Does water ingress have to be the end of your oil's life?

Created by: KLEENOIL

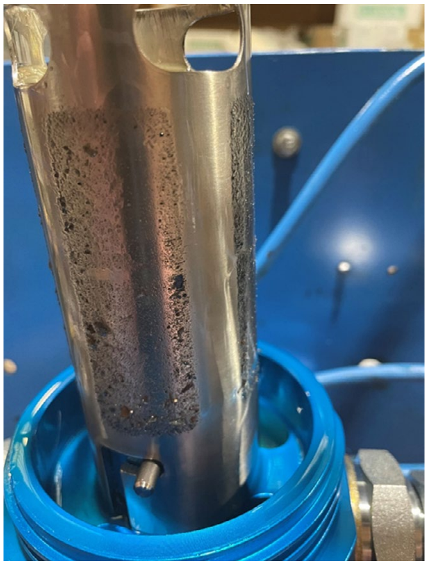
Water is an ever-present threat to machinery, and hydraulic systems are particularly susceptive. But the ingress of water into a machine's oil does not mean the oil must be discarded; the water can be removed, allowing for the continued use of the oil. And, with the implementation of depth filtration technology, this removal process doesn't have to be complicated or expensive.

What is depth filtration?

Depth filtration is an old but reliable technology. In this case, each metal vessel tightly holds the vital filtration cartridge, which is made of tightly packed, long fibre cellulose; this allows the oil to travel up the centre and push down slowly through the entire thickness of the cellulose media. This "depth" matrix is used to trap suspended particles, separating them from their carrying fluid; working by adsorption and absorption, it has the unique filtration ability to trap not only the particulate but also moisture.

Depth filtration is most commonly applied in 'polishing fluid' applications as it takes filtration to a finer level, but that is no reason to underestimate its ability to keep any tank of oil continuously clean and dry.

Where does the water come from?



Even under the best circumstances and most controlled environments, it is impossible to prevent water from entering a hydraulic system. Water can enter through cylinders or leaky seals, through rain or washdowns, and, most likely, through condensation and heat exchangers.

Water can be present in not only hydraulic fluids but also in most lubricants as either dissolved, emulsified, or free water. The point at which the fluid cannot hold any more dissolved water is called the saturation level. If more dissolved water is present than the fluid can hold, the excess water (or free water) can be present either as an easily seen separate water layer or as an emulsion that, simply put, looks like milky tea.

What are the consequences of wet oil?

Long before a failure, problems begin to occur when the saturation point is reached:

- Surface corrosion.
- Oxidation.
- Reduced viscosity, lubricity, compressibility, and load-carrying capability.
- Bearing system damage.
- Hydrolysis — causing acids to form, which wear and corrode system components.
- Crystallization/ice formation (at low temperatures).
- Higher operating temperatures can force the system to work harder and respond more slowly.
- Cavitation.
- Foaming.
- Premature additive depletion or precipitation.
- Sludge formation — water carries dirt; it bonds with system contaminants such as soot, resins, and other dirt, to create the sludge often seen in the bottom of tanks.

Water not only affects the components of a hydraulic or lubrication system, but it can also change the fluid itself, physically and chemically, affecting:

- Viscosity.
- Lubricity and load-carrying characteristics.

Large machinery that is often set outside (such as that used in recycling — balers, shredders, shears, compactors, etc.) and mobile plants operating in extreme environments still need to run on clean, dry oil; anything but will result in regular breakdowns, worn pumps, and damaged cylinders; the last thing any busy site needs is downtime.

Adding permanent extra filtration that will clean and maintain particulate levels (down to 3 microns) and remove moisture as it is created in the same application can only be beneficial to the overall operation.

 KLEENOIL

One of the biggest concerns in outdoor operation is the water; this can be addressed, even in fully emulsified oil, as this case study shows on a small application.

Cellulose depth filtration is often dismissed as an old-fashioned, slow process, but when it comes to fine filtration, slow and steady wins the race. Pushing fluids through media too fast will not ensure the capture of particles and moisture. Conversely, a steady, deliberate pace will achieve only the best results. And if placed as a permanent extra, your machinery will operate with continuously good oil. Alongside scheduled condition monitoring and filtration changes, you can use laboratory oil reports and the visual checks of the filter surfaces to see what is being prevented from entering your systems, as shown in the following case studies:

Case Study A
Cleaning water-contaminated oil in an on-site mobile machine.

The problem: Volvo excavator with water contamination.

- The owners had changed the oil, but due to numerous shafts, cylinders, and pipes, the water has blended back into the new oil to render it the same.

The solution:

- Opting for a one-day manned cleaning to remove the moisture and improve the oil.
- Using a four-vessel filtration system; although the hydraulic tank is small (200 litres), the obvious level of water contamination would require a few cartridge changes to remove.
- An MS4 offers an oil flow rate of approximately 1000 litres per hour with a water retention capacity of 750ml per cartridge.
- The system includes the Micromag MM10 to remove ferrous particulates at a submicron level.
- Remove all particulates down to 3 microns and all moisture.

Stage 1 — Before cleanse — Oil is visually wet.

Fig. 1 — Sample before cleaning.

Fig. 2 — Magnet visual.

Fig. 3 — Particle count reading: ISO 22/21/16 (NAS 12).

 KLEENOIL

Stage 2 — Mid-cleanse — Some improvement.

Fig. 4 — Sample shown mid-cleanse with some visible improvement.

Fig. 5 — Magnet visual.

Fig. 6 — Particle count reading: ISO 21/20/15 (NAS 10).

Stage 3 — Completion — Clean and dry.

Fig. 7 — Samples before cleaning, mid-cleanse, and after completion.

Fig. 8 — Magnet visual.

Fig. 9 — Particle count reading: ISO 18/16/10 (NAS 6).

Conclusion

New clean oil straight from the barrel is ideally rated ISO 18/16/13 (NAS8). The cleaned oil was better than new oil and is dry; wear and chemistry were unaffected. Independent laboratory analysis confirmed the findings (Fig. 10).

KLEENOIL not only allows the systems to clean and dry oil in operation but offers a scheduled quarterly service to provide condition monitoring and ensure filters are changed — offering a predictive maintenance plan with no extra charge other than consumables.

Database:	KLEENOIL1
Area:	H406 - VOLVO

Sample Date	08/03/2021	08/03/2021
Sample #	2153731	2153730
Unit Usage		
Oil Usage		
Oil Added		

Wear	0	0
Aluminum	0.00	1.00
Chromium	1.00	3.00
Copper	5.00	5.00
Iron	5.0	16.0
Lead	2.00	1.00
Nickel	0.00	0.00
Silver	0.00	0.00
Tin	1.00	3.00
Titanium	0.00	0.00
Vanadium	0.00	0.00
FW Idx	0	0

Fig. 10 — Independent laboratory analysis.

Case Study B
Cleaning water-contaminated oil in a fixed machine on-site.

The problem: 800 litres of water accidentally transferred into a HARRIS BALER TG604 tank.

- Owners did not want to stop vital operations while getting the oil dried and cleaned.

The solution:

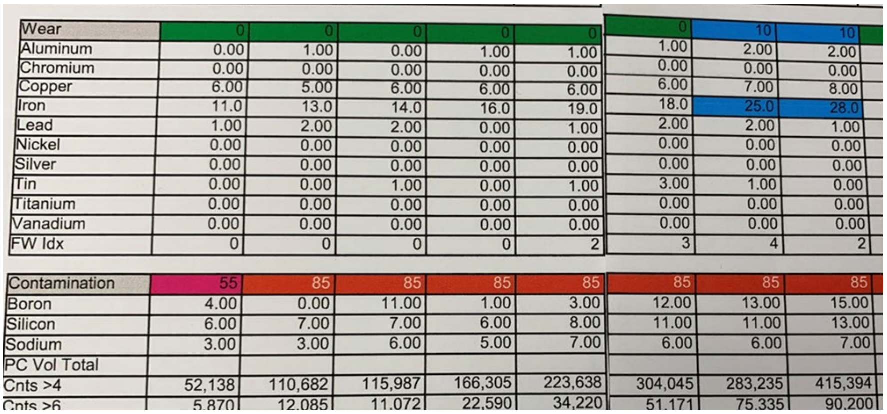
- The eight-vessel unit was brought in on a fixed two-month cleanse to remove the moisture and improve the oil.
- Opting for the MS8 as cleansing a large tank (approximately 8000 litres) with high levels of water contamination would require a few cartridge changes. Time was not an issue if operators did not need to stop production.
- An MS8 offers an oil flow rate of approximately 1000 litres per hour with a water retention capacity of 750ml per cartridge.
- The system includes the Micromag MM10 to remove ferrous particulates at a submicron level.
- The replacement filter cartridges remove all particulates down to 3 microns and all moisture.

Fig. 11 — Waterlogged oil and stages of cleanliness/dryness (left to right).

Weekly lab reports showed the water content dropping from 24810 ppm to just 133 ppm over what ended up being 14-weeks as the client wanted to continue to operate the system over the holiday period. Cartridges were changed three times a week for the first three weeks and then weekly thereafter.

This made a considerably more affordable alternative to:

- Stopping production.
- Tank cleansing.
- Changing the oil.
- Potentially still being left with wet oil as rams, pipes, pumps, and cylinders trap contaminated oil, which re-contaminates the good fresh oil.



Wear	0	0	0	0	0	0	10	10
Aluminum	0.00	1.00	0.00	1.00	1.00	1.00	2.00	2.00
Chromium	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Copper	6.00	5.00	6.00	6.00	6.00	6.00	7.00	8.00
Iron	11.0	13.0	14.0	16.0	19.0	18.0	25.0	28.0
Lead	1.00	2.00	2.00	0.00	1.00	2.00	2.00	1.00
Nickel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Silver	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tin	0.00	0.00	1.00	0.00	1.00	3.00	1.00	0.00
Titanium	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vanadium	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FW Idx	0	0	0	0	2	3	4	2
Contamination	55	85	85	85	85	85	85	85
Boron	4.00	0.00	11.00	1.00	3.00	12.00	13.00	15.00
Silicon	6.00	7.00	7.00	6.00	8.00	11.00	11.00	13.00
Sodium	3.00	3.00	6.00	5.00	7.00	6.00	6.00	7.00
PC Vol Total								
Cnts >4	52,138	110,682	115,987	166,305	223,638	304,045	283,235	415,394
Cnts >6	5,870	12,085	11,072	22,590	34,220	51,171	75,335	90,200

Fig. 12 — Independent laboratory analysis on a weekly basis throughout the cleanse (left to right).

 KLEENOIL

Fig. 13 — The Micromag traps any ferrous particles down to submicron levels, making it an essential addition to the filtration system.

Fig. 14 — Water carries dirt, moving it as a sludge that settles on the filter tops.

Case Study C
Cleaning water-contaminated oil in a mobile plant used for rentals.

The problem: Top-ups are random and inconsistent for machines hired out to remote sites.

- Owners want to address oil cleanliness during a routine service check between rentals.

The solution:

- The two-vessel unit was brought in on a two-hour cleanse to remove the moisture and improve the oil.
- An MS2 offers an oil flow rate of approximately 500 litres per hour with a water retention capacity of 750ml per cartridge.
- The system includes the Micromag MM5 to remove ferrous particulates at a submicron level.
- The replacement filter cartridges remove all particulates down to 3 microns and all moisture.
- A quick demonstration with just an MS2 shows significant improvement.

Neither the client nor the operator realized the degree of water contamination involved in this instance; this presented an opportunity to demonstrate the filtration ability on both moisture and particulate.

Particulates could be seen on the filters and magnet. The ISO went from 24/22/17 to 22/17/10. This is equal to going from NAS 13 to NAS 8 — a remarkable improvement. The oil was milky with severe water contamination. Alarm levels in hydraulic oil are around 500 ppm — this oil began filtration at 3199 ppm. The quick cleanse brought it down by half to 1785; a longer cleanse would have eliminated the remaining moisture content.

Kleenoil

Established in 1976, Kleenoil is a UK-based manufacture of the Kleenoil cellulose depth filtration system, serving all applications where oil cleanliness is key, whether it be heavily worked engines, production machinery, or oil tanks for large systems such as balers and shears in the recycling industry.

Kleenoil manufactures the entire system and the replacement filter cartridges to ensure source reliability and continual service, offering the system through established distributors across the World.

In the UK, Kleenoil offers a service-based package to alleviate the work of machine condition-based monitoring from the client, allowing for quarterly servicing, independent laboratory oil sampling, and full reporting to achieve predictive alerts to potential issues.

A Worldwide distribution network offers the Kleenoil system as a direct installation or mobile unit to suit any application. Even in the most aggressive environments, Kleenoil can address the issues of moisture, particulates, varnishing, and component failures due to poor oil hygiene.

The Kleenoil ethos is to reuse your oil rather than change it — reduce your oil consumption to merely top-ups, and you will save not only your own resources but also the rest of the World's.