The Synthetic Revolution

Technical Topic

Are synthetic lubricants magical? Why are they so popular? Why should I pay more for synthetics? This article explains some of the key features of synthetic lubricants that can contribute to increased productivity of industrial equipment.

Synthetic Oil Properties Relation to Energy Savings

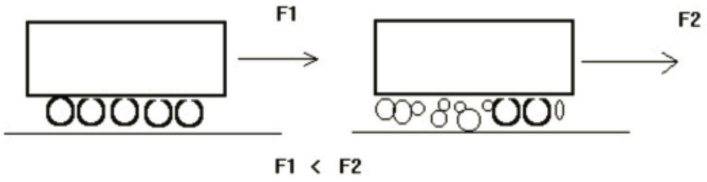
Crude petroleum, commonly referred to as crude oil, or more simply crude, is a complex mixture of hydrocarbons. While crudes from different sources vary in chemical composition, they all possess the same basic elements. Light gases, such as ethane, methane, butane and propane, are removed by atmospheric distillation. Gasoline and other fuels are also distilled from the crude leaving residuum, from which, mineral lubricating stocks are derived. A variety of sophisticated refining techniques are used for the removal of undesirable components such as asphalt, waxes, and sulfur compounds.

What remains is a lubricating oil base stock, which, despite the degree of refinement, still contain organic compounds of oxygen, sulfur, and nitrogen as well as small amounts of inorganic substances. The point being made is this: there are virtually thousands of compounds present in crude oil and some will remain in lubricating oil stocks.

In contrast, synthetic products are produced by chemical reactions in which pressure, temperature, and the ratio of component elements are carefully controlled. This results in a pure compound with maximized properties and uniform molecule size. Due to the controlled manufacture of synthetic base oils, a very uniform molecular size is achieved. This uniform molecular size reduces the traction coefficient of the synthetic lubricant. The traction coefficient of a lubricant is defined as the force required to move a load divided by the load. The coefficient represents the ease with which the lubricant film is sheared.

Due to their uniform molecular size, when compared to mineral oil molecules, Mobil™ synthetic lubricants have up to a 30% edge over mineral oils when measuring the traction coefficient. A simple analogy would be to compare moving a load over many marbles.

The uniform sized marbles distribute the load evenly. The force needed to move the load is less. While this analogy between oil molecules and marbles is primitive, it illustrates the point well. Less force relates to less energy input to perform a given amount of work.



We can carry this concept to a typical industrial gear reducer. In the gear reducer, the gear teeth slide across each other during operation. The lubricant in the tooth mesh is sheared, and as in our analogy, the lower the traction coefficient, the lower the energy dissipated due to lubricant shearing. Differences may be observed by both lower amperage draw on the electric motor and reduced lubricant/gear temperature. Tests have shown that switching to a low traction synthetic oil reduces power consumption in a spur/ helical gear by 0.5% for each reduction, and up to 8% for high reduction worm gears.

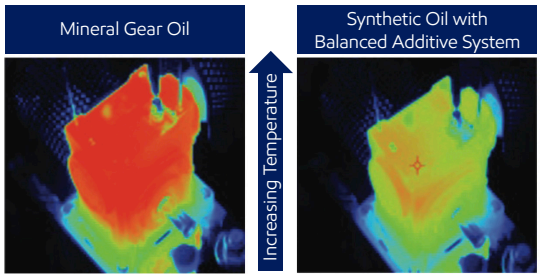
Mobil SHC™

Documenting Efficiency in Gear Reducers

In a gear box, energy is consumed either through work (movement) or through heat. All heat produced is equivalent to an energy loss. As a result, when the temperature of a gearbox is reduced, less energy is wasted and the motor requires less energy to produce the same amount of work. This effect has been well documented both in the laboratory and in field applications.

The following thermographs show the dramatic impact of synthetic lubricants in a worm gear reducer. The efficiency of the gear box is increased by 2% while oil sump temperature is decreased by 13oF. Lower temperatures and increased efficiency can translate to reduced operating costs and longer component life.

Synthetic vs. Mineral Gear Oil
Thermographs of gearboxes



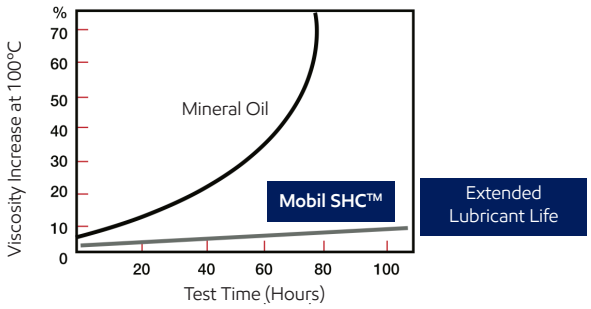
Tested using the Mobil™ Research modular small worm gear test stand.

Extended Oil Life

The following graph demonstrates the oxidation stability of a Mobil SHC™ fluid compared to standard mineral oils. This graph is representative of a pure synthetic oil. Semi-synthetics are not expected to have similar results. Higher oxidation stability means longer life under even the most severe operating conditions. Longer oil life also equates to less maintenance, lower labor costs, and less downtime. All factors which can directly impact your maintenance budget.

It is not uncommon for the Mobil SHC™ synthetic gear oils to last as much as three to four times longer than a conventional mineral type gear oil. Extending drain intervals will reduce the amount of waste oil and directly affect the amount of money spent on lubricants each year.

High Temperature Protection - Less Oxidation

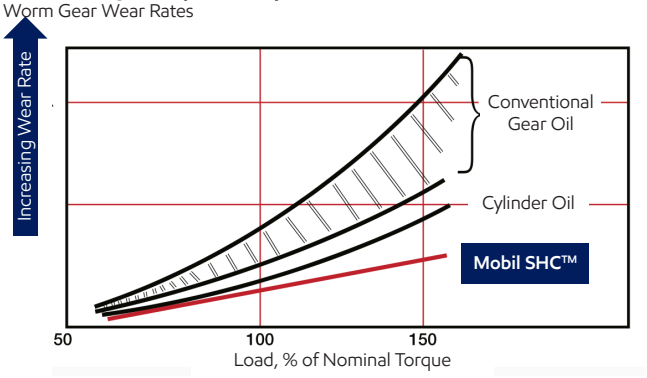


Comparison of Mobil SHC™ versus a mineral oil in oxidation stability testing.

Extended Equipment Life

The following graph demonstrates the ability of synthetic lubricants to better protect your plant equipment. Using Copper wear metal as a baseline, this information shows that the synthetic gear oils provide superior protection, even under overload conditions.

Excellent High Temp Viscosity - Prevents Wear
Worm Gear Wear Rates



Tested using the Mobil™ Research worm gear test rig.

While the gearboxes in your plant may not operate under these conditions, we can equate this superior protection to extended component life. Longer component life means lower maintenance and replacement costs and less unexpected downtime.