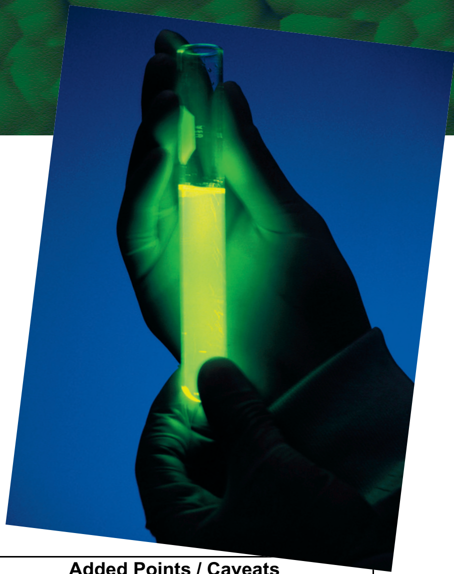
Hydraulic sampling and testing components



By Jack Poley

We continue our discussion from the July TLT with tables suggesting preferred groups or suites of tests for routine monitoring of various components used in specific applications. This time we'll look at hydraulics.

Hydraulics — Industrial Applications

TEST SET	Primary Objective(s)	Reasoning and Evaluation	Added Points / Caveats
Spectro Metals (SMA)	1. Spot (some) wear events. 2. Check for abrasives. 3. (Some) Additive conformity.	Many hydraulic wear mechanisms are large particle in nature, thus, SMA plays a fill-in role, e.g.: correlating abrasives with increased particles and silicon, verifying additive package conformity (not efficacy), possible metallic (wear) correlation.	Rotary equipment offers the most difficulty for SMA to contribute its full value because a lot of the wear situations involve large particles not detectable with this test.
Micro-Patch Particle Debris Analysis (MP) *AND / OR* **Particle Count (PC)**	Identify and Quantify large particles not detectable via SMA.	This is the key test for hydraulic systems. Technically MP and PC are not "either" / "or" tests. Having both tests available would be ideal, however, economics becomes an issue much of the time, forcing a choice. The PC is often recommended ahead of MP solely because it's a holistic approach to particle detection, i.e., All particles within the ranges tested are accounted fo and sized. Normal levels for a given system type usually suggest there are r problems.	One could also employ a ferrous metal debris inspection, however, this results in a highly limiting result in terms of drawing good inferences. Further, the fine filtration employed by hydraulic systems causes removal of much of the clue-providing information one is seeking.
Viscosity (VIS)	1. Verify proper film strength. 2. Oxidation correlation.	VIS results are usually very stable for hydraulic systems. Changes, particularly abruptly, are first suspicious as to accuracy, i.e., mis-identified sample, sample switch in the lab, etc. Once significant changes are deemed credible then they become near-critical: either a high temperature issue or addition of wrong oil, both particularly dangerous occurrences in hydraulic systems.	VIS should *always* be a part of an oil analysis test package, simply for negative (*i.e., non-problem*) inferences that it tends to offer when the value is as expected.
Infrared Spectro (FTIR)	1. Oxidation* 2. Additive depletion (as applicable).	Certain lube additives may be detectable via FTIR and, if so, may allow monitoring of the additive's continued efficacy, i.e., the additive's potential depletion.	****NOTE***: FTIR will be ineffective in detecting oxidation when certain synthetics are employed, where the oxidation band overlaps significantly with the lube's chemistry.
Optional? **Acid Number (AN)**	1. Oxidation correlation. 2. Additive depletion (as applicable). 3. (Process contaminaton).	Acid contamination rarely enters a hydraulic system, so that oxidation and (possible) additive depletion are the primary benefits to be derived from AN. If FTIR is able to monitor the oxidation level and/or additives, AN likely becomes an optional test.	Oxidation often causes AN increases, but not always. FTIR and VIS are more dependable oxidation indicators much of the time.
Water Karl Fischer (KF)	1. Process contamination. 2. Poor lube handling techniques.	Water is highly deleterious to hydraulic systems, accordingly, a more sophisticated and accurate method is usually employed to allow early detection before a critical level is reached. Such levels are often well below 300ppm (0.03%), a level not detectable, let alone quantifiable, by typical cursory methods (e.g., a sputter test).	We've noted that water quantity detection is particularly undependable in terms of repeatability because of its non-miscibility with oil. Sampling for KF water is particularly critical in this regard if meaningful results are to be obtained.

Postscript

Hydraulics, like most rotary type systems, cannot be properly fathomed for wear particles with SMA. The ratio of large-to-small particles can be relatively significant, particularly when a failure mode is developing. As with gearsets, however, we emphatically recommend SMA testing routinely for all its support value.

When we defined the Micro-Patch test (MP) in an earlier column, we noted that one could preweigh the filter patch then, upon proper and careful solvent evaporation from the patch, determine the weight of debris collected. If this procedure option is included in the MP test, we would often choose MP over Particle Count (PC) for hydraulics and other industrial systems.

With a weight analysis component, the MP effectively bridges the gap between PC and analytical ferrography (AF). While one might always want to perform AF before rendering a critical decision about a component's near-term serviceability, MP may at times preclude the need. PC, conversely, should almost never be a criterion for equipment maintenance (other than the obvious filter or fluid servicing).

Note, as well, that responding to an unsatisfactory PC result by servicing the filter or fluid removes possible evidence of wear if the SMA result is non-revealing (a wear mode such that mostly large particles are involved), which is why MP (or AF) might be advisable, perhaps on alternate samples (but *including* the PC test).

Hydraulic sampling and testing, or any sampling where the sample is destined to receive a PC, requires particular care in the process because it is relatively easy to contaminate the container with additional particles. Certified clean sample bottles, with a maximum particle contamination certification, should preferably be used. Care is also required in the laboratory to avoid contamination introduction prior to testing. The sample must also be properly agitated just prior to actually performing the PC test.**<<**

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