Hydraulic System Care and Maintenance

Basics
Hydraulic machines work by forcing fluids through a series of pipes and hoses to force a machine component to move. Hydraulic systems can be small, simple and straightforward and can also be very large, high-pressure systems with a complex array of servo valves and pumps, and everything in between. No matter the size or complexity, it is crucial to maintain the hydraulic oil and the system itself; this will in turn reduce repair costs.

Hydraulic “Oil Care and Maintenance”
Hydraulic Oil is the life-blood of any hydraulic system, and therefore should be treated as such. The hydraulic oil transfers pressure and energy, minimizes wear and tear, seals close-clearance parts against leakage, dissipates heat, flushes away dirt and particles, and serves as rust protection. Conventional mineral oils are normally used in hydraulic systems, but fire-resistant, synthetic, and biodegradable fluids can also be used in certain situations.

There are four crucial elements to address in order to ensure long lasting Hydraulic Oil:

Control the Temperature — the oil develops heat as it is forced through the motor tubing, pumps, and relief valves. In conventional systems, high temperatures will start the natural degradation of the oil namely “oxidization,” and can lead to varnish and sludge build-up in the system. On the other hand, running the temperature too low will allow condensation in the reservoir, and if free water gets into the hydraulic system it can cause a lot of damage.

Typical industrial hydraulic system temperatures often range between 40 to 65 degrees Celsius. Selection of the proper grade of hydraulic oil is critical to ensure cold start, high temperature protection and to obtain the optimum system efficiency. Keep systems which operate on a water based fluid below 60 degrees Celsius to prevent the water from evaporating.

To allow heat to radiate from the system, ensure that the outside of the reservoir is clean and the surrounding area clear of any obstructions. Make sure the oil cooler is functioning properly and keep air-cooled radiators clean. Reservoirs should be filled to the specified level to allow enough fluid residence time for the heat to dissipate and to shed water and dirt.

The varnish produced by oil degradation can plug valves and suction screens and cause high-tolerance servo valves to seize and/or operate sluggishly. As stated before, oxidizing oil produces varnish; therefore oil can absorb and hold a certain
amount of varnish. If varnish has begun to stick to the valves and/or other components in the system, it can be removed simply by introducing new oil and/or adding a filter system, which is capable of removing varnish. Varnish cannot be removed from system components once it has set, only through oil so if a filter system is continuously removing varnish from the oil, the oil will continue to absorb the varnish which has set on the components and in time will clean the system of varnish all together.

In modern equipment using servo valves, oil degradation can be even more damaging. High pressure (up to 300 bar), high temperatures, and small reservoirs stress the oil. With minimal residence time and high pressures, entrained air bubbles will cause localized heating of the hydraulic oil. This results in nitrogen fixation that, when combined with oil oxidation, can form deposits, which will plug oil filters and cause servo valves to stick.

Keep the System Clean — new systems may be contaminated and should be cleaned properly before use. Prevent any contaminants such as dirt, water, cutting fluids, and metal particles from entering the system around the reservoir cover, openings for suction and drain lines, through breather fill openings, past piston rod packing, and through leaks in pump suction lines.

Keep the Oil Clean — keeping hydraulic oil clean begins with good storage and handling practices. To prevent contamination before use, store new oil in a protected area and dispense it in clean, DEDICATED containers. Clean the fill cap before removing it to add hydraulic oil. This is also where an aftermarket filtration system can be a good investment, preferably one that works outside the system's own flow, which would be an “offline filter.” With an offline filter you can filter the oil at a flowrate that ensures optimum cleanliness, without interfering with the hydraulic system's own mechanics. A 3-micron filter would be the best option here, it will remove dirt, particles, varnish and water.

Full-flow filters designed into the system keep the oil clean while in service to some extent, they are quite coarse to allow for better flow as to not obstruct the flow of oil in the system, therefore they don’t catch everything, mostly large particles are filtered but particles smaller than 5 micron are allowed to pass through, and these particles can cause the biggest problems. On top of being too coarse, these filters are often forgotten and go into bypass mode, thus allowing dirty oil to circulate. Inspect oil filters frequently and change or clean them before they go into bypass mode. Offline filters will supplement the installed filters and should be constantly run to ensure the oil stays clean. These filters often work with inserts which can be changed when clogged, thus reducing the costs of buying brand new filters each time they need to be changed.

Keep an Oil Analysis Program — OEM’s generally specify that system hydraulic oil be drained annually. However, with an effective oil analysis program coupled with an offline fine filter, you can safely increase that interval while at the same time provide
yourself with an “early warning” of possible mechanical problems. At minimum, check your critical and large volume hydraulic systems at least annually by oil analysis. Semi-annual or even quarterly sampling intervals may be required for extremely critical machines.

Hydraulic System Care

Hydraulic system maintenance is just as important, and directly related to, hydraulic oil maintenance. All the filtering and analysis done on hydraulic oil would be meaningless and useless if the system itself is in a bad condition.

A 10 Point Check — A lubrication technician or operator responsible for hydraulic system maintenance should, at minimum, perform the following 10 point checklist as part of a routine weekly check of a hydraulic system:

1. Check fluid levels. Add oil (if needed) via portable filtration (if available). DO NOT MIX OILS! Use the same oil brand and viscosity grade that is being used in the system.

2. Inspect breather caps, breather filters and fills screens — DO NOT punch holes in screens in order to expedite adding oil.

3. Check filter indicators and/or pressure differential gages.

4. Visually inspect all system hoses, pipes, pipe connections for leaks and frays. Hydraulic fluid leakage is a common problem for industrial systems. Excessive leakage is an environmental and safety hazard, increases waste streams and oil consumption, and, if ignored, can reduce the system capacity enough to overheat the system.

5. Check system temperature via built-in thermometers or hand-held infrared detectors. Normal temperature range for most systems is 40-60 degrees Celsius. If temperatures are high, check cooler operation and relief valve settings.

6. Visually inspect the inside of the reservoir for signs of aeration (via the fill hole using a flashlight). Aeration is a condition in which discrete bubbles of air are carried along in the stream of oil as it enters the pump. Visual signs of aeration in the reservoir are generally foaming and/or little whirlpools taking small gulps of air into the suction strainer. Causes of aeration include: low fluid levels; air leaks in the suction line; low fluid temperature; fluid is too viscous to release air or maintain suction at the pump; or faulty shaft seals. When air leaks are suspected on the suction line, smothering these points with oil will usually pinpoint the leaks by creating a marked change in pump noise. A pump ingesting air sounds as if it were gargling marbles.

7. Listen to the pump for the signs of cavitation. Cavitation is slightly more complicated than aeration, but bares some similarities. Cavitation occurs when air is...
released from the hydraulic oil during momentary depressurization at the pump suction and then imploded onto metal surfaces upon discharge. These implosions are extremely destructive to pump surfaces. A cavitating pump will emit a high-pitched whine or scream. Causes of cavitation are the same as those of aeration with the exception of suction side air leaks. How do you discern aeration from cavitation? One solution is to install a vacuum gage on the suction side and make sure the pressure is equal to or greater than that prescribed by the pump manufacturer. Foaming in the reservoir is usually the telltale sign of aeration.

8. Inspect a small sample of fluid for color, signs of contamination and odor. Keep in mind that visual inspection is limited in that it will only detect signs of excess contamination.

9. Scan electrically controlled servo valves with an infrared thermometer. High valve and solenoid temperatures (over 65 degrees Celsius) usually indicate the valve is sticking.

10. Scan the electric drive motor with for housing hot spots and rotor bearing temperatures using an infrared thermometer.

**Fluid Change-Out Recommendations** — these are the proper steps to follow when changing the hydraulic fluid in a system.

1. Drain the system while the fluid is hot to keep contaminants in suspension.

2. Empty fluid from cylinders, accumulators and lines that might not drain properly.

3. Mop, siphon, or pump out oil left in the reservoir.

4. Wipe reservoir clean with lint free rags and remove rust and free paint.

5. Replace or clean filter elements and strainers and clean filter housings.

6. Refill the system with new fluid making sure to vent high points.

7. Restart and check system for proper operation.

**Safety Precautions**

Hydraulic systems operate under very high pressures. Shut the system down and relieve system pressure before opening any part of the system that is under pressure. Do not allow spray from any high-pressure leak to contact any part of the body, as serious injection injuries may result. Pumps, valves and motor may become hot; be cautious of incidental contact between bare skin and hot surfaces. Keep hands and clothing away from moving parts of the system.