Lube-Tech

No.49

Not all Hydraulic Fluids are Created Equal

How to minimise operating problems and save money

Hydraulic fluids are the work horses of the hydraulic system. They have two main purposes: lubricating equipment and cooling it by transferring heat. Additional roles are controlling flow, handling pressure, transmitting power, minimizing wear, reducing friction, preventing rust and corrosion, keeping system components deposit free and providing a viscous seal. That's a lot to ask of the fluid.

But, not all hydraulic fluids are created equal. So what do you do to ensure that the fluid you are using is performing its job.

Work with Your Hydraulic Fluid Supplier

The number one thing you can do to ensure performance - minimising your operating problems and saving you money - is to know your fluid supplier. Talk with your supplier about your specific application. And discuss the environment in which your equipment is operating.

Does your equipment run in wet conditions? If so, your fluid probably needs an additive package that provides corrosion protection and contains a demulsifier to separate water from the fluid. Or, are high temperatures an issue? If so, you'll need an additive package that provides good thermal and oxidation stability. Various environments and applications call for a different mix of additive components.

Using the Right Additive

Hydraulic fluids are made up of about 99% base oil and 1% or less additives. The components of that one percent can be critical to your operation, particularly when the trend is to use longer life fluids. There are a variety of hydraulic fluid additive packages that can be used in your fluids. Using the right additive combination is critical; your fluid supplier can help you identify what mix will provide the best performance for you.

If you use the wrong fluid, be prepared for the financial consequences. There are costs associated with: the labor to drain the old fluid; the labor to replace the fluid; the fluid; lost productivity while your equipment is down; fluid disposal; and the negative effects of wear, corrosion, etc. on your equipment.

Why Pumps Fail

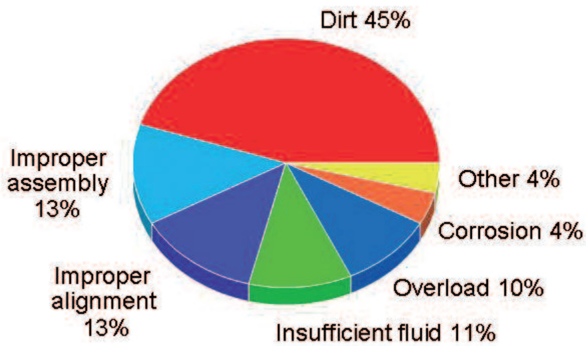
Want to avoid this?

More than 90% of hydraulic pump failures can be attributed to one or more of these six causes.

1. Aeration – the presence of dispersed air bubbles in the system's hydraulic fluid. Aeration can result in severe erosion
2. Cavitation – pump noise that occurs when the hydraulic fluid does not fill the existing space. Cavitation can result in severe erosion.
3. Contamination – any foreign material in the fluid that affects its performance. Contamination can cause abrasive scratching, corrosion and wear.
4. Excessive heat – temperature above a specified limit that affects fluid viscosity/causes fluid degradation, resulting in acid, sludge, gum, resin and varnish formation.
5. Over pressurisation – when the pump is subjected to higher pressures than it is designed to accommodate.
6. Improper fluid viscosity – viscosity is a measure of a fluid's internal friction or its resistance to flow.

There are seven major causes of premature pump failure.

Causes of Premature Pump Failure



Want to avoid failures? One answer is using the correct fluid for your application and environment.

3 Things You Need to Know

There are three key things you need to know about and discuss with your fluid supplier.

1. Viscosity. This is the most important property to consider when choosing a fluid for a given application. Viscosity is the strength of the cohesive force in the fluid. It determines the amount of fluid friction and the drag exerted by moving parts, which pulls the fluid between the metal surfaces. The viscosity of the fluid at the equipment's operating temperature determines the bearing friction, the rate at which the fluid will flow through a bearing and the load-carrying capacity of a bearing.

Fluid of the correct viscosity is distributed quickly to moving surfaces - a key to longer pump life. Fluid with lower than recommended viscosity can result in internal pump leakage accompanied by increased temperature. Conversely, fluid with higher than recommended viscosity will be sluggish and not spread well throughout the hydraulic system. Of course, be sure to follow the fluid recommendations of your equipment manufacturer.

2. Base oil used. Traditionally, hydraulic fluids have been produced from solvent neutral mineral oils (called Group I base oils). But the trend is to move toward the use of hydroprocessed base oils (called Group II). As the group number increases, so does the cost. But, the higher base oil group number also provides longer life for your equipment due to lower volatility, better oxidation resistance and better demulsibility. In addition, the higher numbers contain less sulphur and have higher saturate levels, both of which are better for your equipment.

Base Oil Categories

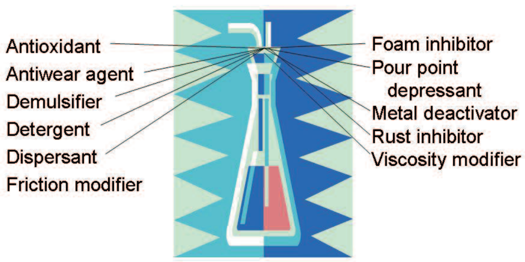
Group	Description	% Saturates	% Aromatics	% Sulphur	Viscosity Index
I	Solvent-refined mineral oil	< 90	> 10	> 0.03	80 - <120
II	Hydroprocessed	> 90	< 10	< 0.03	80 - <120
III	Hydrocracked	> 90	< 10	< 0.03	120+
IV	Polyalphaolefins				
V	All others				

3. Additive package. Factors that influence additive selection include its performance, compatibility, colour, odour and economics.

With the trend toward smaller hydraulic systems, the fluid stays in the system's reservoir for a shorter period of time. That means less time to release air (air contamination affects precision), control foam and cooling (so the equipment tends to run hotter). In smaller systems, the additives in the fluid are asked to work harder because they have less time to perform in the presence of contaminants (e.g., dirt and metal particles). Less time in the reservoir also means that additives have less time to demulsify the water that is inevitably contained in hydraulic fluid through condensation or leakage. Water in the fluid impacts fluid performance by plugging filters and resulting in corrosion and pump wear.

As mentioned previously, using the right additives is critical. For example, demulsifiers separate water from the fluid so the water can be drained from the system. Corrosion inhibitors and anti-wear additives protect surfaces from contamination that can harm the equipment.

Possible Additive Package Components



The additive package also needs to have enough power in reserve, what we call chemistry, to provide the performance and durability the equipment requires if the application is severe, maintenance is past due, or the equipment is experiencing a mechanical problem.

Trends

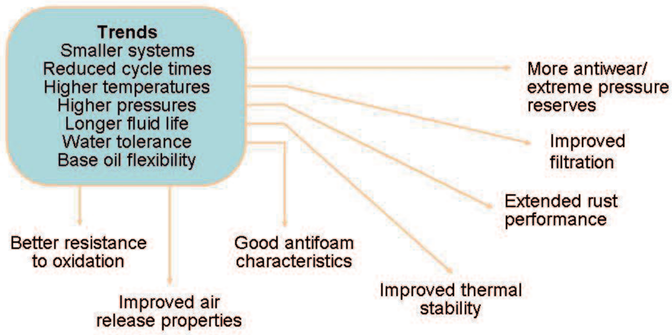
In addition to the smaller systems and increased drain intervals previously mentioned, there are a variety of hydraulic equipment trends impacting the demand on fluids and their additives. There are higher pressures and temperatures (increasing the chance of varnish deposits and sludge), increased power density, reduced cycle times and a greater focus on the cleanliness and filterability of the fluid. Other trends have evolved from such environmental sensitivities as biodegradability, recycling/reclaiming and reconditioning the fluid, and fluid disposal concerns.

Oil Drain Intervals

Construction Equipment Manufacturer	Oil Drain Interval, hrs Previous Interval	Today's Interval
Komatsu	2,000	5,000
Hitachi	2,500	4,000
Caterpillar	2,000	4,000
Sumitomo	2,000	5,000
Volvo	2,000	4,000
JCB	1,000	3,000

Requires all-year,multigrade fluid

Hydraulic Fluid Market Trends



Pay Now or Later

What is your true cost for a hydraulic fluid? Add the costs of: the fluid; procurement, receiving, testing and warehousing; payment processing; disposal; monitoring; unplanned machine downtime and associated labour; fluid replacement; and part deterioration and operating inefficiency due to fluid breakdown. Using improperly formulated fluids can result in excessive wear, shortened fluid life, oxidation, contamination and warranty issues. Obviously, using the wrong fluids can seriously impact your bottom line.

You can pay upfront for the right fluid and protection for your application and environment. Or you can pay for the downtime and repair costs associated with using the incorrect fluid. Considering the high cost of your hydraulic equipment, the fluid is not the sensible place to cut corners. You have the power to prevent the problems and costs associated with using the wrong fluid in your equipment.

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Lubricants Play Critical Role in Use of Plastics in Automotive Applications

Key to the performance of plastics is the selection of the appropriate lubricant, which reduces friction to improve wear, reduce noise and increase customer satisfaction. While lubricants have been broadly used with metal automotive parts for many years, lubricants for use with plastic has a short history. Unlike choosing lubricants for metal, selecting the correct plastics lubricants can be particularly complicated. Because plastic components degrade more quickly than metal through friction, an improper lubricant can cause severe consequences.

Automobile manufacturers are increasingly turning to plastics components to reduce weight, improve performance and add flexibility to design options. From door trims and instrument panels to engine components and car hoods, plastics now comprise approximately 10 percent of the average passenger car.

Types of Lubricant

The first step in selecting the proper lubricant is to know the different types of lubricants available and where they can be used. The lubricants used for automotives can be classified under main categories of oils, pastes, greases, dry films and solids.

Oils are the most common automotive lubricant, with use as engine oils, gear oils and automatic transmission fluids. Their viscosity (thickness) can be adjusted for their intended purpose by blending polymer additives into its fluid base.

Greases are semi-solid lubricants with an oil base and thickener. They hold and adhere better than oils and eliminate the need for complex sealing units. As with oils, additives are formulated to meet application needs. Greases are widely used for many car components from chassis to sunroof.

Pastes are mixtures of solid lubricants and oils and were developed in response to the need to use solid lubricant more efficiently. Although applications are limited, the main use of pastes is assembly of components, where the lubricant must bear high loads.

Dry films are paint-like lubricants created by dispersing of solid lubricant into a resin binder, dry film is used on parts that cannot hold oil type lubricants.

Solid lubricants are used mostly as an additive for greases and oils to improve load carrying capability. They can also be used for press forming in metal working, additives for brake linings and plastics materials.

Physical Properties of Plastics

Many types of plastics are used in automotive applications, each with various grades and compatibility with lubricants, which can also be affected by the selection of additives, fillers, or molecule size of the plastic. For example, some grades of plastics have smaller molecule size and less oil compatibility than standard grades. From the view of a lubricant expert, selecting plastics to meet lubricant needs would be the best approach. In reality, this approach is difficult. Because plastics materials are limited, it is necessary to choose the appropriate lubricant given a specific grade of plastic.

Another important consideration is the physical properties of the plastic and many physical properties must be taken into consideration when selecting the appropriate lubricant to be used with plastic parts. Often, the properties are very different than those found with metal components. Here, for convenience, the points will be explained with a functional plastic and the plastic for structures.

Functional Plastics

Functional plastics, in the form of lubricating materials, are used for automotive parts such as gears and sliders. Generally, these plastics (polyamide, polyacetal, etc.) have good oil resistance, and are compatible with many conventional oils and greases designed for metal parts.

However, because some additives in lubricants degrade these materials, it is necessary to check the contents in advance. It is also important to investigate the compatibility of the lubricant actually used through standards such as an immersing test.

Some functional plastics such as Polyacetal and Nylon have self-lubricating properties, which means they can replace metal lubricating components without any lubrication.

Fig. 1 – Friction of plastic parts with and without grease.

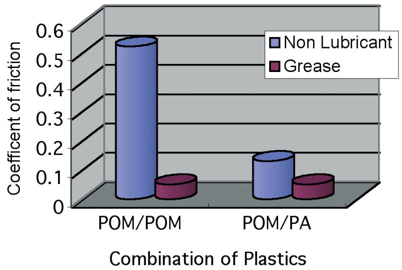
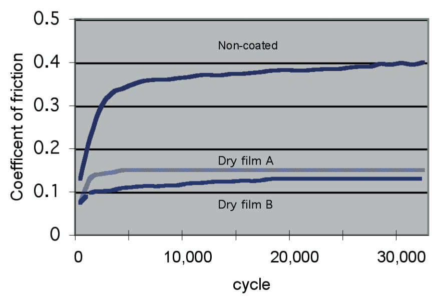


Fig. 2 – Friction of plastic parts and steel plates with and without dry film.



Usually, multiplication of speed is used to select lubricant for plastic components. Use of lubricants can extend the maximum of the usable limit. Many additives in metal lubricants react with metal surfaces, developing a lubricating and wear-resistant film. However, since most thermoplastics melt below the temperature at which additives react, and the reactivity of plastic surfaces is weaker than that of metals, the same performance for traditional additives with plastic cannot be expected. It is important to pay attention when selecting solid lubricants for plastics, because plastics are not as hard as metals. If the wrong type of solid lubricant is used, friction will create wear and tear of the plastic. Selected solid lubricants can be used as an additive to create self-lubricating plastics.

We cannot neglect to consider entire units where plastic parts are used. Many applications require not only lubrication of plastics, but also combinations of plastics against metals and metals against metals. In this case, it is necessary to consider the lubrication performance of metals against metals as well as metals against plastics. At the same time, the comparability for housing plastic materials is required, because the exposure of lubricants may happen during operation. Fortunately, lubricants are available today that meet these requirements.

Structural Plastics

The application of structural plastics includes door trims, instrument panels, housing units, etc. Most of the plastics used are polyolefin, ABS, polystyrene, and some polymer blends. It seems that there are few applications that would require extensive lubrication; however, proper lubrication can reduce noise, vibration, and the sensation of movement at sliding and connecting parts. In this case, there are fewer concerns regarding severe lubrication. The comfort of passengers, which is directly impacted by vibrations and noise, is the most important consideration.

It is important to check the compatibility of these plastics against lubricants more than once for functional plastics. A lubricant that dissolves or deteriorates plastic cannot be selected. Additionally, chemicals that cause cracks and stress fractures must be considered. If these points are neglected, problems in appearance or functional troubles such as the failure of braking parts may arise.

Several methods to test the compatibility of plastics and lubricants are available, all of which involve applying lubricant to the section of plastic, then bending it and applying stress. The plastic is then placed in the test unit for a selected period of time. After several cycles, the plastic sample is examined for cracks.

Base Fluid	PS	ABS	PP	POM	PA
Mineral oil	poor	selected	fair	fair	fair
Ester	poor	poor	fair	fair	fair
Polyalpha olefin	fair	fair	good	good	good
Perfluoropolyether	good	good	good	good	good

The above table explains the compatibility of lubricant base oils against different types of plastic. Polyalpha olefin base oil, currently a popular choice as a replacement for mineral oils, is suitable for many plastic applications. Perfluoropolyether, a chemically inert lubricant, can be used with many plastics without deterioration. Unfortunately, its high price limits its applications.

Appearance is one important criterion in the selection of a lubricant. Where lubricant is visible, a transparent or semi-transparent product will be needed. Lubricants that will not rub off on drivers and passengers should they come into contact with them are often required. Dry film lubricant and semi-dry film lubricant are often used for these applications.

It is necessary to check compatibility when the films are applied and before curing, because many films contain solvents which can cloud and crack plastic materials.

Applications

Noise reduction -- Lubricants reduce the noise level when applied to plastic gears or sliding parts. Plastic gears generate noise when they strike one another, as opposed to metal parts, which generally produce noise by sliding. Viscous characteristics of lubricants, such as high viscous grease, can absorb the vibration of plastic parts and reduce noise. However, automotive lubricants must be able to function properly at low temperatures. One must have a balance of noise elimination and low temperature capability.

Door panels -- Many plastics requiring lubrication are used in door panel applications, including guide rails, sliders and rollers, window regulators, actuator units of door locks, micro motors and exterior mirrors. Since every application requires a lightweight and compact size, it is necessary for the lubricant to have low friction in addition to being compatible with plastics. Grease contains special solid lubricants used for such applications.

Window regulator motors -- a combination of polyacetal gears and steel gears are used. Selected synthetic base greases have been used for the micro-motors, which use rubber parts to absorb vibration. This application requires the lubricant to be compatible with plastics and rubbers.

Guide rails of the window regulator -- consist of galvanized steel guides and plastic sliders. High viscous grease is used to meet the needs of noise reduction and plastics compatibility.

Door trim -- Dry film is used just before the plastic door trim is assembled at the door panel because it eliminates harsh noises in running vehicles. This dry film also improves productivity of the assembly line where flocked plastic tape is used, effectively reducing noise and increasing productivity.

Conclusion

Some lubricant manufacturers participate in component development programs at automotive manufacturers during the early stages of production. This consultation supplies a different view on the process and supports further testing of material and lubrication. Plastic manufacturers and lubricant manufacturers may debate about compatibility, so it is important for them to work together at an early stage of development.

Inviting the lubricant supplier to participate at the early stages is essential to reducing the cost and time spent in the development process.

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