OIL
CONDITIO
MONITORING

The oil analysis laboratory can play an important role in supporting root cause investigations. However, the laboratory needs to be powerfully equipped, with both the best analytical instrumentation and fluid know-how if it is to be effective.

An Effective Lab

Sampling method and record keeping are the most important parts of any investigation if a lab's conclusions are to be valid. Sampling must provide a representative sample for the analyst, and a sufficient set of samples is required for a statistically meaningful suite of conclusions to be drawn.

Since most investigations are likely to be concerned with identifying potential contaminants, it is vital that contamination during sampling be minimized. In fluids and fine powders testing, sample containers must be clean and their storage conditions controlled and documented.

Sampling equipment should be flushed with the material at least three times, where practical. Sampling valves/pipes should be flushed of old product and debris, if this is not relevant to the investigation. As large a quantity of fluid as is practical should be obtained to ensure that the sample is fully representative and, where possible, sample containers should be filled to 80 to 90 percent of capacity.

Thereafter, the laboratory investigation can proceed under the

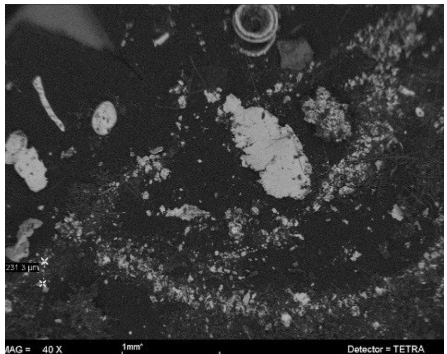
N

KEEPS EQUIPMENT HEALTHY

BY ROBERT CHAPMAN

usual strict controls set out by the accredited laboratory quality system, including full traceability of sample custody and origin. The remainder of this article presents some useful technical information on some common tests and a two case studies, which, at a technical level, we are permitted to disclose and where expert laboratory support has been a key to root cause incident diagnosis or preventative monitoring.

The case studies shown below illustrate the role that an expert laboratory can play. It also explores the innovative nature of an analysis laboratory in supporting industry and saving money.



SEM image of wear particles isolated from used lubricant.

Optical image of wear particle isolated from used lubricant.

What's Measured

Lubricant and fuel testing can be a critical first line of investigation where tools traditionally used for oil condition monitoring and fuel quality certification can play a critical role. Depending on the circumstances, a suite of tests must be carefully deployed to provide the key diagnostic data.

Particulate Analysis: A scanning electron microscope with energy dispersive X-ray fluorescence (SEM-EDXRF) can identify the constituents of particles or particulates found in fluid samples.

Rogue particulate contamination can often provide critical root cause evidence of a failure. For metal particles, analyzing the morphology – shape and size – and their elemental composition can determine the metal alloy type, and this can

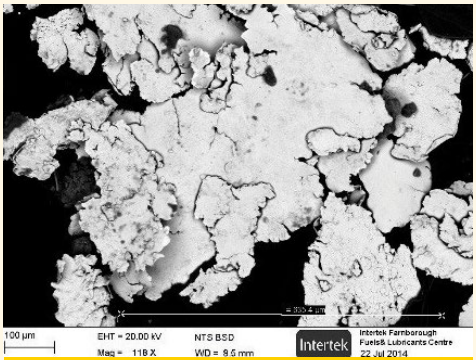
[Blowing in the Wind]

Intertek's OCM diagnostician team identified a sudden increase in wear metal (Iron) and PQ (Ferrous) Index results in a sample taken from a wind turbine gearbox. We performed a full debris investigation using Scanning Electron Microscopy with Energy Dispersive X-Ray. The results indicated that the metal was a low alloy bearing steel. We recommended that the gearbox be inspected to check for bearing or raceway damage.

The customer investigated and confirmed the analysis, finding a damaged bearing race and housing in the gearbox. Cost savings, taking into account the replaced parts and downtime saved, was estimated to be more than U.S. $75,000.

Elemental Oil Analysis – ICP (ppm)

Date	Fe	Cu	Al	Mg	Cr	Na	Li	Zn	Ni	Si	Pb	PQI
23/6/14	436	40.6	15	4.8	1.3	<0.1	--	5.0	<0.1	9.7	<0.1	222
20/2/14	434	0.5	11	3.7	1.1	4.2	--	3.2	<0.1	8.0	<0.1	748
7/4/13	92	<0.1	6.5	2.8	<0.1	<0.1	--	<0.1	<0.1	4.6	<0.1	54
30/1/13	126	0.3	10.0	3.8	0.8	1.4	--	3.8	<0.1	6.5	<0.1	152
Limit	55	30	25	--	5	--	--	--	10	50	20	50



Wear debris from wind turbine oil sample.

SEM image of wear debris in wind turbine oil sample.

identify the system or component that is producing the material. It is useful for identifying particulate and wear debris that have been generated by components in oil-wetted systems. Unusually high levels of particular alloy types can identify components suffering from excessive wear.

Elemental Analysis: Elemental analysis provides key information about a variety of parameters, all of which are useful to the investigator. It gives a quantitative measurement of wear metal levels in an oil sample down to concentrations as low as 0.1 parts per million.

Lube additive depletion levels and the presence of contamination by other fluids can also be assessed. At an experienced laboratory, data can be compared to the historic records of an individual system, allowing anomalies to be detected.

Fuel Dilution: Fuel dilution of crankcase lubricants may occur due to the build-up of fuel from an injector problem, or because engine wear is allowing combustion chamber blow-by. It can significantly decrease oil viscosity and cause poor lubricant performance and, in extreme cases, crankcase explosions. High levels of fuel dilution along with reduced oil viscosity can indicate piston ring wear, which may be a cause of poor engine performance and fuel economy.

Water Content: Water is a common contaminant and can cause poor lubrication, icing, microbiological growth and corrosion, leading to accelerated and excessive wear, rusting or other performance issues.

Insolubles Content: Soot content increases over time in engine oils, particularly if incomplete combustion occurs. The soot particles are too small to be removed by the oil filter and remain in suspension. Very high soot content can reduce oil viscosity and degrade oil performance.

Total Base Number (TBN): This test measures the level of basic (alkaline) constituents in an oil sample. Alkaline additives are present in certain oils to help prevent the build-up of acidic compounds as the oil degrades. Additive depletion occurs as the oil degrades and oxidizes; therefore, reduced TBN levels can be used to identify engines that are due for an oil change, or engines that may be suffering from poor combustion efficiency.

Total Acid Number (TAN): This test assesses the acidity level of an oil sample. As oils degrade, acidic compounds form that can increase the measured TAN value. High TAN

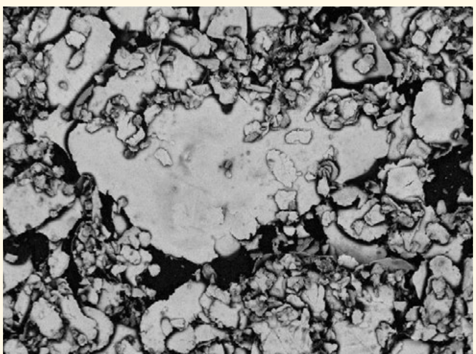
Continued on page 29

Keeping a Ship Sailing

Intertek's oil condition monitoring diagnostics team identified a sudden increase in wear metal (iron) and Particle Quantification Index in an oil sample taken from a ship's thrust block. PQ Index is a measure of total ferrous particles present in the sample. A full debris investigation was performed, using scanning electron microscopy with energy dispersive X-ray spectroscopy (SEM-EDX).

The results indicated that the metal present was a type of carbon manganese steel, but a smaller amount of chromium low alloy steel also was present. An inspection of the thrust block revealed bearing housing and raceway damage.

The vessel was successfully repaired, and it returned to service after sea trials. The cost savings, taking into account the replaced parts and downtime saved, was estimated to be more than U.S. $250,000.



SEM image of wear debris in ship's oil sample.

Continued from page 26

indicates oxidation and excessive oil degradation.

Particle Sizing: Hydraulic systems in particular require fluids that are "superclean"; that is, free of dirt or particulates. Otherwise, excessive wear or blockages can occur. This technique measures the size and number of particles present in a fluid. They are then grouped into counts of particles within particular size ranges, and an overall rating is assigned that illustrates fluid cleanliness.

Conclusion

The examples cited here illustrate the role that the expert laboratory can play in maintaining equipment reliability, supporting an industry and saving money. □

Robert Chapman is the Oil Condition Monitoring (OCM) Global Lead for Intertek, overseeing 21 locations globally. Based in the United Kingdom, he has a background in Physics and provides technical and commercial leadership for the OCM laboratories within Intertek. Contact him at ocmglobal@intertek.com.

Visit Intertek at www.intertek.com/ocm.

Advertisers Index