MH HYDRAULICS TECH TALK #3 – VARNISH, A SILENT KILLER IN HYDRAULIC & LUBRICATION SYSTEMS.

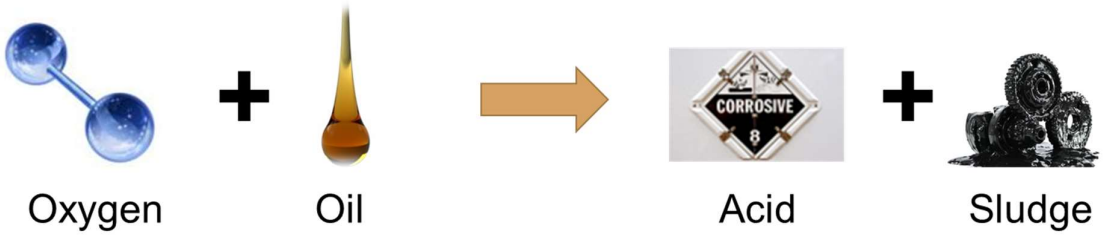
MH Hydraulics FZC, a leading hydraulic solutions provider in the Middle East is talking about oil contamination. In the previous tech talks released in September and October 2020, we have discussed the importance of **oil cleanliness** to our equipment and **the ways to prevent oil contamination**.

In this article, we explain another culprit in the hydraulic system which is **"Varnish"** with the recommendation from **DES-CASE RMF Systems** a market leader and manufacturer of advanced filtration systems / solutions and desiccant breathers from the USA and the Netherlands.

Varnish is a common problem for a wide range of hydraulic fluids and lubricants. It results in valve sticking, shorter fluid life, shorter filter life and unscheduled downtime.

What causes Varnish?

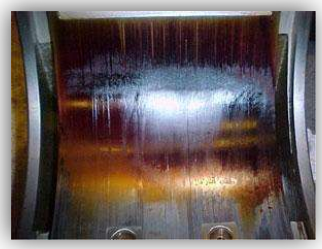
Varnish formation is mainly from oxidation and thermal degradation. When oil molecules come into contact with oxygen under favorable condition, they react to form acids and oil insoluble by-products that form sludge and surface deposits such as varnish.



Thermal degradation happens because of the chemical change in base oil molecules at high temperature. Thermal failure occurs whenever the oil touches a machine at elevated temperatures.

Oil degradation leads to dissolved sludge.

Oil quickly becomes saturated and suspended sludge makes oil appear dark and cloudy.



Oil comes in contact with cool surfaces and causes suspended and dissolved sludge to adhere to machine surfaces.

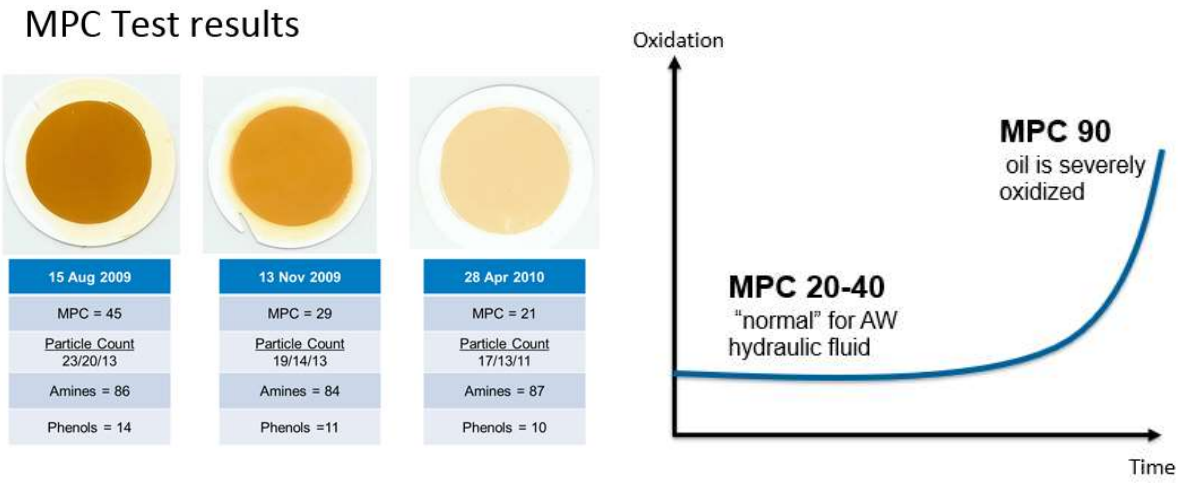
Varnish reduces clearance zones, which means a transition from hydrodynamic lubrication to boundary lubrication which increases wear rates of pumps, bearings and gears. Varnish increases friction in components which will result in higher energy requirements. Varnish acts as an insulator, lowering the effect of heat exchangers and lessening the ability of oil to cool. Varnish accelerates wear by attracting dirt and solid particles.

How to detect varnish?

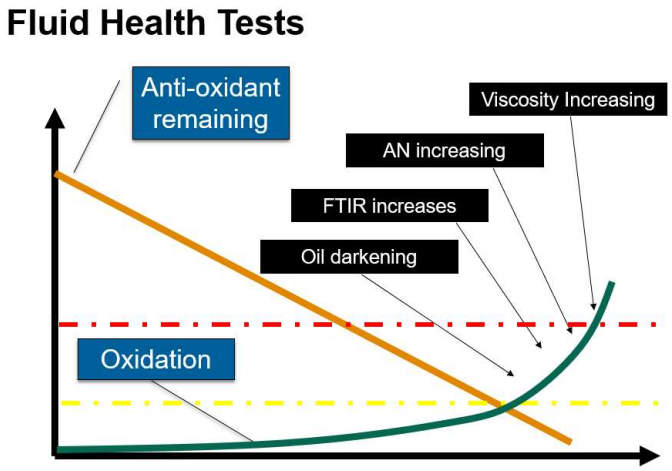
Early detection of Varnish is important and can be done by inspecting oil for visible deposits and discoloration. Oil is susceptible for varnish if switched from Group I to Group II oil or if the oil is blended. A reduction in filter efficiency, filter plugging, high operating temperature, spark discharge in oil reservoir are other symptoms of varnish formation.

Membrane Patch Calorimetry (MPC) is one of the tests used for varnish detection which measures how “dark” the oil is as a result of suspended by-products of oil degradation.

The more severely oxidized the oil is, the longer it takes to “turn the clock back” .

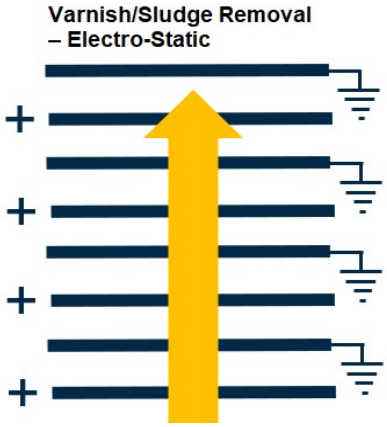


Other tests in use for detecting varnish are Ultra Centrifuge (UC), Remaining Useful Life (RULER), Acid Number (AN), Varnish Potential Monitoring which uses all above tests and includes Particle Count (ISO Code) measuring particulate contamination, Karl Fisher measuring water, IR Spectroscopy (FTIR) measuring wear metals and additive degradation.

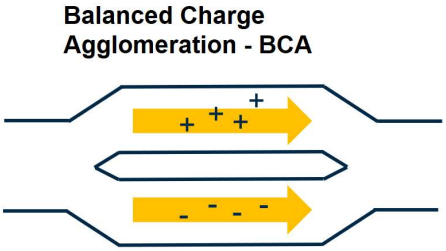


How to remove varnish?

There are different technologies to remove and control varnish. One of them is using **Electrostatic separators** which place a charge on the oil to cause sludge and fine particles to precipitate to a charge collection plate. Very effective for removing semi-soluble soft particle and preventing deposits. Disadvantages are it is affected by moisture contamination, expensive and often not well maintained.

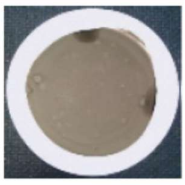


Balanced Charge Agglomeration (BCA) is another way where the separators place a charge on the oil to cause sludge and fine particles to agglomerate so they can be filtered out of the oil. Very effective for removing semi-soluble soft particle and preventing deposits. Affected by moisture contamination.



The **Des-Case RMF solution** is one of the most efficient in varnish Removal. The filter unit acts as a kidney loop, continuously circulating fluid through the filter media. The Varnish Removal System can be configurated for applications with fluid volumes up to 36,000 liters (9,500 gallons). For the best (continuous) results and for the unit to be most efficient, it should be installed permanently or at least for an extended time period. The Long Fiber Cellulose / PP cartridges are specially designed for the removal of varnish byproducts which are dissolved in the fluid. These cartridges adsorb polar acids by means of special compacted fibers which create an intricate internal flow path. Unlike other technologies, the cartridges do not add water to the fluid. They actually remove water and other solid contaminants. Other advantages include that the unit works independent of (high quantity) water presence in the oil and also works within a wide window of oil temperatures.

Des-Case's new RMF varnish removal system results on a plastic injection moulding machine.

	23-07-2019	13-08-2019	29-08-2019	18-09-2019
ISO Code *ASTM D7647*	25/20/14	17/14/11	18/15/11	15/13/10
Component Life Expectancy	15%	70%	55%	115%
MPC Value	63.4	7.8	3.2	1.6
Level Rating	Critical (>40)	Normal (<15)	Normal (<15)	Normal (<15)
MPC Weight	.0182 g	.0072 g	.0018 g	.0038 g
				

To conclude, with the changes to oil formulations which have inherently lower solvency and solubility for varnish precursors, varnish will continue to grow as an issue. Much like the impact of cholesterol on the human body, the impact of varnish can remain hidden until the problems become too late. For critical systems with servos and other critical control valves, removing "bad cholesterol" from your oil is as important as removing solid particles and moisture.