TECHENOMICS INTERNATIONAL
Controlled Maintenance And Technical Services

Providing Lubrication Services for 20 years

TEST EXPLANATIONS

Techenomics International
Office 5/56 Industrial Drive
Mayfield East, NSW, 2304
Ph: 02 6571 2699
Fax: 02 6571 2044

TECHENOMICS your Condition Monitoring Partners

Dear Customers and Friends,

We are sending you a little information on tests so that interpreting your results will be a much easier. If you have any questions or require more information on your reports, please contact your nearest Techenomics Laboratory and they will gladly assist you.

1. METALS ANALYSIS

Spectroscopy identifies the amount and type of wear metals, additives, contamination in both new and used lubricating oil. By determining the metal content can able to alert the severity and type of problem occurring in the equipment compartment. Spectrometric analysis can detect metals up to a maximum of 8 microns in size. All measurements are made in parts per million (ppm).Based on the extensive knowledge of both lubricants and equipment, the serviceability of the oil can be analyzed by interpreting the source of each metals.

A.WEAR METALS

The primary goal in doing an oil analysis is to identify the wear metals. Frictional wear occurs during the relative motion between lubricated surfaces, despite the fact that these surfaces are usually coated with an oil film. Metals that are identified are:

Lead – Usually a soft metal, most common related to bushings and Rod Bearings. Engine oil which are highly oxidized can attack the bearing material, leads to increased lead readings.

Iron – Mostly comes from Cylinder liners, Rings, Crankshaft, Camshaft, Rods, Valve Train, Oil pump gear, Wrist pins, cast iron components and Gears. Usually found as fine particles due to abrasion or wear.

Aluminium –Generally comes from Pistons, Turbo Bearings, Main and Rod Bearings, pumps, thrust bearings and washers, plates and Aluminium castings. Aluminium associated with silica indicates dirt. Aluminium found in hydraulic system should be generally due to dirt ingestion and in final drives can be associated with dirt or sand.

Techenomics specialises in providing oil analysis services, and specialty lubricants to the mining industry.

By implementing a regular magnetic plug inspection program you will have a very low cost, effective and immediate early warning condition monitoring tool.

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Copper – Usually like a soft metal present in Main and Rod Bearings, Oil Cooler core, Clutch plates, Brass and Bronze bushings and Roller bearing outer cage. In engines it should be due to the water pump leak or coolant core. If it is found along with potassium, sodium and glycol, it will be coming from the oil cooler. If it is found along with lead and tin, it will be coming from bearing or bushing.

Chromium – Generally a hard metal generated from piston rings, Liners, Exhaust Valves, Shaft plating, Roller bearings, needle bearings, shafts, rods, gears, stainless steel alloys. Its presence indicates something harder is present usually silica and alumina. Chromium found in hydraulic system is from cylinder rods and valve spools.

Tin – Usually found in Bearings, Brass or Bronze Bushings and Flashing from pistons. Tin associated with lead and copper in engines indicate bearing wear.

Nickel – Alloy Valves, Crankshafts, Camshafts, Bearings and shafts.

These are probably the most common metals found in Engines, Transmissions, Hydraulic Systems and Gear Systems.

<u>B.CONTAMINANTS</u>

Silicon

Silicon may indicate either dirt contamination in the oil sample or ingestion of dirt/dust in the engine inlet system. Another source can come from excessive use of Silicone containing sealants to seal certain parts of the engine or gearbox. High levels of Silicone can result in oil foaming and lubricating quality loss and heat transfer capabilities. A foam test on the used oil may be needed if Silicone contamination is suspected. Its presence in new engines indicates liquid silicon sealant used while assembly and usually gets washed away with the first oil change.

Sodium

Sodium associated with boron and potassium confirms glycol contamination. Usually found as a coolant or chemical inhibitors.

Potassium

Usually found in coolant formulations and no longer an additive for engine oils. Its presence with sodium indicates coolant contamination.

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C.ADDITIVES

Engine oil is designed to perform a number of key functions such as lubricating moving parts, transferring heat and reducing friction under normal driving conditions. To enhance the oils performance and even add extra properties, additives are used.

Sulphur

An Extreme pressure additive found along with phosphorous. Extreme pressure agents bond to metal surfaces, keeping them from touching even at high pressure.

Boron

An extreme pressure additive usually found in coolants.

Phosphorus (P), Zinc (Zn)

Usually found in anti-wear oils for gears and hydraulics, as well as in diesel and gasoline motor oils as an anti-wear/anti-oxidant additive which acts as a film to surround metal parts, helping to keep them separated.

Magnesium (Mg), Calcium (Ca), Barium (Ba)

A detergent-type additive which provides some alkalinity to help neutralize acids formed from diesel fuel combustion.

2. PARTICAL COUNTING

Commonly used to monitor hydraulic systems, transmissions and turbines. Particle counting indicates the cleanliness of oil by determining the level solid contaminant particles present. This method is often done in conjunction with spectrometric analysis. Particle Count is the measurement of all particles that have accumulated within a system, including those metallic and non-metallic, fibers, dirt, water, bacteria and any other kind of debris. By using a light scattered principle, particle size in micros can be analyzed. Results are presented utilizing ISO 4406 level coding. Due to the dark opaque nature, engine oils cannot be analyzed by this method.

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3. VISCOSITY

Viscosity measures a lubricant's resistance to flow (fluid thickness) at temperature and is considered an oil's most important physical property. Two temperatures are routinely employed for most oil analysis, 40^{o}C (ISO oils) and 100^{o}C (SAE oils). Viscosity determinations of oil baths heated to one of the two referenced temperatures. A small sample of the oil is heated in a capillary tube until it reaches equilibrium with the bath temperature. The oil is then caused to flow vertically downward via gravity through a measuring volume area within the tube and timed as it flows through that area. The lubricant viscosity is calculated based on the time spent in the measuring area. Viscosity Index (VI) of lubricant is measured on the basis of viscosity values at 40 ^{o}C and 100 ^{o}C and can identify the lubricant grade as mono/multi

4. OXIDATION

Oxidation can increase wear, retard performance and shorten equipment life. Oxidation is the chemical degradation of the lubricant caused by a reaction with oxygen, primarily at high temperatures. While most lubricants contain special additives to inhibit oxidation, excessive oxidation can still occur under some operating conditions. When it does occur, a wide variety of harmful by-products are produced, which increase component wear, retards performance and shortens equipment life. High oxidation level indicates oil thickening and will results in equipment failure due to inadequate lubrication. Oxidation level can be identified from the infra-red signatures of the oil and any deviation from the virgin oil sample indicates its severity.

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BLUE OCEANS

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5. NITRATION

Nitration indicates excessive "blow-by" from cylinder walls and compression rings. It might be also due to the presence of nitric acid, which accelerates oxidation. Inconsistencies between oxidation and nitration denote air to fuel ratio problems. As nitration increases, total acid number and viscosity increases simultaneously, while total base number decreases. Usually nitration is the chemical degradation of oil caused by the action of nitrogen oxides and its by-products enters the oil due to the blow by past the compression rings.

6. TOTAL ACID NUMBER (TAN)

Acid Number denotes the amount of acid present to make the lubricant chemically neutral. Elevated values indicate oxidation and contamination. Often used to determine the serviceability of the lubricant.

7. TOTAL BASE NUMBER (TBN)

Total base number measures a lubricant's alkaline reserve, or ability to neutralize acid. New engine oil should relatively have higher TBN values and it depletes over time. As the lube oil base number gets lower it is time to change the oil.

8. PARTICLE QUANTIFIER PQ INDEX

PQ Index is the measurement of the total ferrous metal content in oil. Particle Quantifier exposes a lubricant to a magnetic field and the presence of ferrous metals creates a distortion in the magnetic field. If the PQ index is small, the ferrous metal content is less and viceversa.To obtain this index, oil samples are subjected to a strong magnetic field which becomes distorted by the ferrous particles passing over it. The limits are set at low levels so that major problems can immediately be detected. The method is mostly useful for testing differential, transmission and gearbox oils. The PQ Index picks up all sizes of ferrous particles, not just up to 8 microns.

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9. WATER CONTENT BY KARL FISHER

Karl Fischer titration is a widely used analytical method for quantifying water content in oil. The fundamental principle behind it is based on the Bunsen reaction between iodine and sulphur dioxide in an aqueous medium. Water can distort the metal to metal surface lubrication.

10. SOOT

Soot is generally the impure carbon particles generated from the incomplete combustion of a hydrocarbon. Fuel Soot is formed of carbon and is always found in diesel engine oil. Laboratory testing is used to determine the quantity of fuel soot in used oil samples. The fuel soot level is a good indicator of engine combustion efficiency and should be monitored on a regular basis. The main reason for this is improper air/fuel ratio, poor fuel quality and improper injector adjustment. Excessive amounts of soot indicate timing issues, Over-fuelling or dribbling injectors, worn compression rings.

11. FUEL DILUTION

Fuel dilution of oil by unburned fuel reduces lubricant effectiveness. The thinning of lubricant can lead to decreased lube film strength. Depending on certain variables, when fuel dilution exceeds 2.5% to 5%, corrective action should be taken. Fuel dilution is measured by both gas chromatography and fuel dilution meters. Fuel dilution can be identified from the viscosity values. Fuel dilution is the raw fuel residing in the crankcase. The main causes for this is leaking injector seals or jumper lines, leaking fuel pump, excessive idling, allowing unburned fuel to escape past compression rings.

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