

A proactive approach to reducing industrial power consumption

Implementing synthetic lubricants can go a long way toward increasing energy efficiency and performance

Taking an aggressive approach to reducing the power consumption of industrial systems requires putting a strategy in place that extends equipment performance, reduces heat and minimizes friction loss. Studies reveal that energy reduction can be achieved by incorporating efficiency technologies and practices such as proper machine design, usage and maintenance that decreases the cost of system ownership.

Specifically, the use of proper lubricants enhances machine investment and ensures critical applications run at peak performance. The challenge to finding the right lubricant product has been made simple with the advent of synthetics and their additive technology customized for a myriad of applications and environments. Users are achieving significant results including product quality and energy savings — which eventually attribute to greater profitability.

Defining energy efficiency

$$E \text{ (energy)} = W \text{ (work)} + Q \text{ (heat)}$$

Achieving energy efficiency occurs when machinery output is maximized. Effective operation of pumps, compressors, fans, blowers or other industrial equipment and components is reached when the maximum amount of work is achieved vs. the total energy put into the system (i.e., minimize losses due to heat and friction). Common energy inefficiencies result from overworked machines running at increased speeds, friction or at high operating temperatures causing overheating or breakdown. While identifying these challenges is simple, without the right lubrication product in place industrial plants will continue to face production hindrances and take longer to realize investment payback.

Comparative lubricant studies have shown that power inefficiencies result more often when mineral-based lubricants are employed and defined through such characteristics as fluid churning or friction wear. Other drawbacks of mineral-based products are witnessed through higher operating temperatures, increased need to relubricate components or even outright component replacement. Over time, these issues not only increase the amount of energy being released but drive down the efficiency rates of production, potentially diminishing profitability.

Alternatively, synthetic lubricants, used throughout numerous industries, bring benefits ranging from reduced temperature, rust and corrosion prevention and fewer change outs. Synthetic lubricants ultimately increase efficiency levels while reducing the amount of power needed to maintain consistent processing.

For example, lubricants engineered to withstand extreme heat are measured by their ability to lower machinery and component operating temperatures. These positive effects not only lessen heat loss, they also prolong bearing and gear life through optimization of machinery performance and by mitigating production interruption. Such benefits translate into overall cost savings while reducing the energy needed to achieve the same work output.

Along with using the right synthetic lubricant, making sure equipment operates within its specified design range minimizes mechanical dysfunction and downtime, helping to gain efficiency. Other tactics are turning equipment off when it is not in use, cutting down work shifts and implementing electronic controls that put machines into an energy-conservation mode.

Maximizing performance

Fully understanding a plant’s operation and using the right tactics lets manufacturers stay ahead of the power efficiency curve for a variety of applications (i.e., pumping, mining, power generation, etc.) that require gas and electricity power. A first step in reducing the total cost of equipment ownership is met by employing the right equipment for the job and realizing one size doesn’t necessarily fit all.

For example, when a company uses a pump that produces 100 gallons of water per minute, while needing only 20 gallons, they’re far off the efficiency curve. Here conservation can be achieved by buying a smaller pump. Other industrial equipment challenges may be simply resolved by resizing a belt or motor. And using a properly sized rotary-type air compressor can significantly decrease energy vs. a reciprocating compressor requiring storage and surge tanks to achieve constant pressure.

Companies also extend their machine investments by applying energy-reducing lubricants that decrease wear and help mitigate the need of full-out replacement. In the case of a ball-milling operation that made the switch from a mineral-based oil to a mining-specific synthetic, this is exactly what happened. In fact, implementing the non-asphaltic product attributed to longer pinion gear life, decreased instances of failure and reduced friction resulting in an estimated \$30,000 per year savings in overhead. Non-direct energy savings occurred from the lubricant’s excellent cling properties, which quickly formed a protective coating that actually cools equipment.

Table 1: Synthetic and mineral-based gear lube: effect on efficiency

Synthetic versus mineral oil at 75% load capacity

Temperature, °C	Mineral Base Efficiency %	Synthetic Efficiency %	Delta (Δ) Increase in Efficiency
20	88.2	89.8	1.6%
30	89.2	91.1	1.9%
40	90.0	92.1	2.1%
50	90.7	92.8	2.1%
60	91.2	93.4	2.2%
70	91.5	93.7	2.2%

Table 1 represents the reported energy improvements of gears when utilizing a synthetic lubricant. The chart provides a side-by-side comparison of synthetics and mineral-based lubricants over different temperatures at constant load. As temperature increases, the benefits of a synthetic lubricant are enhanced.

Economics of synthetics

Choosing a synthetic over a mineral-based oil maximizes energy efficiency as the initial investment proves to be far less than the cost of energy down the line. When synthetics are tested in controlled experiments, they have shown a 1% to 8% improvement in energy conservation on average over mineral oils. This is due to the fact that synthetics provide a proprietary chemical makeup that protects itself from formula depletion, thus extending the effective life of the lubricant.

Chart 1 shows energy savings through the testing of a natural gas compressor applied with a synthetic lubricant and varying working loads. The findings highlight diminished natural gas consumption of engines and the rate of exhaust oxygen. Chart 2 shows the comparison of worm gears tested with synthetic and mineral-based lubricants at a 75% load, indicating a 2% to 3% energy improvement from use of the synthetic lubricant.

Chart 1: Integral natural gas compressor

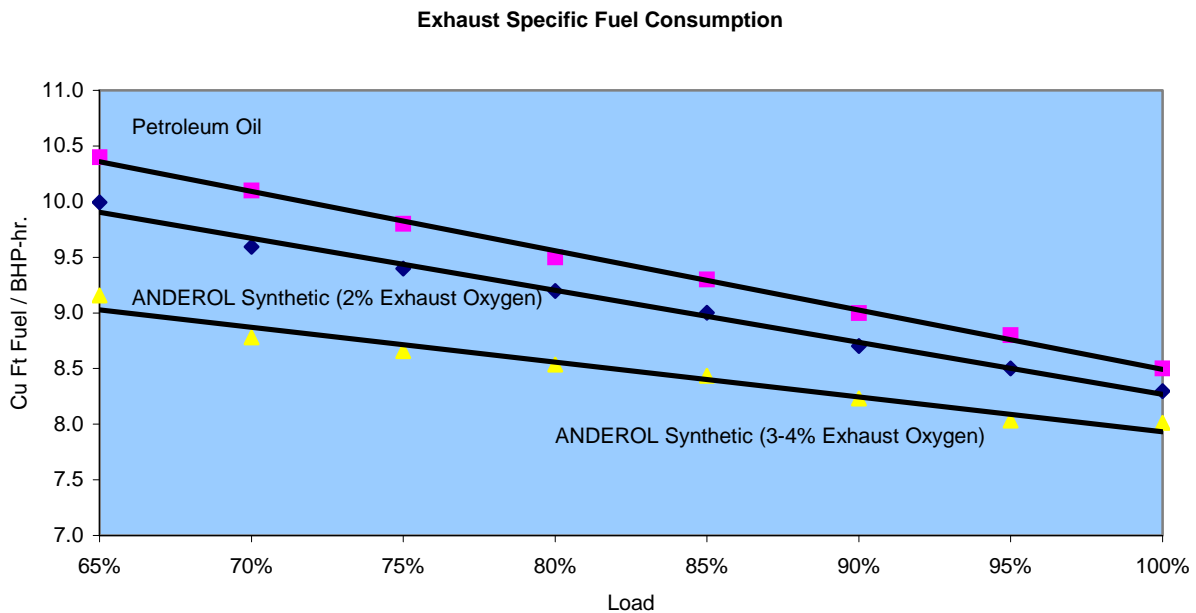
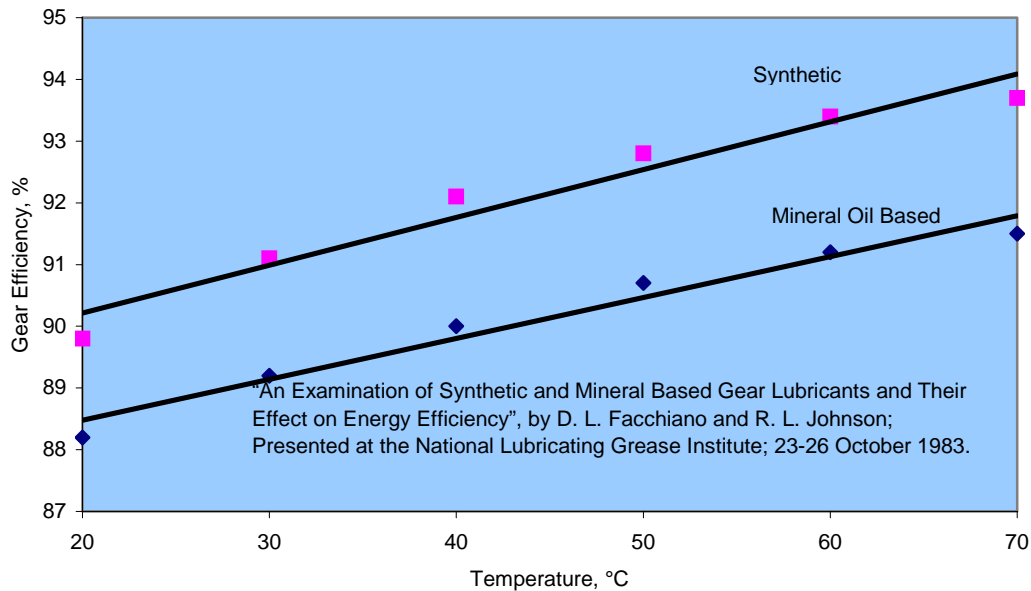


Chart 2: Worm gear efficiency improvement

Fluid Comparison - Synthetic vs. Mineral Oil
ISO 220 Lubricants at 75% Load



Due to the performance capabilities of synthetics, companies operating in extreme hot or cold environments also achieve increased energy efficiency. At a recent trial 12 pump jacks in Canada at bitter temperatures down to -51°C (-60°F) gained a 14% reduction in energy consumption from the product's low viscosity and pour point. Other benefits include extended gear performance by the elimination of friction, reduced start-up torques, lower amperage draw and improved lubricant pumpability. Furthermore, the formulation minimizes downtime, prevents premature wear and requires change-outs after five years, supporting decreased lubricant use.

Lubricant technology

Choosing a lubricant with the right balance of base oil and additive chemistry is the best way to reduce power consumption. Investment in synthetic technology reduces power consumption, labor costs and equipment downtime for companies that understand the benefits of synthetic lubricants. Specifically, energy-savings directly result from the engineered lubricants that meet a myriad of industry-oriented applications.

In comparison to mineral oils, synthetics in field trials consistently show higher efficiency levels and improved machine operation because of the ability of a synthetic to maintain its original properties longer. Synthetic lubricants include antioxidants for reduced oxidation byproducts and extreme pressure additives for components needing to withstand heavy-loads.

Gears operating with polyglycol-based lubricants (PAGs) experienced less friction decreasing power loss. This result is directly related to the lubricant's superior viscosity characteristics, fluid density and high molecular weight. Assessment of polyalphaolefin (PAO) and PAG gear oils on cylindrical gears revealed less churning losses at low temperatures and less gear erosion, helping to eliminate costly maintenance. Table 2 summarizes the application testing of a 60-hp gearbox,

lubricated with a synthetic as well as a mineral oil product. The conclusion favored the synthetic, which yielded a 7.5% annual power savings.

Table 2: Energy savings using a synthetic lubricant versus mineral oil

Power Use Calculations	Factor	Costs based on Use of Synthetic	Baseline Mineral oil
Unit horsepower		60	60
Divide by efficiency (synthetic)	0.92	65.2	----
Divide by efficiency (mineral oil)	0.85	----	70.5
Divide by Power factor	0.773	84.4	91.2
Convert hp to kWh	0.7457	62.9	68
kW per day	24	1509.9	1632
kW per Operating Year	260	392,584	424,320
Annual Cost of Power	\$ 0.06	\$ 23,555	\$ 25,459
Annual power cost savings		7.5%	

Summary

Cost-efficiency occurs when machinery increases output without increasing the amount of input energy used (i.e., maximize work by minimizing losses due to heat and friction). This situation permits industrial companies to quickly recoup machinery investment, reduce overhead expenditures and enjoy larger profit margins. The key to reaching this efficiency is making sure the right equipment is used to meet production goals. Also important is incorporating a lubrication strategy that reduces energy consumption.

Use of synthetic lubricant products initiate energy savings mainly as a result of additive technology that is customized to meet a variety of extreme processing environments, which ultimately drives down the cost of doing business. Together the right practices and technology will bring industrial companies greater profitability by maintaining equipment performance while conserving energy resources.

For further reading

1. Facchiano, D.L. and Johnson, R.L., "An Examination of Synthetic and Mineral Based Gear Lubricants and their Effect on Energy Efficiency," Presented at the National Lubricating Grease Institute. Oct. 23-26, 1983.
2. Gerber, A.F. (Aderol Co., Inc.), "Gas Engine Lubricants—Synthetic V. Petroleum," Presented at the A.G.A. Transmission Conference. May 4-6, 1981.