

# CALLCOTT & DOWNEY

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## ENGINEERING SERVICES

### Causes of Darkening Hydraulic Fluid



*"After pulling a fluid sample from one of our hydraulic systems, we noticed that the hydraulic fluid had become darker. We were concerned, so we rushed the sample to the lab for analysis. The results of the fluid analysis appeared normal. The acid number, viscosity and oxidation by FTIR have all remained stable. A quick inspection of the hydraulic system revealed that the hydraulic valves have turned goldish in color. What should we do?"*

The fact that the acid number, viscosity and oxidation have not changed indicate that oxidation is not taking place in the hydraulic oil. However, the golden residue on the valves is a clear sign that varnish is precipitating out of the fluid. Since varnish is composed of fluid degradation byproducts, you must determine the source of the fluid deterioration if it is not oxidation. Most likely it is thermal degradation, which occurs in the absence of oxygen. Left untouched, this varnish will impact the valves' capability to function properly.

The cause of thermal degradation is heat. Two of the most common sources of extreme temperatures in a hydraulic system are a hot spot caused from an external heat source in close proximity to the lube system and the implosion of entrained bubbles as the bubbles flow from the reservoir into higher pressure zones like the pumps or valves.

To address this problem before performance issues start to occur, you should first confirm that thermal degradation is indeed the source of the problem. Ask the laboratory to provide the FTIR curve, and instead of looking at the wave-number region where oxidation levels are measured, look for a peak in the nitration region. If so, thermal degradation would be substantiated.

In addition, you should perform a root-cause analysis to investigate the source of the heat in the system and determine if it is a system design flaw or if there is a solution that could be engineered to remove this heat source. If the problem appears to be entrained air, there are technologies available to remove bubbles from the hydraulic fluid to solve this problem.

Finally, if it is concluded that the thermal degradation is a result of the system design, you can utilize a separation technology to remove the thermal degradation byproducts from the fluid, providing a permanent Band-Aid to the varnish formation until a system redesign can be accomplished.