The American Club

THE IMPORTANCE OF LUBE OIL ANALYSIS

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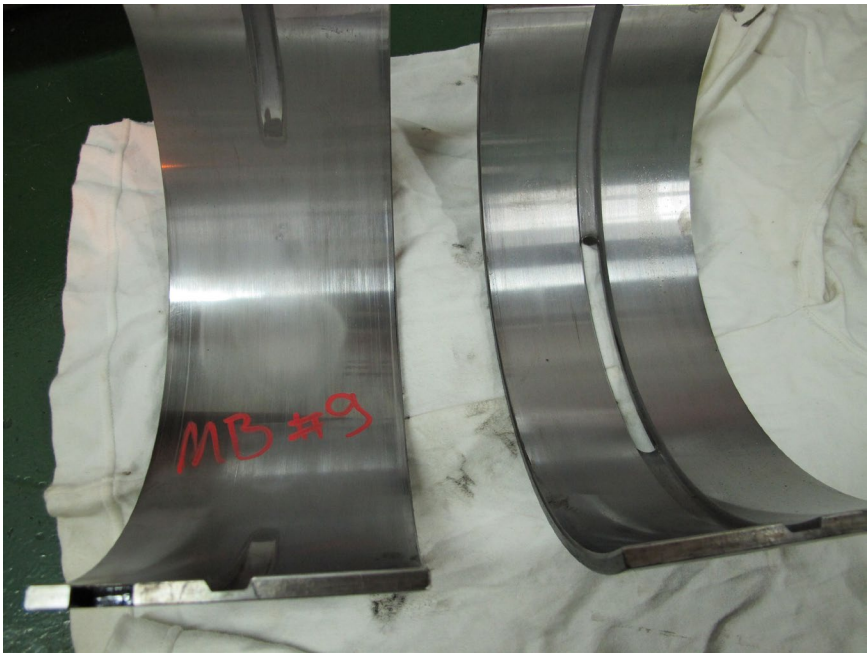
The importance of regularly performing lube oil analysis for shipboard machinery cannot be understated as it is essential for monitoring the actual condition of the vessel's machinery systems and the timely scheduling of proper maintenance. It can also be a good advance indicator of developing problems.

Why is lube oil testing important?

Oil analysis can help identify problems in the machinery such as abnormal wear, lube oil degradation, contamination of harmful agents, etc. all of which can lead to the potential failure of the machinery and its components. Failures can lead to a loss of propulsion and/or blackouts that can cause consequential incidents such as groundings, collisions, or damage to third party property. Periodic oil analysis can help maintain a proactive maintenance strategy, thus maintaining component life, mitigation of premature component failure and improved Mean Time Between Overhauls (MTBO). The economic impact of breakdown prevention could result in considerable savings mitigating repair costs, downtime, loss of hire, wasting spares and the improving safety of operations.



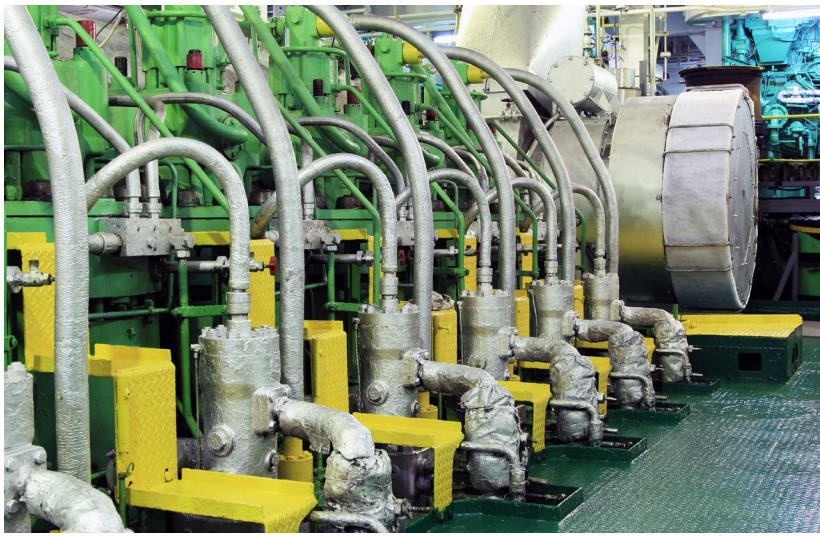
The results of lube oil analyses are unique to every machinery system and can be compared against specified manufacturers' standards and limits as specified by international standardization regimes. Such analysis establishes whether certain key performance parameters are within operational ranges and so certify the oil's fitness for use. In certain instances, further investigation involving some advanced analysis may be required to determine whether the lube oil meets recommended fitness for use.

Modern lubricating and hydraulic oils are designed to operate under specified conditions and durations (running hours). Deviating from recommended limitations may harm vital properties of the lube oil that can lead to poor performance and/or potential damage of the lubrication film thus paving the way for potential failure of the machinery.

What to look for in lube oil analysis

Lube oil samples are normally tested by specialized laboratories to determine the following characteristics:

- the viscosity, as a main factor of lubricating oil to provide sufficient film thickness between the relative motion of the machinery parts;
- the closed flash point, as an indicator of oil contamination, blowby and dilution of engine fuels;
- infrared spectroscopy, to determine the presence and concentrations of insoluble solid contaminants such as combustion soot, dirt, oxidation products and metal wear debris;
- the Total Base Number (TBN) as a measure of the reserve alkalinity of the oil and its ability to neutralize harmful acids;



- the Acid Number that shows the acidity of the oil, identifying its potential to cause varnish and harmful deposits on the machinery and indicating the presence of organic acids generated by oil oxidation;
- the level of oxidation that has occurred during the oil's ageing process by an Infrared test to assess the change in the molecular structure of the lube.
- the water percentage (by volume) defining the total amount of water contamination;
- the PQ Index that measures the total ferrous (iron) particles present;
- the presence of asphaltenes, as an indication of heavy fuel derived components from raw fuel ingress and/or the products of combustion from blow-by;
- levels of various metals in the oil sample determined through Elemental Analysis that may indicate accelerated wear and tear in certain components of machinery. Depending upon the type of machinery and operational conditions, some typical elements and metals found in engines can be:
  - a high level of aluminum suggesting excessive wear of pistons, bearings, housings, fuel derivatives; increased calcium displaying the lubricant derivative;
  - a higher level of chlorides indicating possible sea water contamination;
  - excessive chromium that can result in wear and tear of piston rings;

- high concentrations of copper that can exacerbate the wear and tear to bearings, gears, oil coolers, pipework, and piston-rod glands;
- increased level of iron that can result in the wear and tear of cylinder liners, crankshafts, piston rings, gears;
- high concentrations of lead, silver or tin that can result in the wear and tear of plain bearings; high level of magnesium – wear of casings, housings, lubricant derivative;
- concentrations of manganese that can result in the wear and tear of cylinder liners;
- concentrations of molybdenum that can lead to the wear and tear of piston rings;
- high concentrations of nickel that may lead to the wear and tear of bearings, valves, gears and indicate the presence of fuel derivatives;
- presence of potassium that indicates salt water contamination;
- phosphorus, zinc, calcium, magnesium, etc. help monitor the health of the additive packages;
- high level of silicon that are products of dust and dirt from fuel or lubricant derivatives;
- sodium indicating salt water, coolant or fuel derivatives are present; and
- increased level of vanadium showing fuel derivatives are present.

In particular, high levels of water, aluminum, chromium, copper, iron, lead and tin may require an additional in-depth testing and advanced analyses.

Additional sampling and advanced analyses could be required in some cases where a determination of suitability of certain machinery for continuous use becomes crucial as the withdrawal of a vessel from service due to machinery repairs can be costly. Moreover, the (delayed) availability of spares may cause the owners to defer critical repairs for several weeks or months.

Lube oil sampling points

It is important that samples are taken from select control points representing the characteristics of the oil circulating through the machinery system. In summary:

- the sample points should be clean to prevent contamination during sampling;
- samples should be drawn at regular intervals (one to three months) depending on the running hours, workload, type of environment and operational conditions of the machinery; and
- samples should be properly sealed and labelled with relevant information on the machinery (component or system), running hours and the date the sample was taken.

The results of the analyses should be presented in absolute figures and as graphical trends, displaying potential deviation vector of the oil properties and contaminants. General interpretation of a lube oil analysis should be provided in each report with an indication of the normal range, critical limits, probable causes and recommended actions. A typical report provides assessed rating of the oil and condition of machinery as “Normal”, or “Caution” or “Alert” with suggested corrective actions.

Other preventative measures

Preventative maintenance and overhauls of machinery should be performed to mitigate risks of potentially significant machinery system damages. The procedures of lube oil testing should be included into the planned maintenance system and followed.

It is recommended that each vessel and its managers have established procedures for sampling and analyzing lube oil samples, reviewing the results, monitoring the condition of machinery and implementing relevant and adequate planned maintenance.

There are some basic do’s and don’ts for lube oil sampling:

Do’s

- Sampling should be performed by qualified and trained personnel.
- Samples should be taken from machinery that has been running.
- Samples should be collected upstream of filters.
- Samples should be taken at regular intervals.
- Samples should be properly sealed and labeled with relevant information on the machinery (component or system), running hours and date the sample was taken. Proper documentation is imperative.

Don’ts

- Collect samples from drain plugs as sediments and other contaminants accumulate at those points.
- Wait to send samples for testing.

The American Club thanks the VISWA Group for their contributions to, and review of, this guidance.

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