The Importance of Lubrication Oil Analysis Reports in Vessel's Machineries

The importance of regularly performing lubrication oil analysis for vessel machinery cannot be overstated. These analyses are essential for monitoring the condition of machinery systems, planning necessary maintenance proactively, and identifying potential issues before they escalate.

Common issues detected through oil analysis include abnormal wear, oil degradation, and contamination by harmful substances. These issues can lead to machinery and component failures, which in turn may result in severe consequences such as loss of propulsion, blackouts, groundings, collisions, or third-party property damage.

Regular lubrication oil analysis forms the foundation of a proactive maintenance strategy. This approach helps extend component life, prevent premature failures, and optimize overhaul intervals (*Mean Time Between Overhauls - MTBO*). Oil analysis results, specific to each machinery system, are compared against international standards and manufacturer-defined limits to verify whether critical performance parameters are within acceptable operational ranges and confirm the oil's fitness for use.

Modern lubrication and hydraulic oils are designed to operate under specific conditions and durations (*running hours*). Deviating from recommended limits can compromise the vital properties of the oil, leading to reduced performance, damage to the lubrication film, and ultimately machinery failures.

Lubrication oil samples are analysed to determine the following parameters:

- **Viscosity:** The key property ensuring adequate oil film thickness between moving machinery parts.
- **Closed Flash Point:** Indicates contamination by volatile substances, blowby gases, or fuel dilution.
- **Infrared Spectroscopy:** Detects insoluble contaminants such as soot, dirt, oxidation byproducts, and metal wear debris.
- **Total Base Number (TBN):** Measures the oil's reserve alkalinity and its capacity to neutralize acidic byproducts.
- **Acid Number:** Indicates the oil's acidity level, highlighting the potential for varnish, harmful deposits, and the presence of organic acids due to oxidation.
- **Oxidation Level:** Assessed through infrared tests to monitor molecular changes in the oil as it ages.
- **Water Content (by volume):** Measures the total level of water contamination in the oil.

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- **PQ Index:** Quantifies ferrous (iron) particles in the oil.
- **Asphaltene Content:** Identifies heavy fuel residues or combustion byproducts from raw fuel ingress.
- **Metal Levels:** Elemental analysis identifies metals in the oil sample, which may indicate accelerated wear or mechanical issues in specific components.

Result

Characteristic	Method	Min	Target Val	Max	Value	Unit
Density @ 15C, Relative	ASTM D4052		0.8980		0,8839	g/ml
Appearance	Visual		Clear & Bright		Clear & Bright	
Viscosity, Kinematic 100C	ASTM D445	13,50	14.13	14,50	14,25	mm²/s
Zinc, % wt	ASTM D4951	0,041	0.043	0,048	0,047	% wt
Foam Sequence II, Tendency	ASTM D892		0	50	10	ml
Foam Sequence II, Stability	ASTM D892		0	0	0	ml
Flash Point, PMCC	ASTM D93	200,0	221.8		208	°C
Total Base Number, TBN	ASTM D2896	19,0	20	21,4	20,6	mg KOH/g
Viscosity Index	ASTM D2270	95	101		112	None

Depending on machinery type and operational conditions, the following elements and metals are commonly observed in systems:

- **Aluminium:** Indicates wear in pistons, bearings, or housings.
- **Calcium:** Represents lubricant additive components.
- **Chlorides:** Suggests seawater contamination.
- **Chromium:** Indicates piston ring wear.
- **Copper:** Reflects wear in bearings, gears, oil coolers, or piston rod glands.
- **Iron:** Shows wear in cylinder liners, crankshafts, piston rings, or gears.
- **Lead, Silver, or Tin:** Points to wear in plain bearings.
- **Magnesium:** Indicates wear in casings or lubricant additives.
- **Manganese:** Suggests wear in cylinder liners.
- **Molybdenum:** Indicates wear in piston rings.
- **Nickel:** Reflects wear in bearings, valves, gears, or fuel residue contamination.
- **Phosphorus, Zinc, Calcium, and Magnesium:** Monitors the condition of lubricant additive packages.
- **Silicon:** Indicates contamination from dust or dirt.
- **Sodium:** Suggests seawater, coolant, or fuel residue contamination.
- **Vanadium:** Indicates the presence of fuel residues.
- **Potassium:** Evidence of saltwater ingress.

High levels of water, aluminium, chromium, copper, iron, lead, or tin in oil samples may require additional specialized testing. In situations where the continuous operation of a vessel's machinery is critical, further detailed evaluations may be necessary. Advanced sampling and analysis can facilitate early detection of potential failures, enabling maintenance to be planned proactively and risks minimized. While individual contaminants may not immediately point to a specific failure, cumulative analysis over time can reveal the root cause of potential issues.

To ensure accurate results, oil samples must be collected from designated control points that represent the characteristics of the oil circulating within the machinery system. Best practices for sampling include:

- Ensuring sampling points are clean to avoid contamination.
- Collecting samples at regular intervals (*every 3 to 6 months*), based on operational conditions, workload, and environmental factors.
- Properly sealing and labelling samples with relevant information, such as the machinery component or system, running hours, and sampling date.

Analysis results should be presented as absolute values, supplemented by graphical trends that illustrate deviations in oil properties and contaminant levels. Each report should include:

- ***Normal operating ranges,***
- ***Critical limits,***
- ***Probable causes,***
- ***Recommended corrective actions.***

Typical analysis reports classify the condition of the oil and machinery as:

- **"Normal"** (no issues),
- **"Caution"** (monitoring required),
- **"Alert-Critical"** (corrective action needed).

To minimize the risk of significant machinery damage, regular preventative maintenance and overhauls are essential. Lubrication oil analysis should be integrated into the Planned Maintenance System (PMS) and conducted according to established procedures. This ensures machinery reliability, operational continuity, and long-term cost efficiency.