

Practical Applications

Hydraulic industry under pressure

A variety of technical issues await those in charge of purchasing lubricants for hydraulic machinery.



By the Afton Chemical Industrial Team

A fair amount of hydraulic lubricant now is formulated with Group II base oil in the United States.

The variety of hydraulic equipment in the United States is matched with a variety of lubricants designed to make it operate efficiently. The lubricant purchasing decision maker is bombarded with a battery of fluids which may be categorized as follows:

- Antiwear hydraulic fluid.
- Multigrade antiwear hydraulic fluid.
- Tractor hydraulic fluid.
- Biodegradable hydraulic fluid.
- Food grade hydraulic fluid.
- Fire resistant hydraulic fluid.
- Synthetic hydraulic fluid.

To add to the confusion, there are a dozen or more viscosity grades associated with many of these categories. Over the past 10 years or so, equipment manufacturers have

acknowledged that water contamination is a reality with most applications and is difficult to control.

Many mobile equipment suppliers prefer that any contaminant water be emulsified into the oil; others prefer the water to be separated from the oil.

Pump manufacturers such as Parker Hannifin (formerly Denison) and Sauer Danfoss (Sundstrand) have established pump tests which examine the ability of the oil to protect the pump under conditions where water contamination is present in the oil. The T6-C vane pump test, introduced by Parker in the mid-90s, included a wet phase examining the impact of water. This new Parker test replaced the T5-D pump, which was typically run without the addition of contaminant water and which formed part of the HF-0 specification. The Danfoss pump forms part

Figure 1. Scratches on a piston pump caused by particulates in the oil.



(Photos courtesy of Philippe Parreau, Parker Hannifin (formerly Denison))

Figure 2. Lubricant-related pump failure.



of John Deere's tractor hydraulic specification J20-C using the Series 90 piston pump.

For many years, the industry recognized that filtration performance is impacted by water contamination. This was tested a number of ways including Parker's filtration test, AFNOR filtration test and others. Typically, these tests screen the oil's ability to filter in the presence of water contamination.

In recent years, however, the stakes have risen. There is more stress on the oil caused by equipment operating under higher pressure as well as environmental considerations.

Higher pressures

Generally, smaller pumps are being designed to run at higher pressures.

Higher pressures give rise to higher temperatures, more shearing of any polymers in the oil and hydrolysis and oxidation. The impact of water on the oil is now even more significant.

In a recent presentation given at the 2005 STLE Annual Meeting, Parker highlighted the impact high pressure has on properties of the oil such as viscosity index, shear stability and wear protection. Parker has responded to this industry trend of higher severity with their new hybrid pump

test. This unique test, which is run in a few labs around the globe, examines the impact of water on wear and filtration performance of the oil in both a piston and a vane pump in the same test.

Environmental considerations

It is no longer considered acceptable for new hydraulic equipment to leak.

CONTINUED ON PAGE 26

Figure 3. Schematic cutaway of the T6H20-C hybrid pump.

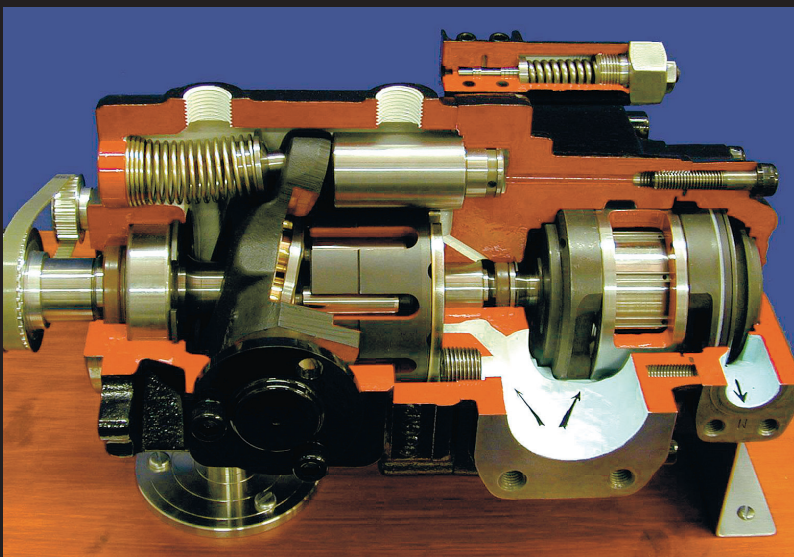
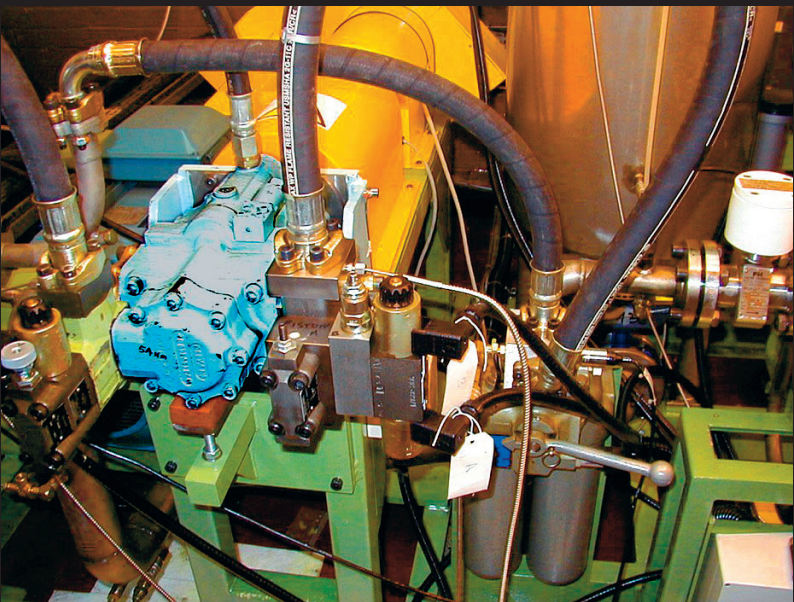


Figure 4. The T6H20-C hybrid pump.



CONTINUED FROM PAGE 25

As pressures get higher, oils get hotter and require higher performing lubricants focusing on viscosity index and shear stability.

Leaking hydraulic oil is a safety hazard, implies poor quality and adds maintenance cost. No leaks, however, means that there is little need for regular topping off of the hydraulic lubricant. Topping off was a convenient way to add extra antiwear chemistry, corrosion inhibitors and antioxidants which are present in the lubricant. This regular additive replenishment is now missing.

OSHA noise standards have caused the industry to focus on noise levels of hydraulic equipment. Baffles are often included in the design of the equipment to reduce noise. Unfortunately, such noise damping also can result in less air flow around the pump, which may result in increased operating temperature of the hydraulic oil. Increased operating temperature accelerates any hydrolysis and oxidation and reduces the effective oil film thickness.

The challenge continues...

Tests such as the Parker hybrid pump test allows the formulator to ensure that there is sufficient robustness in the oil. This robustness may be measured in terms of:

- Antiwear properties.
- Air-release effect.
- FZG properties.
- Hydrolytic stability.

Table 1. Importance of Viscosity Index to film thickness at higher temperatures.

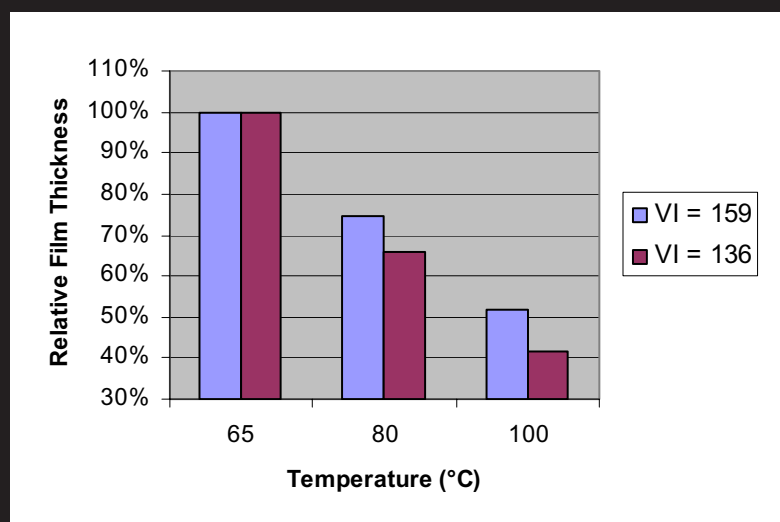


Figure 5. Impact of poor antiwear properties of an oil T6H20-C hybrid pump.



Figure 6. Impact of poor air release properties of an oil T6H20-C hybrid pump.



- Anti-oxidation properties.
- Filterability.
- Seal performance.

Antiwear properties are measured usually within the vane pump by changes in the vane and cam ring weight changes. This is a fairly realistic measure which is believed to correlate well in the field. One challenge, however, is that the pump tests available in the industry tend not to run at as high pressure as some mobile applications. The FZG test is an attempt to take the pressures higher, albeit under a different configuration. The high level of sliding motion designed in the FZG test gears give some simulation of these higher pressure conditions in vane pumps, though the correlation has not been well established.

At higher pressures the air-release properties of the oil become even more important. The possibility of cavitation of a pump is greatly increased under higher pressure operating conditions. Air-release properties are influenced heavily by the type and

amount of additive present in the oil and in, particular, are influenced by the selection of foam inhibitor.

Higher temperatures give rise to higher reaction rates such as hydrolysis (the reaction with contaminant water). Hydrolysis is measured by a hydrolytic stability test which measures both the build up of acidity and the tendency for corrosion. This parameter is very important to oils used in piston pumps containing yellow metal and is very significant in systems running under high pressure.

The industry has seen some pump failures in mobile equipment which are believed to involve a corrosive mechanism and water. The additives and polymers selected for use in hydraulic oils are generally tailored to reduce this tendency.

It is interesting that higher pump pressures lead to a need for higher levels of wear protection and higher lubricant film thickness. In turn, higher wear protection and higher film thickness result in higher additive and polymer levels. It is these additives and polymers, which if not selected carefully, lead to hydrolysis and corrosion problems.

Viscosity Index

In addition to the environmental and mechanical changes that are underway in the area of hydraulics, we are also experiencing the evolution of base oils. A fair amount of hydraulic lubricant now is formulated with Group II base oil in the United States. The higher pump pressures and other influences that tend to result in higher operating temperatures put greater stress on the seals. Ideally, hydraulic fluids formulated with Group II base oil will have the same seal performance as their Group I counterparts. Unfortunately, there is yet to be much focus in this area in the industry.

As pressures get higher, oils get hotter and require higher performing lubricants focusing on viscosity index

and shear stability. The number of mobile hydraulic applications using straight grade hydraulic oil is likely to decrease as the higher pressures in these applications demand higher film strength and viscosity index. This is an interesting time in the hydraulic oil industry. <<

For more information or if you have questions about this article, contact Ian Macpherson, marketing manager-industrial additives for Afton Chemical Corp. in Richmond, Va., at ian.macpherson@aftonchemical.com.

Resist mycobacteria safely and effectively with very low odor.

Synergex™ Premier
and Synergex™ T Plus

The control of mycobacteria is one of the greatest challenges facing the metalworking fluids industry. Synergex Premier amine additive is part of your solution.

Benefits of using Synergex™ Premier amine additive

- Excellent amine additive for the synergistic control of mycobacteria growth
- Excellent adjuvant to help control the growth of bacteria and fungi
- Very low odor additive for metalworking
- Completely compatible with most formulations
- Optimized HLB emulsification

Synergex™ T Plus, a tertiary amine, provides similar performance in helping to control mycobacteria.

Synergex™ Premier and Synergex™ T Plus are only effective when used with appropriate biocides.

For more information, including samples of Synergex™ Premier and Synergex™ T Plus

1-215-419-5232
www.arkemaamines.com

Synergex™ Premier and Synergex™ T Plus are trademarks belonging to Arkema Inc.
©2005 Arkema Inc.

ARKEMA
www.arkemagroup.com