



MotorSilk[®] Engine Lubrication



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.

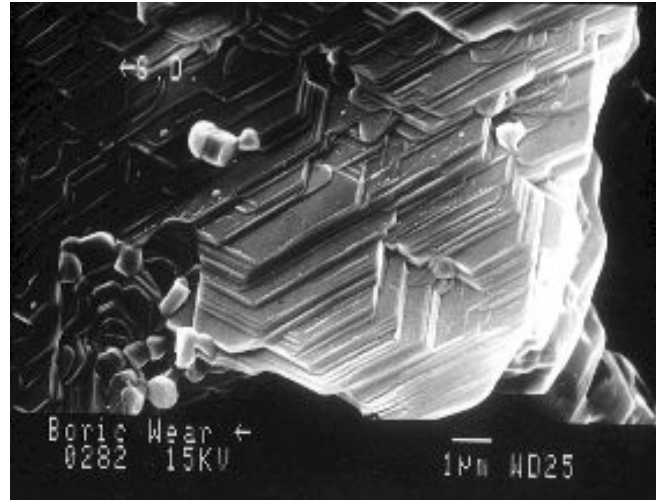


MotorSilk® Engine Treatment is process compliant under ISO 14064 as the only engine treatment to qualify for carbon offsets or credits due to less fuel consumption and green house gases.



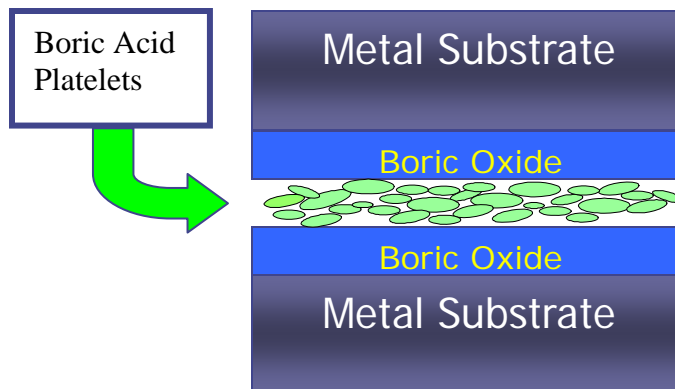
Boron CLS Bond™ Technology in MotorSilk® Engine Treatment

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

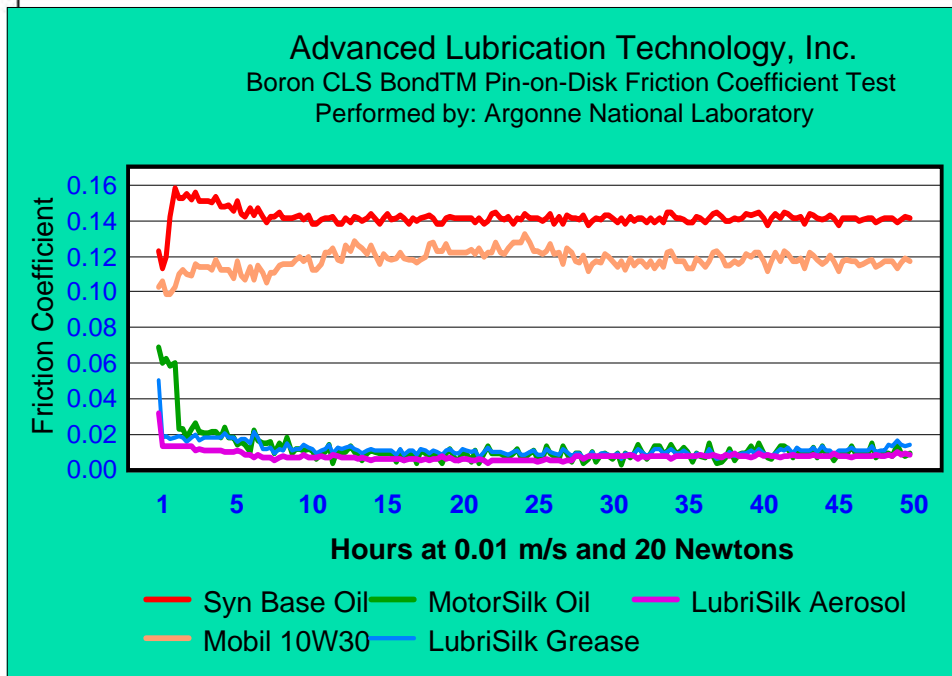
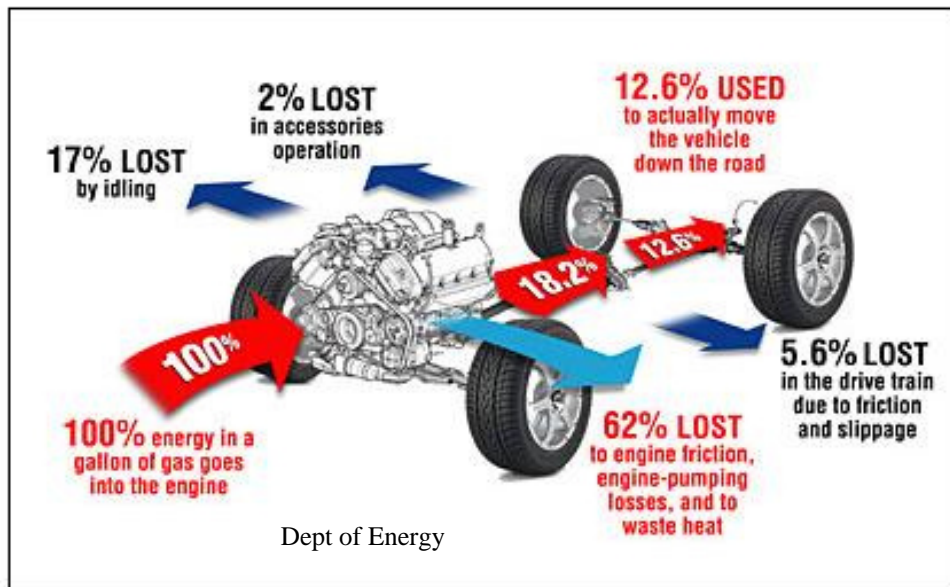
- Boric acid is introduced to a metallic substrate in the presence of water vapor. Interaction between the substrate, the water (H_2O) and Boric Acid (H_3BO_3) forms a continuously self-replenishing film of boric oxide (B_2O_3) that bonds to the substrate, forming a corrosion-resistant barrier.
- The 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.



Up To 1/2 The Worlds Energy Is Lost To Friction

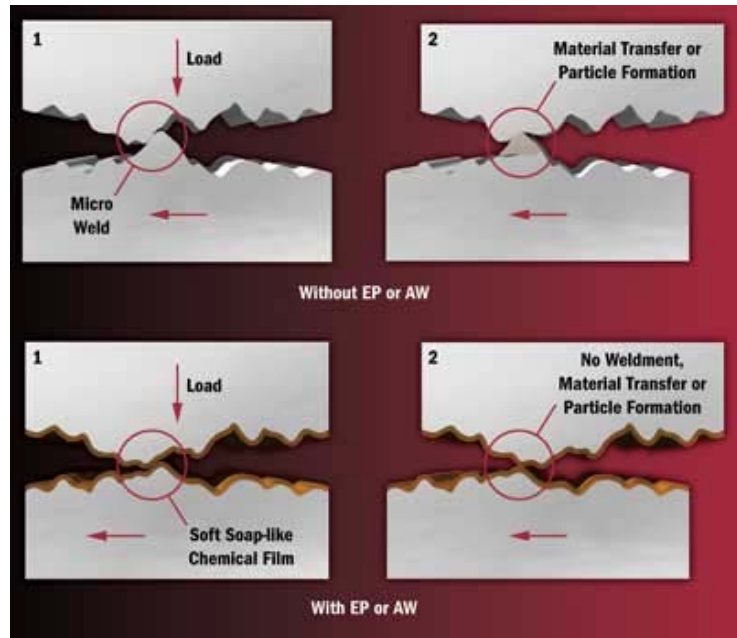
-Dept. of Energy

- Loss of horsepower or power in hydraulics
- Decrease in fuel economy
- Frequent oil drain due to fluid contamination and heat
- Accelerated component wear
- Increased emissions
- Rising maintenance cost
- Rising labor cost



Boundary Additives

- Intent of boundary additive powders are to form a boundary layer of molecules to prevent surface-surface contact
- Additives in use are Graphite, Molybdenum, Zinc, Phosphorous, Sulfur and over based Calcium Sulfonate
- The downside of most of these additives are their chemical reaction with metal and other contaminants such as moisture and oxygen causing them to become acidic and corrosive resulting in micro-pitting the metal alloy. They are also inert and do not form a covalent bond with the surface.



Over the years the field of Tribology has been researching for a solid boundary powder which could eliminate toxic powders and also not become acidic in reaction to the fluid system environment. Another goal was to develop a powder which would also act as lubricant, eliminate corrosion and at the same time act as an EP or AW agent. Argonne Tribology division under Dr. Ali Erdemir found the solution which is trademarked Boron CLS Bond™.

Key Components of this lubrication Technology

- **Boron:** Hydrogen Orthoborate (Boric Acid)
- **CLS:** A Crystalline Lattice Structure of boric acid platelets
- **Bond:** Platelets of macromolecular bound molecules renewed from boroxide covalently bound to the metal substrate



What We Look For in an R&D 100 Awards Winner

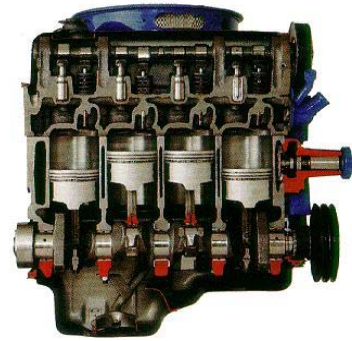
Over the years, we have been asked on numerous occasions: What do you look for in an R&D 100 entry? What makes a winner? Our reply is simple: **We are looking for the 100 most technologically significant products of the year.**



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



U.S. Patent #5,431,830
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MOTORSILK® ENGINE LUBRICATION

All engines both diesel and gas except 2 cycles

DESCRIPTION: (MSET)

MotorSilk® Engine Lubrication with *Boron CLS Bond™* was developed at Argonne National Labs under the Department of Energy based upon the Hydrogen Orthoborate technology. This is the only 100% reactive technology in lubrication available, all additives whether in the oil additive package or an aftermarket additive do not bond to metal alloy, they are inert. Once the Boron CLS Bond™ enters the oil it begins to form a covalent bond with the metal alloy penetrating all carbon, varnish or corrosion forming a near-diamond hard boric oxide surface protecting all vital working components against wear, friction and corrosion activity. This new surface also blocks oxygen to dramatically reduce the oxidation process of the lubricant. MotorSilk® is added to the crankcase at a 10-1 ratio – a 16oz bottle treats a 5 quart crankcase, this is not an oil conditioner and does not disrupt the oils additive package.

FEATURES/BENEFITS

- Up to 30% reduction in operating temperatures
- Reduces surface friction 80% (friction coefficient under 0.01)
- Reduces fluid system wear by 90% (Timken, Four Ball, Pin on Disk)
- Minimize fluid oxidation doubling the oil drain cycle
- Eliminates corrosion 100%
- Absorb shock loads (90+ Timken rating translates as a very high extreme pressure agent)
- Eliminates carbon and varnish





MORE POWER

- By reducing friction by 80%, an increased horsepower of a 6%-8% increase is realized as well as in blueprint engines a 2% increase is realized.

ECONOMY

- The Department of Energy claims that half of the worlds energy is lost to friction thus by reducing friction energy is conserved. Test results for fuel savings vary due to many variables. The average for gas vehicles is 2-4 more miles per gallon, for class 8 trucks 1 MPG is usually achieved.
- Achieving reduction in the PM cycle by half by doubling the oil drain cycle.
- Restores efficiency in older engines.
- Rebuilt cycles extended 2-3 times.
- Retreat every 100,000 miles.
- DuPont reported that maintenance is the single largest controllable expenditure.

ENVIRONMENTAL

- Biodegradable line of lubricants.
- Reduced emissions as a result of a more efficient fluid system requires less fuel while maintaining cleaner oil.
- Reduction of oil drains thus less oil dependency and less oil going into the environment.
- ISO 14064 process compliant for the reduction of greenhouse gases and eligible for carbon offset projects and carbon credits.

EXTENDED WARRANTY AVAILABLE

- A major insurance company performed an 18 month field test on 7000 vehicles operating with MotorSilk[®] engine treatment and realized a 37% reduction in claims on vehicles with an average of 93,000 miles. Offered was a 5 year or 100,000 mile warranty on vehicles up to 125,000 miles.





Specifications

Color—————Translucent white
Base fluid—————Full class #4 PAO readily biodegradable synthetic
Viscosity—————20w-50w
Flash point—————470F
Solids variant—————Boron (60,000 ppm)
Timken load—————90+
DOT—————Unregulated
V.O.C.—————None
Friction coefficient—————Under 0.01
Readily biodegradable—————Yes
ISO 14064 approved—————Yes
Packaging—————16oz, 32oz and 55 gallon drum

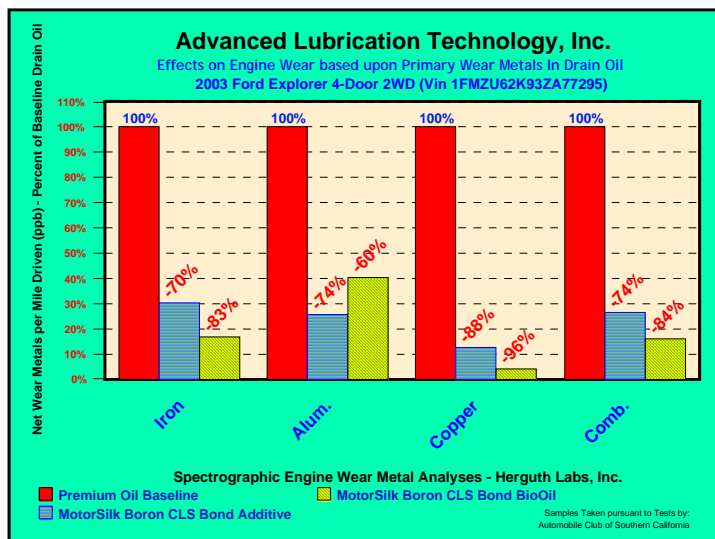


OUTSIDE LABORATORY TESTING

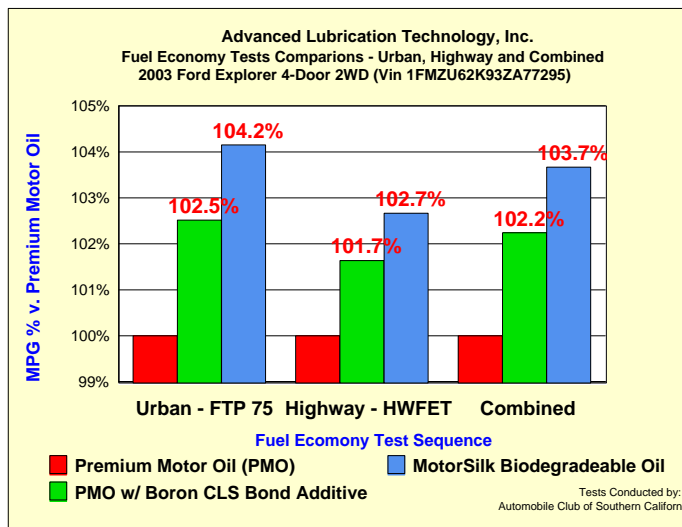
- Argonne National Laboratory, Argonne, IL
- AAA of Southern California, Diamond Bar, CA
- BNM Research, Stockholm, Sweden
- Chevron Laboratory, Vallejo, CA
- Herguth Laboratory, Vallejo, CA
- PDM Research Center, University of Oakland, Detroit, MI
- Southwest Research Institute, San Antonio, TX
- Saybolt Laboratories, Inc. Los Angeles, CA
- T&L Engine Development, Midland, NC
- Van Dyne Engineering, Huntington Beach, CA
- Technion, Israel Institute of Technology, Haifa, Israel
- Bolt Science, Lancashire, United Kingdom

Tests performed at Herguth Labs, samples taken by AAA of California

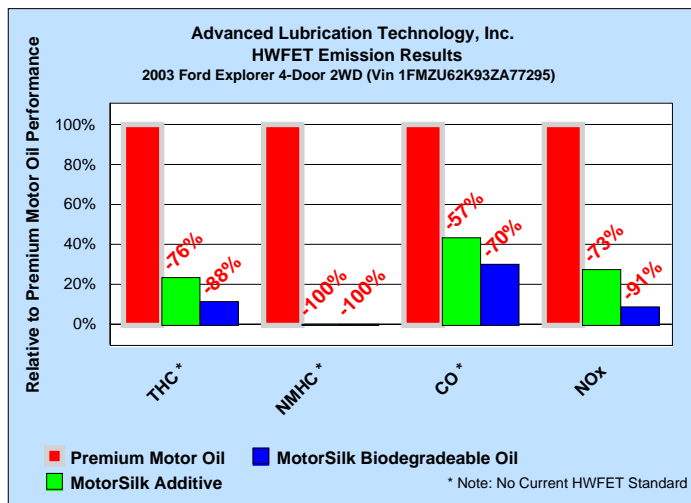
WEAR



FUEL ECONOMY



EMMISSIONS



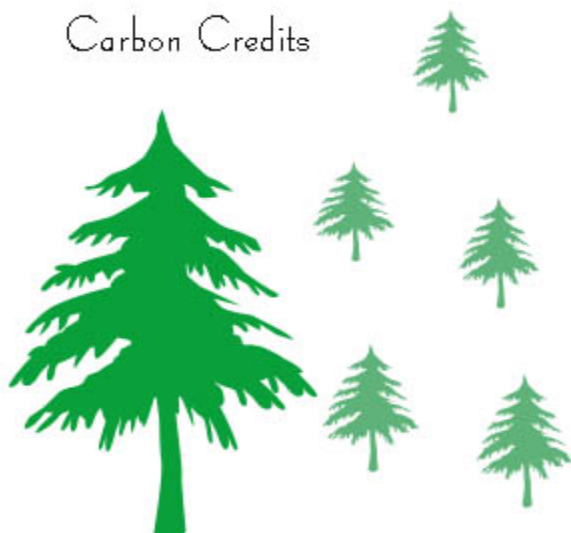


Carbon Credits and How They Work:

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.



The Israel Institute of Technology (Technion) is home to many Nobel Prize winning Scientists and is considered one of the foremost testing and research centers in the world and is 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. 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 NO_x concentrations in the exhaust gases, more pronounced reduction of NO_x 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.



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.