OIL AND FUEL MAINTENANCE

‘The reduced life of lubricated machinery and components is almost totally determined by the amount of contamination of the lubricant’

After selection of the correct lubricant, the most critical factors to long machine and lubricant life is to keep the lubricant **“clean and dry”. Water and particulate** contamination have devastating effects on machine and lubricant life. – Ref USA National Tribology

The presence of wear metals alone can cause oxidation rates to increase to five (5) times the normal rate, while the presence of water can increase the oxidation rate ten (10) times. Combined, water and metal catalysts can increase the oxidation rate fifty (50) times or more. - Ref USA National Tribology

The standard practice of 250 hour oil change has been left over from the 1930s, largely because standard spin on and centrifugal oil filters are not designed to remove moisture in oil emulsion. The centrifugal filter is commonly known to assist the removal of heavy moisture from oil but not the emulsified moisture.

The environmental problems of disposing of used machine oil are caused by the continued use of antiquated standard oil filters.

A ProtxL Filter Module fitted to a 100meg turbine removed moisture and particulate contamination and maintained oil cleanliness to better than NAS 6 Standard. ProtxL will maintain TBN and control the TAN in the oil and also has proven that clean dry oil reduces vibration within the turbine.

Implementing ProtxL by-pass oil filters combined with the use of synthetic or double hydrocracked oil, will reduce the production of used oil on a diesel engine, from up to 20 oil changes to just one per annum. The collection of carbon credits can be done by www.carboncredex.com

For over a decade, ProtxL clients have significantly increased machine availability, reliability and reduced service costs in excess of 50% by operating machinery on an oil cleanliness of better than NAS 6 Standard at all times.

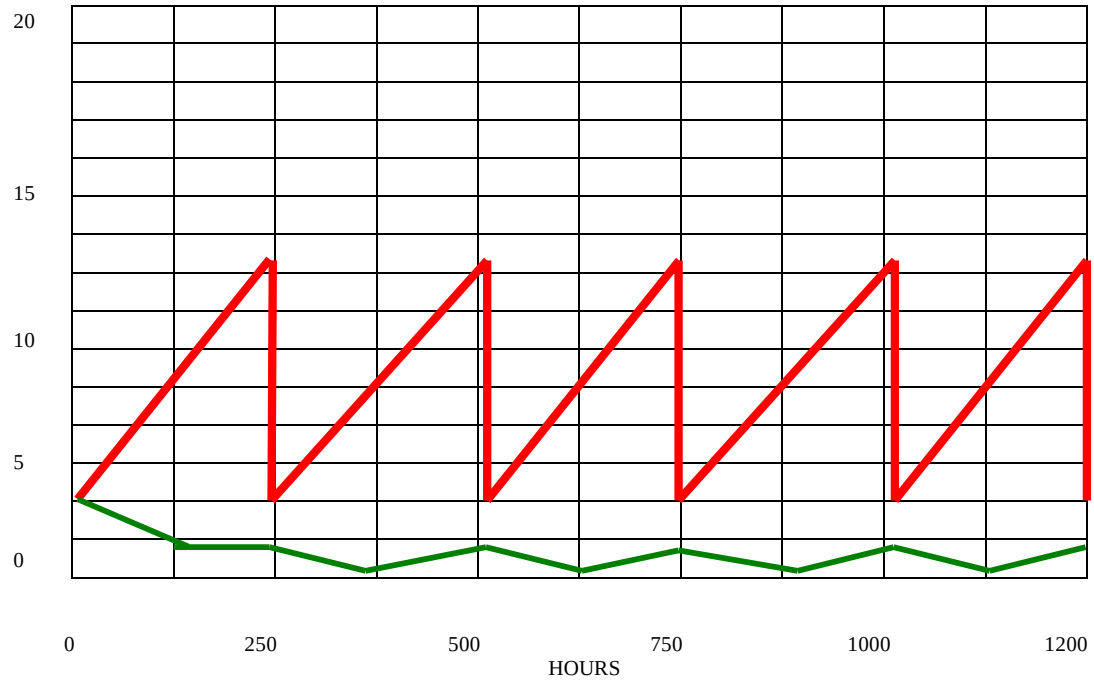
ProtxL Maintenance has the unique ability to remove water emulsified in oil and particulate contaminants down to 1-3 micron, keeping the oil "**clean and dry"** so that the TBN of the additive package is maintained.

The use of by pass filtration does not void manufacturers warranty and the operator can safely initially monitor progressive 250 hour oil analysis to confirm the new acceptable bench mark of machine extended oil change.

The statement contained within MOBIL Oil Australia Technical Bulletin number 863 explains that oil does not require changing because it becomes worn out. Oil is changed because **standard full-flow oil filters** are not designed to remove sludge or do anything but protect the engine from particles above 15-30 micron.

As a result it is the carbon and acidity that depletes the oil additive package and increases capital investment. ProtxL units are designed to be fitted to all equipment from private vehicles up to a 700 Meg Turbine with 70,000 litres of oil. Sizing of the system is rated on engine horse power, desired service interval and reservoir size or system capacity for hydraulics, gearboxes and lubricating systems. There are only two (2) sizes of ProtxL elements that have duel application in ProtxL fuel or oil filters.

Implementing ProtxL by-pass oil filters combined with the use of full synthetic oil will reduce the production of used oil on a diesel engine, from up to twenty (20) oil changes to just one (1) per annum.



Regular 250hr oil drain interval level of cleanliness

ProtxL level of cleanliness. Change element each 250hr interval. Use synthetic oil to reach 1200 and up to *5500hr oil drain intervals. *Monitor with oil analysis.

GRAPH SHOWS THE DIFFERENCE BETWEEN THE OIL CLEANLINESS OF A DIESEL ENGINE PERFORMING 250 HOUR OIL DRAIN INTERVALS AND A DIESEL ENGINE USING A PROTXL OIL MAINTENANCE SYSTEM AND AN OIL DRAIN INTERVAL EXTENDED TO 1200 HOURS OR ON ACCEPTABLE OIL ANALYSIS OUT TO 5,500 HOURS.

The use of ProtxL increases company profit by using the principals of sustainable development and the Triple Bottom Line.

ProtxL Distributors are able to offer the operator of equipment a cost effective option including a full service agreement to install ProtxL to all types of equipment, servicing and maintenance of systems/equipment and perform oil analysis and reporting to clientele management.

Lubricant Cleanliness

USA National Tribology www.natrib.com

Introduction

After selection of the correct lubricant, the most critical factors to long machine and lubricant life is to keep the lubricant '**clean and dry'**. Details such as machine criticality, operating environment and component clearances as well as lubricant type, viscosity, flow rate and economic issues must be carefully considered for optimum lubricant contamination control. This application Note provides information that should be considered when designing a contamination control system to provide the best value. The specifics of each application are different and must be evaluated individually.

Importance of Lubricant Cleanliness

Machine Condition

In any machine application, the most important aspect for insuring maximum machine and lubricant life is the selection of the **correct** oil. This process includes choosing the correct base oil, the correct viscosity and the correct additives for the application. Next in importance is keeping the oil **clean and dry**. **Water** and **particulate** contamination can have devastating effects on machine and lubricant life.

Water contamination can definitely result in adhesive wear. In elastohydrodynamic (EHD) lubrication, such as occurs in rolling element bearings, extreme pressures up to 500,000 psig can be momentarily generated at the interface between the rolling element and the bearing race. Because lubricant viscosity increases with increasing pressure, the lubricant momentarily becomes a solid, protecting the surfaces in motion. Water however, does not change viscosity (with increasing pressure) over its entire liquid-state temperature range and can have the effect of reducing the viscosity of the lubricant, both overall in cases of bulk contamination or in localized situations. At the high pressures generated in a rolling element bearing or between heavily loaded gear teeth, such a viscosity drop can allow surfaces to come in contact and adhesive wear will occur.

Moisture contamination should be aggressively controlled, as it can be just as devastating on machine condition as particulate contamination. Its effect may not be as immediately noticeable but it has a more widespread interaction with machine surface properties and lubricant properties. The overall effects of moisture contamination can be more systematic than particulate contamination. Moisture contamination can have numerous direct effects on machine condition. The most obvious effect is to cause rust and corrosion of steel and steel surfaces in a process called corrosive wear. Most lubricants are somewhat acidic by nature and the addition of certain additives can make them more acidic. The normal degredation process also tends to increase lubricants acidity. Water combines with the acids in the oil to increase the corrosive potential and increase the attack on ferrous and nonferrous metals. Corrosive wear results in the removal of metal

from the component surface, typically in the form of ferrous oxides. Ferrous oxides or rust particles are abrasive, and in conjunction with other wear debris and abrasive particles, they can expose fresh base metal for further corrosion.

The viscosity of water is lower than virtually any lubricant applied and its viscosity does not increase with increasing pressure as a lubricant will. Therefore water adversely affects machine condition by causing insufficient fluid-film strength and allowing machine components to come into contact. This effect can occur regardless of whether the aqueous contamination is in the form of water or if it is emulsified with the oil. The resulting emulsion will have a viscosity higher than water but lower than the oil and proper fluid-film strength will not be achieved.

If water is present in a lubricant under conditions of low pressure, it can form a water vapor bubble. When the water vapor bubble is then exposed to a high –pressure region of the machine it will implode and condense back to the liquid phase in a process called cavitation. The implosion results in the formation of micro jets, which impact the metal surface at high velocity and force and also bring dissolved oxygen to the grain boundaries. In the millisecond that it takes for cavitation to occur, the micro jets cause disintegration of the metal, while the oxygen results in corrosive chemical attack of the metal grain boundaries. The initial effects, microscopic in nature are called micro-pitting. As the damaged surface experiences further cavitation and fatigue, the pit enlarges until a spall is formed as described earlier in the discussion about fatigue wear. Cavitation can occur with air bubbles as well as water vapor bubbles. Water contamination increases the lubricants ability to retain air which in turn, increases the potential for cavitation-induced wear.

When water is present in a lubricant, some of it will decompose to form hydrogen and oxygen. Hydrogen can interact with the metal surfaces to cause hydrogen embrittlement. As the name implies, this process causes the metal to become more brittle or lose its ductility, rendering the metal prone to fatigue wear.

Lubricant Condition

While particle contamination has a more direct influence on machine condition, water contamination has a more direct influence on lubrication condition. Independently, either type of contaminant can degrade both the machine and lubricant conditions. Together, they can feed off each other to greatly increase the degradation rates of both the machine and the lubricant.

One of the more critical lubricant condition properties is the oxidation that has occurred, as all lubricants will oxidize over time. The oxidation process is accelerated in the presence of elevated temperatures, water content and solid contaminants. Beginning with the formation of organic peroxides, further oxidation will result in the formation of alcohols, aldehydes, ketanes and organic acids. These products can be further oxidized to form high molecular weight polymers that are insoluble in oil. These polymers manifest themselves as sludge’s, varnishes and gums and impair normal equipment operation.

Organic acids are formed as a result of oxidation. They are corrosive to many machine component metals and thus increase the rate of corrosive wear. Additionally with oxidation, lubricants increase in viscosity further compounding the oxidation rate by increasing the fluid friction and therefore the heat input to the oxidation process.

Solid contaminants, whether they are dirt or wear-generated debris will increase the oxidation rate of the lubricant because these materials contain metals that catalyze the oxidation process**. The presence of these metals alone can cause oxidation rates to increase to five (5) times the normal rate, while the presence of water can increase the oxidation rate ten (10) times. Combined, water and metal catalysts can increase the oxidation rate fifty (50) times or more**.

Although the presence of heat and air are not typically considered contaminants, excessive heat can increase the oxidation rate. A rule of thumb for the rate of heat-induced oxidation is for every 10C above 60F the oxidation rate doubles. As the amount of air in lubricant increases, the oxidation rate increases at a similar rate. Entrained air can result from excessive agitation in the lubricant system, the presence of water or too much or too little antifoam additive.

The combined presence of water, metals, heat and air can cause a lubricant to oxidize rapidly. Contaminants, notably particulates and **water** also cause **additive depletion.** Additives are chemicals used in lubricants to add or enhance certain properties to the base oil. These materials vary greatly in their function and their concentration in the lubricant. Water promotes accelerated additive depletion because water is also polar compound. Therefore it has a natural affinity for the additives and will interfere with their intended function. Additionally some additives (and certain synthetic lubricants) have poor **hydrolystic stability,** meaning that they have poor resistance to chemical degradation and are rapidly depleted in the presence of water.

The combined effects of solid and moisture contamination pack a one-two punch that no machine and lubricant can endure for long without a suitable designed contamination control system in place. A contamination control system must be appropriate for the application and must also pack its own one-two punch that prevents the ingression of contaminants and successfully removes any contaminants that are present. “

Advantages of Clean and Dry Lubricants

Maintaining lubricants at minimal particle and water concentrations, maximizes both machine and lubricant life. For example, a lubricant operating at a typical ISO Cleanliness Code of 21/18/15 could achieve life improvement of 1.5 to 2 times if it was cleaned and maintained to a target ISO Cleanliness Code of 18/15/12. This obviously depends on the specifications on of the application and the type of machine components involved, but serves to illustrate the point.

In some applications, maintaining water content in a lubricant at 1,000 ppm can result in a 75% reduction in component life versus operating at a water content of 100 ppm if all other factors remain constant. Combining the effects of cleaner and drier lubricants provides a cumulative improvement in machine component life.

Maintaining clean and dry lubricants requires a continual effort utilizing a two pronged approach; ingression prevention and contaminant removal. Most contamination control efforts only focus on removing contaminants after they have entered the lubricant. Preventing the ingression of particles, water and other contaminants into a lubricant is the most effective and often least utilized method of controlling contamination. Combining the two approaches will maximize machine and lubricant life and minimize contamination control costs.

This article is an extract from a document published by the USA National Tribology titled - Lubricant Cleanliness- available on www.natrib.com

TIMKEN the bearings manufacturer detail on their web state the following;-
With reduced water levels of 100ppm to 25 ppm increases bearing life 2 times. British Hydraulics Research indicate that if solids contamination with particulates larger than 5 micron (.005 or .0002) is reduced from the range of 5.000 – 10,000 particles per milliliter of oil to 160 – 320 particles, the machine life is increased 5 times.

These articles clearly explain the technical reasons why it is critical to address particle and water contamination of oil. However both centrifugal and spin on oil filters are not designed to remove sludge in emulsion. The centrifugal filter is commonly known to only having the capacity to achieve unacceptable minimum 563 ppm moisture.

The common practice of using a vacuum filter when turbine oil moisture has already reached high levels of in excess of 1,000ppm is a bandage approach which ignores the fact that machine damage has already occurred and has depleted the oil additive package and oil life.

The ProtxL - (protects-all) oil filter is designed to be permanently fitted to all machine oil systems to achieve long machine and lubricant life by keeping the lubricant clean and dry. The oil additive package isn't used up as fast so in diesel engines the 5,500 hour extended oil change on acceptable oil analysis results is commonly achieved with the ProtxL Oil Whole of Life Program.

"THE WEAR OF LUBRICATED MACHINERY IS ALMOST TOTALLY DETERMINED BY THE AMOUNT OF CONTAMINATION OF THE LUBRICANT "

The benefit to the machine inventory owner/manager by addressing this most basic issue is reduced servicing costs by up to 65%+, reduced repairs and maintenance costs, reduced down time and increased machine service life, performance and reliability. Therefore clearly, in any COST / BENEFITS ANNALYSIS when using ProtxL oil & fuel Filters, the cost to the owner or operator is negative.