TECHNICAL BULLETIN

Interpreting your oil analysis results

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When testing their in-service lubricants, users often look at reports and ask, "What do these tests mean?" Most routine analysis reports display similar test parameters for monitoring the condition of the operating equipment and the lubricant in service. This simple guideline will help explain the use and meaning behind the routine tests you are likely to see on an analysis report.

Spectrochemical analysis

Spectrochemical analysis measures different metals in parts per million (ppm) that represent equipment wear, lubricant additives and system contaminants.

Spectrochemical analysis for wear metals

The list below illustrates some major sources of wear metals but does not indicate all possible secondary sources. Abnormal wear is usually indicated by a combination of metals.

Iron (Fe) Housing/blocks, cylinders, pistons, gears, bushings, bearing, shafts, valves, rings, rust

Chromium (Cr) cylindr liners and guides, bushings, bearing, shafts, valve, rods, rings, hydraulic cylinder

Lead (Pb) bearings/bushings, thrust plates, washers

Copper (Cu) bearings/bushings, thrust plates, washers, oil cooler, pumps, disc/disc lining

Tin (Sn) bearings/bushings, pumps, motors, compressor piston, piston skirt overlay

Aluminum (Al) pistons, bearings/bushings, thrust washers, rings, housing/blocks, oil cooler, cylinders and cylinders guides, engine aftercooler

Nickel (Ni) gears, shafts, rings, valve trains, bearings/bushings, pumps silver (Ag) bearings/bushings, oil cooler, some gears and shafts, disc/disc lining

Titanium (Ti) bearings/bushings, some gears and shafts, turbine blades, valve trains, gear trains, some shafts (additive in some HDMOs)

Vanadium (V) turbine blades, some bearings and bushings.

Spectrochemical analysis for additives

Antimony (Sb) Antiwear and extreme pressure, antioxidant

Barium (Ba) Rust inhibitor, water separability

Boron (B) Extreme pressure additive, detergency

Calcium (Ca) Detergency, alkalinity reserve (contributes to base number)

Magnesium (Mg) Detergency, alkalinity reserve (contributes to base number)

Molybdenum (Mo) Extreme pressure additive, lubricity additive

Phosphorus (P) Antiwear when present with phosphorus, extreme pressure additive, friction modifier

Sodium (Na) Corrosion inhibitor

Silicon (Si) Anti-foam additive

Zinc (Zn) Antiwear when present with phosphorus, antioxidant, anticorrosive spectrochemical analysis for contaminants

Spectrochemical analysis for contaminants

Aluminum (Al) Aftercooler brazing flux; dirt if in combination with silicon

Boron (B) Engine coolant

Magnesium (Mg) Seawater if present with sodium

Potassium (K) Engine coolant, aftercooler brazing flux

Silicon (Si) Dirt, gasket/sealant material, engine coolant

Sodium (Na) Engine coolant, seawater, byproduct from natural gas (wet gas) transferring

Physical and chemical tests for lubricant condition and service life

Viscosity

Improper viscosity can affect a lubricant's performance.

- Too low of a viscosity will not create sufficient surface film to keep moving parts separated and prevent rubbing on opposing metal surfaces. Too high of a viscosity will create excessive heat and reduced fluid flow within circulating systems. A change in viscosity will indicate a change in the fluid performance integrity.
- A drop in viscosity generally indicates contamination with a lighter product, addition of an incorrect viscosity grade, and in some cases thermal cracking.
- An increase in viscosity can indicate oxidation and reduced service life due to age, addition of an incorrect viscosity grade, or excessive soot or insoluble content.

Base number represents the level of alkalinity reserve available for neutralizing acids formed during the combustion process and may be introduced through recirculated exhaust gases. As the lubricant ages and the additive package depletes, the base number will decrease from its initial fresh oil value.

Acid number in a new lubricant represents a certain level of additive compounding. This can come from antirust, antiwear or other additives. The acid number can drop a bit after a lubricant has been in service for a certain period, which indicates some initial additive depletion. Over time, the acid number will start to increase, which indicates the creation of acidic degradation products related to oxidation. The acid number is a means of monitoring fluid service life.

Oxidation number is a relative number that monitors increase in the overall oxidation of the lubricant by infrared spectroscopy. This test parameter generally compliments other tests for fluid service life, such as viscosity and acid number. Generally, this test is not used as a primary indicator when all other tests are within normal limits. Accurate oil information is required to get the most valid test results.

Nitration number is a form of oxidation that relates to chemical reaction with nitrogen, also forming nitrogenous compounds. Nitration is a relative number that monitors increase in the overall fluid degradation due to reaction with nitrogen and oxygen by infrared spectroscopy. This test parameter generally compliments other tests for fluid service life, such as viscosity and acid number. Generally, this test is not used as a primary indicator when all other tests are within normal limits. Accurate oil information is required to get the most valid test results. Contributors to increased nitration can come from exhaust gas blow-by or reaction with natural gas products with the lubricant and heat. It is also an indicator of electrostatic discharge across filter surfaces in turbine oil.

Sulphation number is a form of oxidation that relates to chemical reaction with sulfur compounds. Along with nitration number, sulphation number should also be part of thorough lubricant testing. Sulphation is a relative number that monitors increase in the overall fluid degradation due to reaction with sulfur compounds and oxygen by infrared spectroscopy. This test parameter generally complements other tests for fluid service life, such as viscosity and base number. Generally, this test is not used as a primary indicator when all other tests are within normal limits. Accurate oil information is required to get the most valid test results. Increase in sulphation generally correlates to a decrease in base number.

Water as a contaminant will generally lead to increased corrosion, depletion of proper lubricating film, decreased lubricant performance life and increased acid formation.

Coolant contamination will degrade lubricant service life and performance, create sludge and block lubricant passageways.

Fuel dilution will decrease the fluid's viscosity, therefore affecting its lubricity properties. Fuel dilution also promotes degradation of lubricant service life and additive properties.

Excessive **soot** increases viscosity, creates excessive wear, and will tie up active additives needed for lubricant performance.

Particle count: "Clean systems" require a minimum level of cleanliness in order to operate reliably. This is especially true for circulating systems with high-pressure and close-tolerance components. The ISO Cleanliness Rating is a convenient way to communicate the level of particulate contamination within a system based on the particle count for micron sizes greater than 4, 6, and 14.

PQI is a valuable trending tool for monitoring the relative level of ferrous wear material within a lubricant sample.

Filter patch inspection provides a visual assessment of wear particle and other solid debris present in a sample after collection on a 0.8 micron-to-5.0 micron filter membrane and examined by a microscope.

Analytical ferrography provides detailed information on different wear particles present in a sample. This is generally an exception test that provides information on the type of metal makeup of the wear particles present and how they were formed.

For further information about chemical tests, please contact: reliability@alsglobal.com.