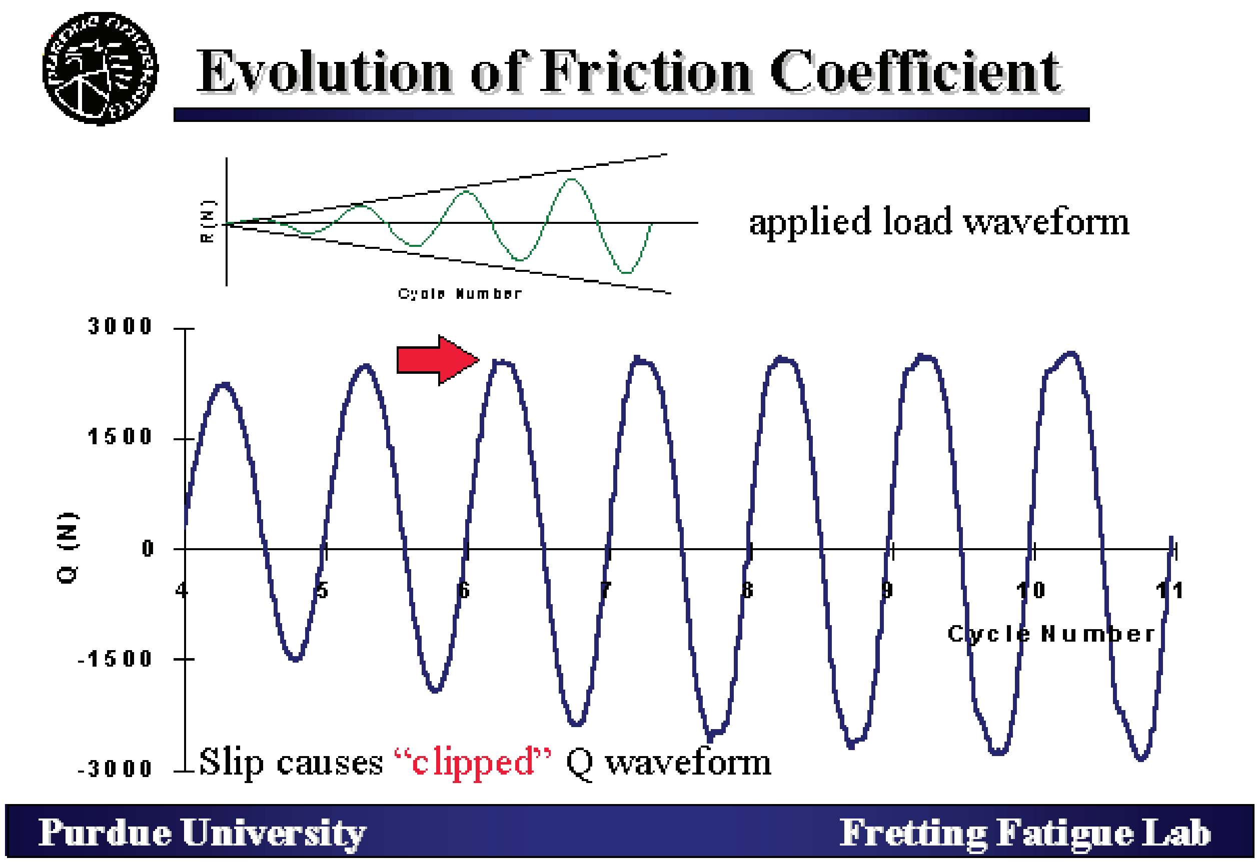


WINNING THE WAR AGAINST FRICTION

By Steven W. Colford

Friction: the resistance to relative motion between two bodies in contact

As much as half the world’s energy production is lost to engine friction, with an estimated $100 billion of that loss suffered in the US alone. In real terms, that’s about how much Americans will spend this year to purchase new automobiles.

Weather it’s one of the nearly 125 million automobiles currently in use in the US, the 11 million boats, or the incalculable number of industrial engines, turbines, and motors, there’s no shortage of potential victims for the inexorable assault by engine friction, wear, and corrosion. So great is the cost of friction, in fact, that engine manufacturers and owners since the Industrial Revolution have invested

Untold money and imagination trying to reverse, or at least arrest, the corruption of time and usage. Oil was the initial answer, with numerous later attempts to improve on its lubricating quality. At various moments in history that included the addition of sawdust or molasses, then more technologically sophisticated additives such as graphite and molybdenum.

The real revolution in anti-friction formulas began in the late 1970's when Teflon-based additives arrived in the engine treatment marketplace. Trying to parlay scientific advancements connected to NASA and space flight, petroleum marketers came up with the first of several engine treatment formulations based on PTFE (polytetra-fluoro-ethylene), or Teflon.

Teflon discovery launched $250 million engine additive market, even after DuPont discounted its effectiveness.

Never mind that DuPont, developer of Teflon and principal beneficiary of its many validated applications, warned that there was no proof of Teflon's ability to reduce engine friction and prolong engine life. So great were DuPont's apprehensions over the rampant claims for PTFE-based engine additives that in 1981 the chemicals giant forbade the use of Teflon in such additives. In 1991, DuPont reconsidered its 10-year old ban, though it continued to warn that verifiable proof of the effectiveness of PTFE-based engine additives remained unestablished.

Nevertheless, the public accepted the slick claims of the marketers of Teflon-based additives, eagerly anteing up to $250 million a year in hopes that the additives could do something—anything— to rejuvenate tired engines and prolong useful engine life.

Feeding the notion with claims of dramatically improved performance and longer engine life were the marketers of Slick 50, STP Oil Treatment, and T-PLUS; these are the best selling engine treatments, and all are PTFE-based.

While they and their many imitators contend that rigorous test results support their product claims of improved engine performance and longer lifetimes, issues of polymer breakdown, particle size, and flocculation dog these products. Benefits seem to be short-lived or based on multiple treatments. It is noteworthy that the impartial Consumer Reports, in its July 1996 report on motor oils and engine treatments, said: "We found no discernible benefits from any of these products."

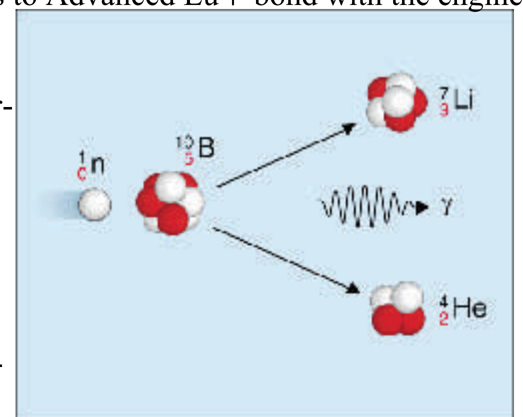
Chance discovery by research scientist pointed to a breakthrough for boron

But that blanket disclaimer was written with PTFE-based products as the target, not boron-bases products. And it's boron-specifically, hydrated boron– that ultimately may be the key to longer engine life. Comparisons with PTFE have given the nod in almost every key characteristic to hydrated

Boron-its particles are smaller, it's less dense, disperses relatively easily in oils, and, in tests, has shown measurable effects on engine wear.

In 1990, Dr. Ali Erdemir, a research scientist at Argonne National Laboratory near Chicago, serendipitously found that hydrated boron Possessed remarkable, potentially unprecedented lubricating properties. So significant was this initial discovery of Dr. Erdemir that he won the prestigious national Industrial Research R&D 100 award in 1991.

In 1995 Argonne's business development affiliate, ARCH Development Corp., granted exclusive rights to develop, produce, and distribute boron products to Advanced Lubrication Technology of Encino, CA. ALT's boron-based engine additive, Motorsilk with Boron CLS Bond already has been nominated for a 1997 Industrial Research R&D 100 award for commercialized products. To date, two boron-based lubricants have been introduced by ALT. Lubrisilk, a Boron grease, and Motorsilk with Boron CLS Bond. Based on their initial showings, both hold promise of defining an entirely new—and unlike their predecessors, effective– product category of lubricants.



The only similarity between CLS Bond and other treatments currently available in the marketplace is that all are added to engine crankcases. After that, all similarities seem to end.

Birth of a new generation of super lubricants

Unlike Teflon products, new lubricants made with the CLS Bond properties are boron based. The key ingredient is hydrated boron, a nonmetallic element that occurs in nature only in combination form. Also known as sassolite or borofax, molecular hydrated boron is super slippery. Ultra fine particles are reduced to less than 1 micron (.000039 inches) by a revolutionary jet-milling process at sub-zero temperatures. The submicrometer hydrated boron particles can invade microscopic spaces and actually chemically BOND to metal surfaces.

The capacity to bond to moving engine parts is a basic claim of most engine treatments, but the facts, as delineated by the Argonne National Laboratory, suggest otherwise. Teflon-based engine additives can adhere to metallic surfaces, they can coat metallic surfaces, they can even form a skin over metallic surfaces, but, because of PTFE's inherent chemical inertness, they can not chemically bond with the engine parts they purport to pro tect. Motorsilk with Boron CLS Bond, on the other hand, actually forms an interatomic chemical bond with surfaces of moving engine parts.

"The main difference with Teflon is that Teflon is inert and simply cannot bond to anything." said William Olliges, Co-developer of Motorsilk and vice chairman of ALT. "On the other hand, boron has covalent and ionic and hydrogen bonds in its crystal structure, which means it can actually form a bond with metals."

The layered, crystal lattice structure (CLS) of boron is the key to its lubricating effectiveness. While the bonding within individual crystal layers is powerful, the bonding from layer to layer is weak, allowing the layers to slide over one another with minimal friction.

The most commonly invoked and illustrative analogy is a deck of cards; while a full deck is highly resistant to perpendicular pressure, the individual cars glide against each other when lateral pressure is applied. Strong interatomic bonding and rigidity of layer prevent direct metal-to-metal contact, thus inhibiting wear damage and corrosion. Those metal to metal contact points are where lubrication is needed, where not only extreme pressures are created but also where significant energy is lost to friction, deformation, and vibration.

Independent testing heavily favors boron technology

Testing by Argonne and independent Falex Co. show dramatic improvement over the supposed benefits of PTFE-based treatments. Repeated laboratory tests showed that the CLS Bond boron product reduced friction by 30%-50%, and wear by 50%-90% depending on the concentration and application conditions. Fuel efficiency improved 8%-12%. The coefficient of friction afforded by CLS Bond boron is one-sixth that of Slick 50, and its wear performance is 11 times better.

Even draining an engine crankcase after adding CLS Bond boron will not attenuate the additive's effectiveness; it's already formed a chemical bond with the metal surfaces. Thus a single treatment will last an engine lifetime, even if the crankcase is completely drained and refilled with regular oil.

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Undersea tests show advantages

In addition to improved engine efficiency and longevity, CLS Bond boron scores environmental points because it reduces emissions, improves gasoline economy, and is biodegradable. And, unlike PTFE-based treatments, there's no hazard potential for toxic gases.

Given their superior lubricating properties, boron-based additives should improve the lot of more than just engines; other kinds of moving machine parts, such as ball bearings, gearboxes, compressors, mechanical seals, transmissions, and various pump systems also can benefit through the increased durability, longevity, efficiency, and smoothness that boron can impart.

In addition, laboratory tests have proven hydrated-boron-thickened grease can lower friction by factors of two to three below what's feasible with existing grease products. Such products can be used to lubricate automotive wheel bearings and chassis for reduced noise and increased longevity. To date the only such product in the market is Lubrisilk.

"Lubrisilk is by far the most advanced grease product that works similarly in principle to Motorsilk Boron." Olliges said. "We've sold it to customers who use it for deep wells, especially gas, in undersea waters. It's used between joints, where sea swells will break greases down. Sea water washed out other lubricants every time."

A form of Motor Silk also could be prepared as a low viscosity, general purpose household lubricant for door locks and hinges, sewing machines, power tools, and the like. Its use indoors is all the more likely because it lacks the toxicity of PTFE-based treatments, thus paving the way for its further applications to robotics arms, servos, solenoids, and computer disk drives.

Potential applications for a proven friction fighter like hydrated boron are virtually limitless; so, too, appears to be the future of CLS Bond boron as it emerges from the shadows of its predecessors and steps to the forefront of a whole new category of engine treatments and lubricants that offers something novel—the capacity to live up to its claims.

Steven W. Colford is a business writer in Raleigh, NC.