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Keith Hooper   Technical Sales & Support Engineer at Kluber Lubrication

We use **energy monitoring** devices such as the Fluke and E-Tracker which measure energy consumption to run comparitive trials on the two oils under the similar conditions. This gives you a fairly accurate measurement of the energy consumption of the two oils. If you do not have such devices then a drop in temperature is also an indication of less friction and therefore less energy consuption.

Dolf van Asbeck   Technical Support Engineer at Shell Global Marine Products Ltd

From the customer's financial management perspective, changing the oil should be the last consideration.
From your perspective as a supplier, you need to make the customer aware he probably has much bigger losses than oil-related pumping losses, that are more easily addressed, if he has the will. A customer will get better cash-on-cash returns by understanding and fixing the major existing energy losses than changing to energy efficient oils and doing nothing else.
Remember that the customer may agree with your test results, but the gains are relatively small and he won't notice them in his energy bill, unless he has a comprehensive energy management plan, and perhaps not even then. At this point he rightly gets upset with you for selling an expensive solution that is not working for him in a measurable way.
We have observed that EE oils are a cost effective option for large volume oil systems that have long service life. Say greater than 2000 - 5000 litres, and perhaps even as much as 10,000L, working 24hrs/day.
The first step: A comprehensive energy management plan must be in place. They must understand the energy use of the plant and gain better efficiencies by implementing the recommended improvements. This includes knowing the power demand of the systems the are considering changing to EE oils.
The second step is to consider the maintenance philosophy. The plant management and operators need to be proactive in their maintenance plan. For the lubrication requirements that means to have decided on, and set, oil condition parameters and actively work towards maintaining the oil within them. NOT waiting for a negative oil analysis before doing something about it.
The third step is to assess the lubricants in use. Use the minimum (optimum) viscosity the application requires to reduce the viscous drag and pumping losses.
- This infers greater monitoring to ensure they have it right
- It infers the plant may have more grades on site than in the past where the viscosity variations were minimised ('rationalised' is a favourite word here) for reasons of cost control and minimising top-up errors.

The fourth step is to re-assess the cost and benefit of using a synthetic like PAO or PAG. These provide greater **film strength** for the same viscosity than mineral oils, and the PAG less pumping losses for the same viscosity compared to mineral or PAO. They come at an increased cost.
Therefore your customer's accountants have to balance the total cost of ownership and decide what mix of practices suits them best. Your role in this is to partner the decision. Avoid forcing a sale. Any subsequent disatisfaction will reflect upon you and your company, not themselves, if they feel they were over promised and oversold.

Viscosity retention as an indicator of **film strength** (1/15)

Viscosity is a measure of a fluid’s resistance to flow. Most used oil analysis laboratories report the measure as kinematic viscosity in centistokes (cSt) at either 40°C or 100°C. ExxonMobil examined over 38,600 data points and found that 96 percent of the readings were within viscosity range for the fluid used.

Furthermore, an in-depth look at 25674 samples found that there was no oxidative thickening or shear over time, suggesting that the lubricant stayed in viscosity grade throughout the reported service. This confirms that Mobilgear SHC XMP 320 is able to maintain film strength and provide excellent wear protection throughout its service life.
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Machinery maintenance in process plants uncovers a seemingly endless variety of lubricated component failures. Frequently it appears that the lubricant or the lubrication mechanism contributed to these defects and failures. A closer look, however, often reveals that the lubricant is seldom at fault if good lubrication practices have been observed.

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Wear failures differ from many other types of failures, such as fatigue, because wear takes places over a period of time. Seldom does the part suddenly cease to function properly. In most instances, wear problems are solved by two approaches: the service conditions are altered to provide a less destructive environment, or materials more wear resistant for the specific operating conditions are selected. Because the latter method is easier and less expensive, it is chosen more frequently.

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Mark O'Brien Lubrication Excellence Champion

You always begin with the basics then add any information for special conditions. Start with L.E.T.S., Load - Environment - Temperature - Speed

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What is the first indication of Lubrication starvation?

Gerald L. Munson, CLS Managing Partner at Fluid Assets, LLC Sr. Partner at McCormick and Munson, LLC

Comments from the Old School: The first clue for me, after 60 years of tearing rotating equipment apart is the sound. Something tells me that something is wrong. In the Modern plant My first tool is a very long or rod to use as a stethoscope to attempt to see where the noise is coming from, then look at the instruments. Works for me.

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Machinery movement and thermal growth are two of the main issues that affect operation and life of machinery

http://www.ludeca.com/training_crash-course-thermal-growth-video.php

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The pour point is the lowest temperature at which an oil will flow. This property is crucial for oils that must flow at low temperatures. A commonly used rule of thumb when selecting oils is to ensure that the pour point is at least 10 degrees C (20 degrees F) below the lowest anticipated ambient temperature.

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Helene Villemure Technical Specialist, Seals and Sumps
Your **friction coefficient** is an indirect measure of how much energy is converted/degraded into

heat, of your total kinetic energy in the sealed joint.

Your **traction coefficient** is one level more precise if you would, as it looks at the proportion of the kinetic energy in the sealing system that translates into mechanical torque. Your mental mapping of this property would be somewhat similar to that of a stagnation pressure; it is a measure of the conversion of diverse kinetic energies into directly applicable torque.

Jean-Michel Demaret   Technical Expert , Concentrating Mill Maintenance at PT Freeport

Satya, the traction coefficient could be described as the coefficient of sliding friction between hydrocarbon molecules moving over each other in an elasto hydrodynamic mode of lubrication. Under hertzian pressure the voids between molecules disappear and the molecules slide over each other.
The friction coefficient is the ratio between the tangeantial force and the normal force during sliding of 2 material over each other.

toby taylor   Consultant Tribologist at MT.TRIBOS

Traction Coefficient is better described as the pressure coefficient of viscosity in which Jean -Michel describes its physical condition within an elasto hydrodymamic mode. Traction Fluids which effectively become an almost glass like fluids when put under such extremely high pressures to effectively be solid hence creating a traction drive . A good practical example is hydraulic fluids when under the high pressures its effective viscosity at atmospheric pressure is much higher as the pressure increase hence the need to check its pressure coefficient for the temp and actual working pressures the fluid is subjected. Traction Fluids use this physical increase to almost solid state to act as a drive mechanism. **Duponts santotrac** is such a material that is used in fluid drive mechanisms.

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Jean-Michel Demaret
An empirical formula which I am using is

p1, v1 percentage and viscosity of oil 1
p2 v2 percentage and viscosity of oil 2
Vr viscosity result of the blend
Ln Logarithm
p1+p2 = 1

$p1 * Ln(Ln(V1+0.8)) + p2 * Ln(Ln(V2+0.8)) = Ln(Ln(Vr+0.8))$

Results give a value similar to John's link. If you are handy with Math you can get the reciprocate formula to find V2 knowing V1 and Vr (many exponential) and apply it on Excel

These formulas work well when the viscosity of the products are in the same order of magnitude (for example blend of ISO VG 220 and ISO VG 460). When mixing a 30cSt and a 10,000 cst I fear that the results of these formulas won't be accurate.

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Propylene glycol is non-toxic and can be used in the food processing industry.

With time all equipped wears off but how fast and slow is the issue. Polish wear can contribute to premature failures , polish wear is not steady wear with time only or wearing off the large asperities .
Many factors contribute to polish wear in equipment, Poor filtration control(quality of air filters of and oil filters) of contaminants in queries and deserts the finer dust is a accelerator of polish wear, soot helps accelerate polish wear. Corrosiveness also leads to polish wear a little too aggressive S/P additives or overdosed formulation in gear oil will give you shiny gear tooth, misalignment in gears and bearing have shown polish wear. It is not always contributed by wear particles of the equipments only although it does contribute, there are contributors as well. Wear is a complex phenomena so no one simple reason for it but the most applicable probable cause are reviewed.

With modern machining process and tools, we do get an nice surface finish eliminating or minimizing the break in period especially in automotive engines. Giving more even and finer asperities which helps reduce the wear rate.

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Seal compatability tests are quite simple. You can do a volumetric swell test based on seals weighed in air and weighted suspended in water, allowing for buoyancy constants so that you get the seal volume. Reweigh them after immersion and I would be looking for +2 to +6% swell with a loss in hardness of no more than 8 degrees Shore 'A' hardness. If the seals swell too much you get binding and tearing of the seal and if the seal softens too much you get the seal rolling in the groove and loss of sealing. Seal shrinkage is a possible issue with synthetic fluids such as PAO and just creates leaks. If you can find a copy, the old UK National Coal Board test NCB 463:1981 is a good start on seal testing.

Generally, High Carboxy Nitrile Rubber (Buna N), PTFE (Teflon) or Fluoroelastomer (Viton) are pretty much compatible with most oil and water-based systems.Composite seals (e.g. nitrile impregnated woven cellulose) are best avoided in my opinion.

By David Stevenson

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Traction is the resistance force to shear from external forces acting on a lubricant film that separates rolling elements. Traction coefficient (tc) is the ratio of the traction force to the normal force applied on the lubricant film. Traction is an important property of lubricating fluids used in engines, gears, cams, bearings, valve trains, compressors, etc., of automobiles, trucks, tractors, aircraft, refrigerators, etc. Traction in such applications is considered to be a major contributor to energy inefficiency due to frictional losses in hydrodynamic, elastohydrodynamic, and boundary lubrication regimes. Thus, these lubricants are formulated to have as low a tc as possible in order to minimize energy loss or maximize fuel efficiency. An example of a widely used low tc lubricant is engine oil, which is formulated to maximize fuel efficiency in cars, trucks, aircraft, and space vehicles. Page 78:

http://d27vj430nutdmd.cloudfront.net/5716/180095/84b0232ff4f8b030053b0c04599123aff8ce9d9e.1.pdf

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Mixed EHL Lubrication

There are situations where both boundary lubrication and full film lubrication play an important role in the overall lubrication of the contacting bodies.

The lubrication regime between boundary and elastohydrodynamic lubrication is termed as partial EHL or mixed EHL. Partial EHL deals with the simultaneously occurring solid to solid contact and elastohydrodynamic lubricated contact.

It is generally believed that if the average film thickness is less than three times the composite surface roughness, the surface asperities will force direct solid to solid contact, resulting in mixed-EHL. A dimensionless film parameter Λ is defined to distinguish the lubrication regimes possible for rough surfaces lubrication:

Λ = h min / square root of (R q,a squared plus R q,b squared)

where h min is the minimum lubricant film thickness, R q,a and R q,b are the root mean square surface finish of contacting bodies respectively. The lubrication regimes are characterized for Λ as:

5 to 100 - hydrodynamic lubrication
3 to 10 - elastohydrodynamic lubrication
1 to 5 - partial or mixed lubrication
less than 1 - boundary lubrication

The average film thickness in a partial lubrication is between 0.01 μm and 0.1 μm.
Because of the partial load support by the bulk lubricant film, the
coefficient of friction of mixed lubrication is usually less than 0.1.

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Generally, the rate of lubricant degradation doubles with every 18 degrees F increase in temperature. Once formulated with antioxidant additives, PAO-based lubricants have a lower baseline rate of oxidative degradation. At low temperatures, a PAO's increased oxidative life may not be noticeable, particularly if you have to change the oil at some point for other reasons. At higher temperatures, the synthetic may last noticeably longer.

Typically, you begin to notice the extra life provided by a PAO above 160 degrees F (71 C). If it is above 180 degrees F, and especially 200 degrees F, the difference in oxidative life becomes quite apparent. However, the point at which a change to synthetic is justified is dependent perhaps on a handful of additional "program management" parameters such as:

1. Do you intend to run your gear oils with an appropriate use of filtration and oil analysis to support life-cycle extensions for many years?

2. Are you currently doing oil analysis and performing condition-based changes?

3. Do you have, and have you communicated to your lab, oxidation limits that flag impending oxidation problems?

4. Does the machine's operating temperature vary a great deal (a PAO's high viscosity index enables it to operate across a wider temperature range)?

5. Do you have an effective contamination control program in place that will enable you to fully exploit the PAO's extended life?

With the appropriate management strategy, a change to a high-performance product can actually cost considerably less than the equivalent mineral oil product type. Outside of these considerations, somewhere around 165 degrees F represents the point at which you probably should begin to consider the use of synthetics for the sake of lubricant longevity, if not for the sake of reliability.

http://www.machinerylubrication.com/Read/28606/hot-for-synthetic

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Viscosity Guide Table of Limits

Maximum Viscosities Centistokes
(Normally At Start-Up)

22,000
Probably maximum pouring viscosity.
11,000
Probably maximum for splash or bath lubrication.
8,600
Barely pumpable by gear or piston pump too heavy to be serviceable.
2,200
Upper limit for an automatic oil lubricator.
2,200
Upper limit for circulation system (good practice).
2,200
Upper limit for an oil constituent of a grease for dispensing.
1,000
Ring or rolling element bearings.

860
Hydraulic Vane Pumps @ start-up temperature to prevent cavitation and wear.
860
Fuel oil for good pumpability and atomizing.
220
Oil mist generators without heat at minimum operating temperature.
220
Hydraulic-piston pump start-up temperature to prevent wear.
54
Hydraulic Systems at operating fluid temperature.

Minimum Viscosities Centistokes
(At Operating Temperature)

33
For gear lubrication.
30
For a gear pump.
21
Spherical roller bearings.
13
Other rolling element bearings.
13
Hydraulic systems to prevent excessive pump wear and slippage.
13
Plain bearings.
4
Minimum viscosity to support a dynamic load.

Optimum Viscosities
The optimum viscosity is the ideal allowable at the operating temperature.-Centistokes

25
Hydraulic systems
30
Plain Bearings
40
Spur & Helical Gears (e.g. ISO-VG 150 @ 60 °C)
75
Worm Gears (e.g. 460 @ 75 °C)

Nitrites + Amines = Bad News

By Nancy DeMarco **28/4/10**

Metalworking fluid manufacturers and marketers need to check with their steel drum suppliers, to be sure they are not using sodium nitrite as a final rinse to prevent rust. Nitrites in the rust inhibitor can react with secondary amines in metalworking fluids, forming carcinogenic nitrosamines.

At its Management Forum in San Diego earlier this month, the Independent Lubricant Manufacturers Association’s Safety, Health, Environmental and Regulatory Affairs Committee reminded all companies handling metalworking fluids that both new and reconditioned steel drums can contain nitrite residues if sodium nitrite is used as a final rust preventive flush.

ILMA has advised its members to contact their drum suppliers, to assure that drums destined to contain metalworking fluids have not been treated with sodium nitrite.

Paul Rankin, president of the Reusable Industrial Packaging Association in Rockville, Md., which represents drum reconditioners, told Lube Report, “Sodium nitrite is a standard rust inhibitor for both new and reconditioned drums. It has been used for decades and it works.” He emphasized that RIPA believes any residue would contain very low levels of nitrites.

John McQuaid, executive director of the Steel Shipping Container Institute in Arlington, Va., whose members are new drum manufacturers, said that some SSCI members use sodium nitrite as a rust inhibitor while others do not.

“In the steel container industry,” said McQuaid, “it is well known about nitrites forming nitrosamines when combined with amines, and what countermeasures to take to prevent that from happening.”

However, McQuaid continued, “One SSCI member commented that sodium nitrite is the rust inhibitor of choice.”

The U.S. metalworking fluid industry discontinued using sodium nitrite as a rust inhibitor in fluids themselves after the Environmental Protection Agency’s 1984 advisory on the formation of carcinogenic nitrosamines when nitrite reacts with secondary amines.

The resurgence of the issue has alarmed metalworking fluid manufacturers. “The industry is concerned about any doubts that can be raised about carcinogens and metalworking fluids,” one source told Lube Report. Fluid manufacturers continue to face numerous lawsuits, and “it’s undeniable that a secondary amine and nitrite are a problem.

“End users would be furious” to learn their fluids might contain detectable levels of nitrosamines, this source continued. “Check your drums.”

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Noack

ASTM D6375 is much faster than D5800 when testing multiple samples sequentially, and it is safer.

Matthew Saragusa • We already have a NCK25G from PAC, D5800, it's slow and I am looking for other options.
EvanUnfollow
Evan Zabawski, CLS •
Mettler-Toledo makes the TGA/SDTA851 for the small scale NOACK

The K44000 from Koehler: http://www.koehlerinstrument.com/products/K44000.html
The NCK25G from PAC: http://www.rofa.at/Leaflet/Isl/NCK25G.pdf
The OilLab 580 from Linetronic: http://www.lin-tech.ch/english/ol580eng.html
The VP250 from Reichel: http://www.reichel-partner.de/wp-content/themes/ttConcept/pdf/Evaporation_V20030912_Reichel&PartnerGmbHGermany.pdf

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MoS2	**Graphite**	**PTFE**
Very wide temperature range **-180 °C up to 450°C**	**High thermal stability up to 600°C**	**Max service temperature of 260°C**
Under vacuum up to 1100°C	**Good lubrication in presence of humidity**	**Limited load carrying capacity**
Very high load carrying capacity **Up to 3000 N/mm²**	**Poor adhesion on metal surfaces**	**Low µ at low loads**
Very good adhesion on metal	**High conductivity**	**Low conductivity**

surfaces		
Good against fretting	**Poor efficiency at vacuum**	**Translucent/ white**
Needs running-in (high loads)	**Good chemical stability**	**Non-coatable**
Humidity sensitive (μ increase)	**Black**	**Good lubrication at vacuum**
Very low conductivity	**Works synergistically with MoS2**	**White / whitish**
Good resistant against radiation and chemicals	**Black**	
Good lubrication in the presence of oxygen		
Black		

Sarma: As the density comes down, the Calorific value goes up. But the units of this calorific value are KCals/Kg. But as people buy fuels on volume basis, this rationale changes. Please see the following information:

Density, Kg/Ltr / Kcal/Kg / Kcal/Ltr

0.75 / 11,219 / 8,414

0.80 / 11,056 / 8,845

0.85 / 10,883 / 9,250

0.90 / 10,699 / 9,629

As the density has gone up from 0.75 to 0.90, Calorific value fell from 11,219 KCal/ Kg to 10,699 KCal/Kg. But it increased from 8,414 KCal/Ltr to 9,629 KCal/Ltr.

While you are buying petrol in a pump, you buy it on a Litre basis. Here, if you get higher density product, you get more mileage. Reason why you should fill up your car when ambient temperatures are lowest in a day.

Suggest you consider to read API 614, then you can get all conventional value for lube system design.

A journal of diameter 150 mm runs in a bearing 300 mm long. The lubricant used has a density of 0.855 and a kinematic viscosity of 180 cSt.
If the radial clearance is assumed to be uniform and equal to 0,05 mm,
determine the power required to overcome the viscous resistance of the lubricant when the journal rotates at 5 r/s.

Answer:

(abs.viscosity μ)
density x kin.viscosity x π squared x dia squared x speed x lenght
Tang. Force = ---

clearance

$$= \frac{855 \text{ x } 1.8 \text{ x } 10^{-4} \text{ x } \pi^{2} \quad \text{x } 0.15^{2} \quad \text{x } 5 \quad \text{x } 0.3}{0.05 \text{ x } 10^{-3}}$$

= 1025 N

Tangential Torque = Tangential Force x radius

= 77 Nm

Power to overcome viscous resistance = 2 x π x torque x speed

= 2416 W

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