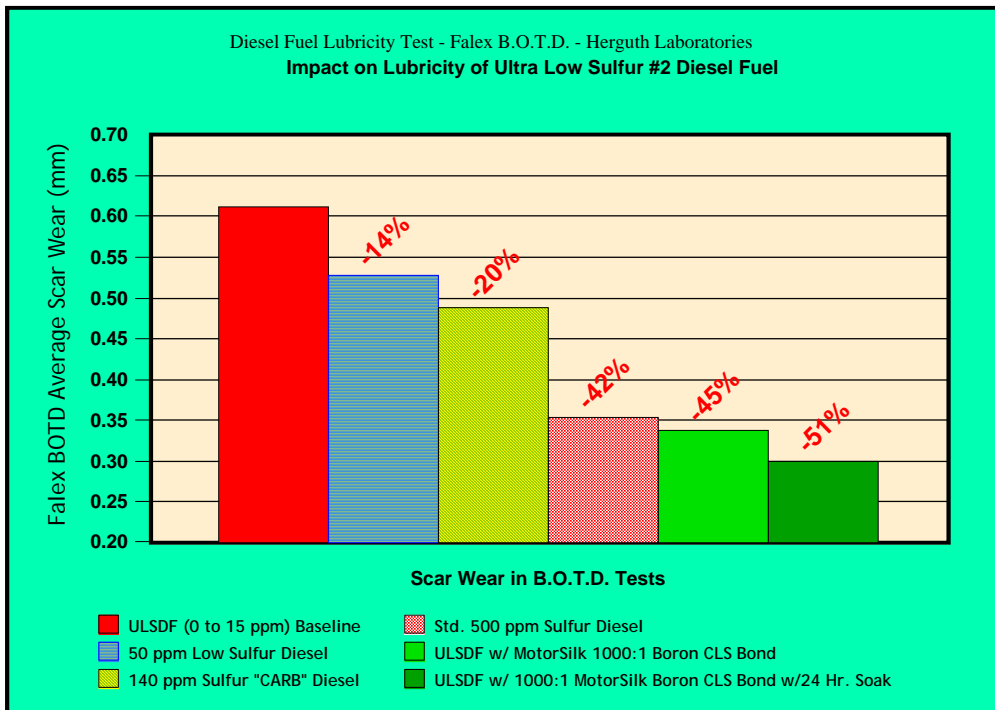
Diesel Fuel Lubricity (50% of diesel fuel in the U.S. does not meet the FIE requirements for lubricity)

Lubricity:

In addition to providing energy, diesel fuel doubles as a lubricant for diesel injection equipment, such as rotary distributor pumps and injectors. Fuel must be capable of lubricating the system components in order to prolong the fuel system. Because of the diesel's dual purpose, the viscosity or weight of the fuel is vital to its performance. In normal temperatures, higher viscosity fuels, such as Diesel Fuel Number Two, or DF2, will perform better than the thinner, lower-viscosity fuels in automotive diesel engines, which can be hard on the injectors.

A test called SL BOCLE will measure the fuel's ability to lubricate and express the lubricity in grams of load. Many engine manufacturers require a minimum SL BOCLE rating of 3,100 grams, and that is the common rating found at diesel fuel stations, **the higher the value, the better the lubricating ability, MotorSilk® diesel is 5,800 grams.**

A 1998 review paper on fuel lubricity worldwide showed that diesel fuel in the U.S. and Canada is some of the poorest lubricity fuel found in the entire world.





Specifications

Lubricity (Falex B.O.T.D.) 195) — <.300
Lubricity (SL BOCLE) 5800 grams
Lubricity (HFRR at 60°) 0.165mm
Wear scar prior treatment 0.34 and after treatment 0.165 (scar width cut in half)
Color..... Clear to slight translucent
Base Fluid..... Proprietary
Flash point..... 181 deg. F. (coc)
Viscosity..... 32.6 - 40.0 SuS @ 100 deg. F.
D.O.T..... Hazard Class 2.1, Packing group II
Marking..... None
Hazardous substance: /RQ Not applicable
Auto ignition temp .. >500 Deg. F. / 260 Deg. C.
Vapor Pressure (mm Hg.) 0.40
Vapor Density (air=1) > 3
Pour Point / Gel Inhibitor....to -45 Deg. C.
PACKAGING: 16oz , 32oz up to any size required

This diesel fuel additive complies with Federal UTRA Low Sulfur content requirements for use in motor vehicles and may be used in 2007 and newer model years. Registered with EPA as a fuel additive-#1899-0001 per 40CFR 79.24

**Up to 10% in lost MPG with deposit buildup.
50% of diesel fuel does not meet the requirements for lubricity
as established by Fuel Injector Manufacturers**



Deposit build up



Clean injectors offer a uniform spray pattern

AVERAGE BIODIESEL EMISSIONS COMPARED TO CONVENTIONAL DIESEL ACCORDING TO THE EPA THEN COMPARED TO CONVENTIONAL DIESEL WITH THE ENHANCEMENT OF BORIC ACID LUBRICATION TECHNOLOGY TRADEMARKED MOTORSILK (MS).

Emission type	B100	B20	MotorSilk/Diesel
Carbon Monoxide (CO)	-48%	-20%	-50%*
Particulate Matter (PM)	-47%	-12%	-50 to -58**
Nitrous Oxide (NOX)	+10%	+2% to -2%	-50%***

* PDM Report Oakland University

**At 1500 RPM (Idle) and a 25% reduction at 2300 RPM (both engine and fuel treated)

***13% to 30% at 1500 RPM (Idle) and 4-15% at 2300 RPM. TECHNION Report Israel Institute of Technology (40 hours), Long -50 is achieved PDM Commercial Bus Fleet

B20 has an adverse affect on fuel economy from -1% to -5% with the average ranging at 3% due to the dilution of the BTU in the fuel. With the addition of MotorSilk® to the engine and fuel the fuel economy is increased by 10% on the low side and 28% on the high side which more than compensates for fuel loss and additional cost for the fuel. Another disadvantage of biodiesel is the build up of varnish in the fuel system resulting in additional fuel loss and power, this also is eliminated. For every gallon of fuel not burned as a result of enhanced fuel efficiency from MotorSilk® equals 22.2 pounds of CO² not entering the environment and 100% of all toxic emissions not entering the environment.





The Israel Institute of Technology (Technion) is home to many Noble Prize Scientist and considered one of the foremost testing and research centers in the world and often compared to MIT.

MotorSilk[®] Engine Treatment and Diesel Fuel System Treatment tested for Fuel Consumption and Emissions under the supervision of Professors L. Tarakovsky, M Veiblat, V.Baybikov, M. Gutman and Y.Zvirin and completed in November 2006

The test results clearly show that MotorSilk[®] Engine Treatment leads to a reduction of specific fuel consumption in the whole test range by **2-7%** compared to the reference case.

With the addition of the Diesel Fuel Treatment resulted in fuel economy improvement compared to the reference case of **5-10%**

The test results show some tendency of reduction of NOx concentrations in the exhaust gases, more pronounced reduction of NOx after 30 hours of 13-30%

PM (particulate matter) reduced by 20-40% and as high as 58%

Field test MPG averaged at 14%



Evergreen America is working with Clean Cities to displace petroleum dependency and reduce emissions from conventional and alternative fuels. In addition, another project we are working on is aggregating CO2 reductions in transportation which has never been done before. This translates into offsets or as a financial instrument to trade on the Carbon Exchange Market.



MotorSilk[®] is Process Compliant under ISO 14064 as the only lubrication and fuel technology to qualify for accumulating carbon credits as a result of reducing green house gases - CO². We meet the Gold standard under the Kyoto protocols.





Carbon Credits and How They Work:

Carbon Credit Offsets™ are based upon established scientific protocols, and represent accumulated reductions of CO₂ in one pound increments. When a sufficient amount of Carbon Credit Offsets are accumulated, they can be converted into a Carbon Financial Instrument (“CFI”) as defined by the current carbon trading community. Companies using MotorSilk® can now accumulate CFI’s to reduce their own carbon profile.

Example

We baseline the vehicles for MPG then add the MotorSilk® Engine and Fuel Treatment and register the improvement in MPG. Using a class 8 rig which clocks 100,000 miles per year and increases the MPG from 6.0 to 6.60 or a 10% improvement in fuel economy would save almost 1,700 gallons of diesel fuel annually. A gallon of diesel fuel produces 22.2 pounds of CO₂ x 1,700 gallons is a reduction of 37,740 pounds of CO₂ or 19 tons. CO₂ is traded by the ton and as a commodity it is subject to market price (as of 4-08 a ton in the U.S. sells for \$17.00 and in Europe and Kyoto signature countries it is \$53.00). Since we have Gold standard CFI’s under the Kyoto protocol and registered in a Kyoto signature country we can trade in the European markets in bulk.



Cost Analysis

Based on the numbers above the annual savings in fuel cost are as follows: At \$3.90 per gallon and driving 100,000 miles annually using 17,000 gallons of fuel at a 10% savings 1,700 gallons of fuel is saved. The annual savings is \$6,630.00.

For test results contact our technical department.

Diesel Fuel Quality Can Vary From One Shipment to Another and From One Area to Another.

The BTU's may vary as well as the Cetane value and Lubricity. By the time the fuel is actually pumped into the fuel tank it may be degraded losing energy and causing a lower MPG.

The following characteristics for your DF2 fuel are what you should be aware of in order to maintain optimum performance of your diesel engine: Cetane, lubricity, and BTU.

CETANE: The word Cetane represents the ignition value of the fuel. Currently the on-highway DF2 has a value from 40 to 45. Most electronic diesel engines require a Cetane rating of 50 for optimum performance. Higher Cetane values tend to improve the engine's cold-starting performance and reduce white smoke.

LUBRICITY: Just like a door hinge needs oil to continue working smoothly, fuel must be capable of lubricating the system components in order to prolong the fuel system. Since sulfur content has been reduced in diesel fuel due to EPA mandates, the fuel has lost some of its lubricating ability. It's important to specify lubricity as many fuels available have too little lubricating abilities.

A test called SL BOCLE will measure the fuels' ability to lubricate and express the lubricity in grams of load. Many engine manufacturers require a minimum SL BOCLE rating of 3,100 grams. The higher the value, the better the lubricating ability. (LubriSilk® Diesel treatment is 5,800 grams)

50% of diesel fuel in the U.S. does not meet the Fuel Injector Manufacturers specs for injector wear.

It is estimated that eight out of every ten diesel engine failures have been directly related to poor quality and contaminated fuel.

Diesel fuel begins to deteriorate as soon as it is produced. Within 30 days of refining, all diesel fuel regardless of brand goes through a natural process called re-polymerization and oxidation. This process forms varnishes and insoluble gums in the fuel by causing the molecules of the fuel to lengthen and bond together. These components now drop to the bottom of the fuel tank and form asphaltene also known as diesel sludge.

The University of Idaho conducted tests on the life expectancy of fuels to determine the timeline on degradation of stored #2 diesel fuel. **The results indicated 26% degradation after 28 days of storage.**

The U.S. department of agriculture did some research on biodiesel as a lubricity agent, and they've determined that it is the glyceride contaminants that provide lubricity, not the fuel itself or any other ingredient in it.

Interestingly, research found elsewhere indicates that these same contaminants are what gels up when its cold out and it is recommended that these be filtered out, so cold weather performance is better.

Summary

The Boron CLS Bond™ solid boundary lubricant technology addresses the three major areas of lubricant challenges with one solid boundary powder: Hydrogen Orthoborate, eliminating the need for toxic corrosion inhibitors, anti-wear additives and extreme pressure agents. In each of these categories hydrated boron far outperforms in all areas, eliminating corrosion and a superior EP agent equal to 85% the hardness of diamonds, even exhausting the limits of the Timken test. MotorSilk® lubrication products are in a category of their own and used worldwide solving lubrication challenges where other lubricants fail.



North America Headquarters
Evergreen America, Inc.
69 North Turnpike Road
Wallingford, CT 06492
866-537-7383
203-265-5700
www.evergreenamerica.com
Email: info@evergreenamerica.com

Call us with any questions.