Top 10 Misperceptions about Oil Analysis

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Studies show that 60 to 70 percent of all mechanical problems can be detected using oil analysis, yet some people still struggle to realize the value a well-engineered oil analysis program can provide. The reasons are many and varied, but are often related to a fundamental misunderstanding of how oil analysis works. The following Top 10 list identifies some of the more commonly held misconceptions and fallacies about oil analysis.

1 ELEMENTAL ANALYSIS IS A SUREFIRE WAY TO FIND ACTIVE MACHINE WEAR

One of the most common tests used in oil analysis is the elemental – sometimes called spectrometric – analysis test. Depending on which lab you use, this test provides concentrations in parts per million of up to 25 elements, including metals indicative of machine wear, such as iron, lead, tin, or copper; additive elements, such as zinc, phosphorus and calcium; and contaminants, such as silicon and sodium.

Most people rely on the elemental analysis test to determine when a machine is starting to wear so they can take corrective action. However, depending on wear mode, this test can lead to a false sense of security. The issue lies in the fundamental test methodology used to determine wear debris, known as inductively coupled plasma (ICP). Specifically, ICP instruments lack sensitivity to particles below three microns, so depending on wear mode, this test can be misleading. While elemental analysis can be an excellent test for revealing slow incipient wear or wear modes that create small particles (<3 um in size), such as corrosive wear, it can completely miss wear modes that generate larger particles greater than 5um, such as adhesive wear in gearboxes or fatigue wear in rolling contacts. Instead, ICP should be complemented by large particle detection tests, such as particle counting, particle quantifier (PQ) or ferrous density.

2 DON'T SAMPLE THE SMALL STUFF

Another commonly held fallacy is that oil analysis holds no value if the oil volume is so small that the cost of the analysis outweighs the cost to change the oil. And while it's true it may not be cost-effective to use oil analysis to optimize oil drain intervals, there is more to oil analysis than just timing an oil change. Simply changing the oil doesn't guarantee an active wear problem or contamination issue has been resolved. The reality is any machine that is production, safety, or environmentally critical should be sampled, particularly if oil analysis is the only predictive tool capable of providing an early warning. Probably the biggest disservice ever given to oil analysis was calling it "oil analysis." Oil analysis also measures the health of the machine and the degree of contamination, not just the health of the lubricant.

3 MEASURING WATER CONTENT IS IMPORTANT

While this is definitely not a false statement, when it comes to paying a lab to determine water content, it is buyer beware. There are several methods used to detect water in oil, from basic screening tests, such as the crackle test, to instrument-based tests, such as Fourier transform infrared (FTIR) and Karl Fischer moisture. While cut-price oil analyses may appear to give you everything you need, these programs tend to over rely on fast, cheap methods like basic FTIR (absent of chemometrics) or crackle, which lack the sensitivity of more sophisticated tests.

Your response might be, "I've got this one covered, we do Karl Fischer moisture." But not so fast! Karl Fischer refers to the test reagent used, not the test method. In fact, according to the ASTM test standards book, there are several different methodologies that fall under the category of Karl Fischer moisture. The problem lies in false positives that can occur due to creation additives, such as phosphorus containing AW additives, as well as some wear metals, such as ferric salts, particularly with volumetric test methods. Where low water level accuracy is required (<100-200 ppm), ASTM D6304, including co-distillation, is the preferred method.

4 OIL ANALYSIS IS A COMMODITY THAT SHOULD BE BOUGHT FROM THE LOWEST BIDDER

Having cut my teeth in the world of lubrication and oil analysis selling and supporting oil analysis services, I can attest that some users will think nothing of switching oil analysis vendors for a 50 cents or $1 price differential per sample. And while I'm certainly not a proponent of overpaying for oil analysis, consider the cost of missing a failure on a critical gear drive because you weren't willing to pay an extra few dollars to get a PQ or ferrous wear test. The best oil analysis practitioners build test matrices around specific ASTM or ISO test methods (e.g., ASTM D6304 vs. simply requesting "test for water") and mandate that their lab follow the method as closely as practical. In oil analysis, like many walks of life, you get what you pay for.

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5 RPVOT IS A GOOD INDICATOR OF OXIDATIVE POTENTIAL

Historically, the rotating pressure vessel oxidation test (RPVOT), formerly known as RBOT, has been used to measure an oil's re-

maining oxidative life. However, because the test is an accelerated oxidation test involving very high temperatures (150 C) and high concentrations of pro-oxidants, like water, copper and oxygen, the RPVOT test alone can be misleading, particularly with modern turbine oil formulations. Where the RPVOT is performed, the results should be considered in concert with other tests, such as varnish potential (QSA and/or MPC) and direct measurement of phenolic and amine-based oxidation inhibitors (RULER instrument), to truly gauge the remaining life and health of the lubricant.

6 SILICON ALWAYS MEANS DIRT

One of the most useful elements to trend is silicon. Common dirt contains high concentrations of the mineral silica (sand) so an increasing silicon trend can be a good indicator of dirt ingression. However, silicon also can be present in other forms. For example, new equipment that has been cast in sand (e.g., new engine blocks) often contains trace silica (silicon) embedded in its walls that sloughs off during the first few hundred hours of operation. Likewise, silicone-based sealants can leach silicon into the oil, while some gear and engine oils contain methyl silicone as an anti-foam agent, often ranging from 10 to 20 ppm in new oil.

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The easiest way to determine silicon from dirt versus other sources is to look for secondary elements, particularly aluminum, which is often present from the mineral alumina. Depending on the geology of your local area or the process, silicon to aluminum levels in used oil range from 5 to 10:1, silicon: aluminum.

7 OIL ANALYSIS IS ONLY GOOD FOR OILS

The term oil analysis, of course, refers to chemically analyzing lubricating oils. But did you know you can also analyze grease? While getting a representative sample can be a challenge, grease can be analyzed for the degree of degradation, presence of contaminants, or other incompatible grease, as well as for wear particles that can be evaluated for their morphological properties (e.g., size, shape, color, etc.).

8 OIL ANALYSIS IS NOT NECESSARY WHERE VIBRATION ANALYSIS IS DEPLOYED

Several studies have attempted to evaluate the relative effectiveness of oil analysis versus vibration analysis. But whatever side of that fence you sit on, it's true that in some cases, such as misalignment or imbalance, vibration will always win the day, while in other cases, oil analysis in a better indicator. The reality is that oil analysis is often an earlier indicator of a problem, while vibration analysis is a much better way to localize the source of incipient machine failure. When it comes to predictive maintenance, both oil analysis and vibration analysis are required for an effective program, a true case of one plus one equals three!

9 LOW ACID NUMBER MEANS NO OXIDATION

Acid number testing uses a classic acid-base titration to detect the formation of acidic by-products in oil formed by incipient oil oxidation. However, since the test effectively measures the concentration of these acids in the oil, dilution effects, particularly in large volume systems like turbine oils and paper machine oils, often negate the effectiveness of acid number testing. Similarly, some oils containing antiwear (AW) or extreme pressure (EP) additives that are mildly acidic can also provide falsely high or low readings (due to additive depletion), so caution always should be used when reviewing acid number data. Like most oil analysis tests, acid number values should be considered in concert with other test properties, like additive health, water content and new oil baseline values.

10 ANNUAL OIL ANALYSIS IS A GOOD WAY TO PLAN FOR SHUTDOWN OIL CHANGES

The cost of oil – both the raw cost and disposal costs – always seems to be increasing. Yet, many companies looking to maximize their investment while minimizing their environmental footprint are using oil analysis to time oil changes. But oil analysis, and particularly lubricant health, is about trend analysis, looking at slow changes over time rather than a one-off snapshot. At a minimum, quarterly oil analysis is required for effective monitoring. For higher speed machinery or higher oil temperatures, monthly analysis is really the only surefire way to get good, trendable data in a timely fashion to make sound maintenance decisions.

So there you have it, the Top 10 oil analysis misperceptions. How many can you identify with? Don't let yourself be lulled into a false sense of security. Precision oil analysis is not about filling a sample bottle with oil, expecting the lab to tell you which component is about to fail, how long it has left and how to fix the problem. Oil analysis is like any other tool; it has to be used in the right way and at the right time by a skilled craftsperson who understands how to maximize the leverage of the tool in hand.

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