MAINTENANCE TECHNOLOGY

An Applied Technology Publication/March 1994

HARMONICS: IDENTIFICATION AND DIAGNOSIS

THE MAGAZINE OF PLANT EQUIPMENT MAINTENANCE AND RELIABILITY

Proactive Hydraulic Oil Maintenance

Technician connects advanced portable oil filter to plant machine. The filtering equipment has the capacity to return oil to better than new condition with regard to particulates.

Dirt and contamination are leading causes of hydraulic system failures. Keeping the hydraulic fluid clean can greatly increase the reliability of fluid power components. In many plants, "maintenance of the oil" is distinctly secondary in importance to "maintenance of the equipment." Yet the two cannot be separated.

Many equipment users have applied effective contamination control to get impressive cost savings. These companies have extended the lives of their hydraulic systems, pumps, servovalves and other components from 2 to 100 times.

Many manufacturers recommend 10 micron filtration of the hydraulic oil in their equipment. Yet 0.5 to 10 micron particles produce the more insidious effect of sluggishness in machine performance and gradual wear of components. Larger particles can block openings in hydraulic systems. But so can the very small ones in the frequent situations where clearances themselves are small, namely submicron to 4 or 5 microns in dimension.

Examples include these typical critical clearances in fluid system components: 0.5 to 5 microns between gear and side plate in a gear pump, 0.5 to 5 microns between valve plate and cylinder in a piston pump, 1 to 4 microns for the spool sleeve of a servovalve, 1 to 23 microns for the spool sleeve of a control valve, and 0.5 micron and up for antifriction bearings. Clearances in many hydraulic components are very small—0.5 micron and smaller.

This attention to really clean hydraulic oil is particularly important in machine tools where reliability is a main consideration. Wear, cavitation, erosion, etc., when a machine is operational result in particulate contamination. These particles are generally of iron composition and hence are abrasive. When carried in high-velocity oil, they can generate more abrasive particles.

A particle may cause a spool to seize, allow movement in one direction only, or cause a frictional drag. Such jamming in a machine tool would cause servovalve spool movement to lag the torque motor signal, which could result in machine movement hunting for the commanded position. When any of these malfunctions occur, servovalve contamination is the prime suspect. If servovalve contamination exists, steps should be taken not only to render the valve operable but also to prevent the recurrence of particle contamination.

In plastics production, injection molding machines leave little room for casual attitudes on hydraulic oil. For the servovalve to provide proper feedback it must be working efficiently. The two-way action between linear transducer, servo, and final lockup must be precise. This action is affected when the very small orifices in the servovalve are silting up with contaminants.

For a 500 ton press to make a final low-pressure touch is a delicate operation. It must achieve an exact position every time, and all elements must be working right. When a technician sees a valve "varnished" with a coat of dirty oil, he must know that the action is not what it should be.

Pump performance also is affected by contamination that cannot be seen. Both particle size and particle concentration exert a strong influence on the ability of the pump to pump fluid effectively. Efficiency begins to degrade at the 5 micron particle size level, and a pump shows a distinct sensitivity to particles larger than 10 microns.

Preventive maintenance, as understood by American industry, has proved itself beneficial. Yet preventive maintenance itself does not begin to reach the true benefits of what is implied by "proper" maintenance. For example, one pump overhauler reports that 60 percent of hydraulic pumps sent in for rebuild have nothing wrong with them. They had just been sent in according to a preventive maintenance schedule as opposed to the true condition of the equipment.

Predictive maintenance goes a few steps further in maintenance efficiency to monitor the condition of equipment so as to heed the warning signs of impending failure. Predictive maintenance of hydraulic oil means field and laboratory analysis of oil samples performed often enough to catch oil degradation before equipment performance and wear are affected significantly.

Proactive maintenance is the most effective means of gaining real cost savings in maintenance procedures. It goes beyond reacting to equipment failure or signs of coming failure. Instead of considering equipment failure as a normal and inevitable fact of doing business, the proactive maintenance philosophy is to avoid the underlying conditions that lead to machine failure and thus extend its life.

Proactive maintenance of hydraulic oil includes consistent efficient filtration to keep the oil pure. This type of oil condition maintenance brings real savings to the care and feeding of hydraulic equipment, for the following reasons:

- Hydraulic oil usually operates under stress. Heat, pressure, and continuous running of the machine combine with the influx of dirt, moisture, acid, and other contaminants to build up sludge. The sludge in turn affects the viscosity of the oil.
- Extrafine particles in the range of 0.5 to 10 microns have the capacity of accumulating, "packing up," or silting in hydraulic oil. When the gap between components separated by an oil film is bridged by contaminants, wear can occur. This situation generates further particles, and these fine particles have the potential of gathering, affecting the performance of a machine, or leading to failure though silting.
- Chemical changes in the oil as well as physical contamination can critically influence hydraulic oil performance and economics. This factor applies particularly to production, where oil is subjected to thermal abuse that can cause rapid chemical change. These chemical causes of oil failure, which can be removed by fine filtration, include increased oxidation rate of the oil resulting in acidity and interfacial tension. Water, air, or copper or iron oxide from the working environment can have negative effects when mingled into oil in high-speed and high-temperature operations.

Effective oil contamination control technology will

- Remove suspended particulates before they can enter tight clearance areas and cause abrasive wear, leakage, and unplanned downtime
- Absorb emulsified water, thus filtering out the major catalyst of oil deterioration
- Remove oxidation byproducts, preventing gummy or waxy residue from building up on parts that affect machine performance
- Retain additives, thus saving the oil's important lubricity, antiwear properties, and other qualities

- Achieve substantial cost savings on new oil purchases, minimize the cost and liability exposures of waste oil disposal, and increase productivity and machine operating uptime.

Consistent oil condition monitoring is a part of both preventive and proactive oil maintenance. It provides the feedback that gives integrity to a contamination control program. A system is not "controlled" unless a feedback loop is provided. Contamination monitoring is the feedback to a contamination control program.

An oil monitoring program, whether performed inhouse or by a contractor, should include a site analysis to identify potential contamination control problems and provide the data needed for developing a program to fit the site.

The program should be unique to the site to reflect the requirements of different environments (moisture levels, air quality, etc.).

Oil samples are laboratory tested to determine the type and amount of contamination. These tests may include particle size analysis, viscosity, acidity, specific gravity, water content, and any other particular measure that can lead to oil recoverability. A continuing oil purification system then can be set up to meet the needs of the application.

Regular analysis of the oil is vital to a working, proactive oil contaminant program. This requirement sets this type of program apart from traditional procedures where oil is left untended until some problem, or suspicion of a problem, develops in the machinery.

A properly designed proactive program will keep the oil at better than new specifications. If proper techniques are used, additive content or composition is not altered.

Changing the oil or adding new oil does little to lower contamination levels because contaminants are present on tank or reservoir linings and in the air vacated by the depleting of the oil. New oil itself, traveling through the supplier's tanks and lines, is seldom if ever really clean.

In addition to the reliability and performance benefits of a proactive oil maintenance program, plants can address the final problem: oil disposal. Under most circumstances, oil can be reused indefinitely when contamination is effectively controlled and additives are not depleted.

A true proactive program in oil maintenance has equipment reliability and extended component life as its goals. Achieving these goals requires keeping optimum machine conditions by staying ahead of the first indication of failure.

Information furnished by OilPure Technologies, Inc., Kansas City, MO.

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