Technical Topic

Oil Analysis — The Basics

Lube oil is the life-blood of machinery. Much like doctors assess our health though blood analysis, critical plant equipment must be monitored in much the same manner. Chronic lubricant or equipment symptoms show up as indicators in oil analysis samples and, if left uncorrected, can lead to equipment degradation and lost productivity. Therefore, the goal of a proactive oil analysis program is to trend gradual changes in fluid properties, contaminants and wear debris so that corrective action can be initiated in a controlled, planned manner.

Oil Analysis Benefits Include:

- Optimum Equipment Life
- Extended Oil Life
- Reduced Downtime
- Improved Safety
- Environmental Awareness

Oil Analysis Assists Maintenance Personnel in Two Primary Ways:

First — Determining the physical condition and contamination of the oil. Lubricant serviceability can be impacted by either reaching the lubricant's life span OR contamination levels have reached a point requiring a drain and refill, unless purification is an option. When talking about contaminants, the objective is to detect the presence of foreign components and to ask "What are they? Where did they come from (built-in, generated, ingressed, introduced)? How can I prevent further entry or generation?" Contaminants act as a catalyst for wear. This generated wear debris further acts as a catalyst for additional component wear. If the cycle is not broken, wear accelerates and downgraded serviceability results.

Second — Monitoring wear metals for abnormal machinery distress conditions. Wear debris analysis relates specifically to the health of your equipment. As you know, the main function of a lubricant is to separate two surfaces, in relative motion to each other, from making contact. However, its is generally impractical to maintain a lubricant film that will keep those same surfaces totally separated from each other. Thus, metal-to-metal contact can occur, even in today's high-tech equipment . In addition, keep in mind that boundary lubrication will always be present during start-up. At that critical point in the machine's operation, some normal and/or abnormal wear metals will be generated, with the amount depending on equipment design and whether or not it has proper lubrication.

Testing

The following tests are used by ExxonMobil (depending on application) to determine changes in physical properties of the oil, oil contamination and equipment wear debris:

- **Viscosity by ASTM D 445:** indicates changes in fluid's resistance to flow. Viscosity results can indicate either physical changes or contamination by other fluids.
- **Oxidation by FTIR (Fourier Transform Infrared Spectrometer):** identifies harmful by-products of thermal degradation. Lubrication oxidation represents a physical change.
- **Nitration by FTIR:** identifies harmful by-products of fuel combustion. Nitration is a physical lubricant change, much like oxidation.
- **Glycol by FTIR/ASTM D 2982:** identifies the presence of engine coolants.
- **Soot by FTIR:** identifies the by-products of unburned fuel. This is also contamination.
- **Water by FTIR/Hot Plate/Karl Fisher ASTM D1744:** identifies the presence of water, a common and potentially harmful fluid contaminant that can accelerate physical lubricant change and rapidly degrade metal surfaces.
- **Total Acid Number (TAN) by ASTM D 664:** measures/identifies acid by-products of oxidation and contamination. TAN is a physical change.
- **Fuel Dilution by Gas Chromatography:** identifies the presence of fuel, another contaminant.
- **Elemental Analysis by ICP (Inductively Coupled Plasma Spectroscopy):** identifies both additive and wear debris metals.
- **Total Base Number (TBN) by ASTM 4739:** identifies acid neutralizing capacity. This is a physical lubricant change.
- **ISO Particle Count:** identifies the size and amount of solid contaminants.

Where to Start

It's easy to see the importance of a proactive oil analysis program, but knowing where to start can often be overwhelming. Don't let the vast array of analysis hardware and test results keep you from getting started. Here's a simple seven-step process to get you off and running:

Step 1: Identify "Mission Critical" Equipment

It's not necessary to perform oil analysis on every single lubricated system in your plant. Identify critical applications that would seriously jeopardize production if they were to shut down unexpectedly.

Step 2: Register Your Equipment

It is important to have your equipment properly registered with the lab. This supports routine trending and plays a key role in early detection of lubricant or equipment problems. There's no need for you to decide which tests are appropriate for a particular application because the lab has already established test slates for specific applications.

Step 3: Establish Best Practices

Establish a consistent "how-to" practice for taking oil samples from your equipment and train your maintenance personnel to use this practice. Correct sampling practices are critical to the value received from the analysis data. This extremely important step rarely gets the attention it needs.

Step 4: Sample

Retrieve samples in accordance with your best practice and send them to the lab as soon as possible. Samples that are set aside may deteriorate and give non-representative results. For further guidance on Steps 3 and 4, please see our Signum Oil Analysis technical information guide titled "Condition-Monitoring Fundamentals." This guide can be found on www.signumoilanalysis.com.

Step 5: Analyze

A thorough analysis, keyed on trends, helps determine your systems' conditions. General laboratories may have a pretty good idea of what they are measuring, but often know little about specific formulations and don't always understand whether or not the differences they see are significant.

Step 6: Interpret

Reviewing the results and determining what, if any, action is required can make or break a successful program. ExxonMobil has an extensive database of test results and has developed recommended control limits based on years of testing. In any case, it's important to remember that an alert sample does not necessarily mean imminent failure. Seek consultation on alert samples and re-sample to confirm present data before taking massive corrective action.

Step 7: Take Corrective Action and Document, Document, Document!!!

As always, documentation is the key to knowing where you've been and where you're going. Document corrective actions resulting from oil analysis. Historical oil analysis and corrective action documentation is difficult for an OEM to dispute when you call for warranty work.

Why Sampling Programs Fail

When sampling programs fail, the reason is usually one of five major factors:

- **Lack of Understanding:** Knowing what to expect from your analysis program helps determine the right units to sample and the best sampling frequencies. Before starting a sampling program, you'll find it useful to define why you need a sample program and how the test data relates to the productivity of your equipment.
- **Lack of Interpretation Knowledge:** It is important to know the equipment well enough to quickly relate the analysis results to the noted performance of the equipment being tested.
- **Lack of Commitment:** There must be a mutual commitment from all involved, from the highest levels of management down to the person taking the sample. For the program to succeed all parties must be willing to devote time and training to the program.
- **Poor Sampling Procedures and Practices:** Improper sampling procedures cause erroneous results.
- **Irregular Sampling Frequencies:** Monitoring fluid condition and system performance by trending is far superior to hit-or-miss sampling methods. Lubrication scheduling and oil analysis software, such as Mobil Monitor LMS and Mobil Monitor Lubrication Technician can assist in the implementation and tracking of routine sampling.

Oil analysis is a useful, predictive and proactive too that can help prevent equipment breakdowns, determine the root cause of failures and aid in locating operational and contamination problems. If you need help implementing an oil analysis program, our ExxonMobil field team is ready and willing to help. We can help develop your program and provide on-site technical support and training to properly administer this seven step process.

Refs: "Protecting Your Assets With Oil Analysis"
By Jon Sewell
Mobil Periodical — "The Engineered Difference"

www.mobilindustrial.com