IB003. ELEMENTAL ANALYSIS

Methods of Element Analysis

The most common method for element analysis is using the ICP method (ASTM D5185, GB/T 17476,) which can detect more than 20 elements during one inspection. In usual cases, the lubricant samples should be diluted in a solvent, before it can be tested.

Another quick method is the X-Ray Fluorescence Spectrometry element analysis (ASTM D 6443), it can detect Ca, Cl, Cu, Mg, P, S and Zn in unused lubricants and additives.

Common elements of fresh lubricants

For fresh lubricant, without contamination from others sources, there are very limited elements in the lubricant, some of which can be very indicative. The most common elements present in the fresh marine lubricant are listed below in the table.

Element	Content
Ca/Mg	0.5~4%
Zn	0.03~0.10%
P	0.03~0.10%
S	0.1~0.8%
N	0.01~0.2%

Common elements of used lubricant

Identifying the element sources is a key issue to lubricant monitoring. Usually, we know that some element may come from the fuel oil and engine parts, however, at times it may be difficult to identify the source. Therefore we have to be very cautious while making an evaluation as some element may have a very complicated path way to the lubricant. The table below lists some of the common ways of foreign element contamination.

Metal	Element	Source	Comments	Other Sources
Aluminium	Al	Fuel	Cat fines	Pistons, bearings, housings, fuel derivative
Boron	B	Cooling water, system oil	Cooling water leakage, EP additive	
Barium	Ba	Cylinder oil	Rare	
Calcium	Ca	Cylinder oil	High. Main metal part of all lubricants	Lubricant derivative
Chromium	Cr	Ring grooves, top ring	Abrasive wear, thus also high iron found	Piston rings
Copper	Cu	Piston skirt	Older pistons only	Bearings, gears, oil coolers, pipe-work, piston-rod glands
Iron	Fe	Liner, rings	• Temporarily high: running-in • High: severe abrasive wear, scuffing	Cylinder liners, crankshafts, piston rings, gears
Lithium	Li	Cylinder oil	Rare	
Manganese	Mn	Fuel	Low	Cylinder liners
Molybdenum	Mo	Piston top, top ring	Abrasive wear, thus also high iron	Piston rings
Sodium	Na	Fuel, seawater		Salt water, coolant derivative, fuel derivative
Nickel	Ni	Fuel	Theoretically also from exhaust valve corrosion	Bearings, valves, gears, fuel derivative
Phosphorous	P	System oil	System oil has about 200 ppm	
Lead	Pb	Bearings	Sometimes also in poor quality cylinder liners	Bearings
Silicon	Si	Air, fuel	Sand dust, cat fines, lubricant additive	Dust, dirt, fuel derivative, lubricant derivative
Tin	Sn	Bearings		Bearings
Vanadium	V	Fuel	Higher when incomplete combustion (Ni too)	Fuel derivative
Zinc	Zn	System oil	System oil has about 300 ppm. Proportional to P.	Lubricant derivative

Evaluation of elements in lubricants

Frequent inspection of the element content is a must during lubricant applications. By conducting a check of elements in the lubricant, we can quickly tell if there might be a lubricant failure or water contamination. There are times when the lubricant elements are within the acceptable range but the engine still fails due to issues such as bearing fatigue, even though the wear debris are filtered out. Therefore we cannot tell that there was a hidden problem in the lubricant unless an element analysis was conducted.