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NEWSLETTER

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August 2012

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Recommended Testing for Engines

Engines, specifically diesel engines are most certainly the most widely tested pieces of equipment among mobile and industrial equipment. There is a good reason for that: locomotives, earth moving equipment, buses, trucks, ships and industrial machines are often pushed to their limit in harsh operating conditions.

As stated in a previous issue of this newsletter, tests are usually prescribed as test packages or combinations in order to provide a reliable diagnostic.

For instance, contamination and wear particles detection must be combined with viscosity and additives testing in order to determine both the condition of the oil and of the engine, the same tests being applied to **gas and diesel** engines.

Basic Tests

As indicated in the June 2012 issue of this newsletter, four (4) basic tests are prescribed on both mobile and industrial engines (http://www.tribologik.com/predictive.php?section=NEWSLETTER):

- **Color, odor, clarity, precipitate and foam** : This visual test may serve as an indication of the degree of use of the oil or fuel. Precipitate is a solid formed in the oil or fuel by contamination. Foaming can result from **excessive agitation, improper fluid levels, air leaks, contamination or cavitation**. This test however is just a preamble and must be supplemented by three more sophisticated analyses using laboratory instruments.

- **Elemental Analysis by ICP (inductively coupled plasma)** detects up to **23 elements** that can be present in used oil due to mechanical wear, lubricant contamination or additive depletion. Spectroscopic analysis indicates the condition of the equipment, parts and components and suggests which ones among these parts should be inspected or changed. For instance, **iron** particles are an indication that critical pieces of the engine are wearing down, such as cylinders, shafts, gears, rolling elements, bearings, housings, cases, pistons, etc. High **lead** could indicate bearing overlay wear or plating wear. A high **silicon, chromium, iron** combination signals dirt entry through the air induction system causing ring and liner wear.

- **Viscosity at 100 °C** measures the thickness of the oil sample at a high operating temperature. The ASTM D445 method indicates the **condition of the lubricant**. If viscosity is **too low** the lubricant will not be able to protect the engine at high temperature. **Too high viscosity** makes engine start-up difficult at low temperature. Possible causes of high viscosity are contamination soot/solids, incomplete combustion - A/F ratio,oxidation,degradation, leaking head gaskets, extended oil drain period, high operating temperature, improper grade oil.

- **Fourier Transform Infrared Analysis (FTIR)** detects contaminants such as **soot, water, ethylene glycol and unburned fuel.** FTIR is used to measure lubricant degradation and the presence of chemical degradation products due to oxidation, nitration, lube breakdown and anti-wear additive depletion :

    - **Oxidation:** Oil exposed to oxygen from the air at elevated temperature will oxidize to a variety of compounds, the majority of which are carbonyl compounds including carboxylic acids. These substances contribute to the **acidity** of the oil, depleting the basic additives present in the oil and contributing to **corrosion**.

    - **Nitration :** Nitrogen oxides are produced from the oxidation of atmospheric nitrogen during the combustion process. It increases the oil viscosity and is the major cause of the build-up of **varnish or lacquer.**

    - **Sulfate:** Sulfur oxides are produced by the combustion of sulfur compounds present in the fuel and can react with water to form **sulfuric acid**. The sulfuric acid is neutralized by the oil's basic additives, forming **inorganic sulfates**.

    - **Lube Breakdown I&II**: The base stock breakdown in synthetic lube is monitored in two regions: region I indicates that the breakdown products are mostly composed of weakly hydrogen bonded **alcohol or acid groups**; region II is due to the numerous hydrogen bonded by-products formed in the polyester lubricant.

Mobile Equipment

Mobile equipment engine testing combination includes the four basic tests plus **water, fuel and glycol detection.**

In a series of articles published in June and Fall of 2011, we have seen how harmful these contaminants can be to engines. That is why these three analyses are always prescribed on mobile equipment engines.

Total base number (**TBN**) is also recommended when FTIR results indicate a reduced acid neutralizing capacity or a depleted additive package. A relatively high TBN is associated with increased protection against ring and cylinder liner corrosion.

Industrial Engines

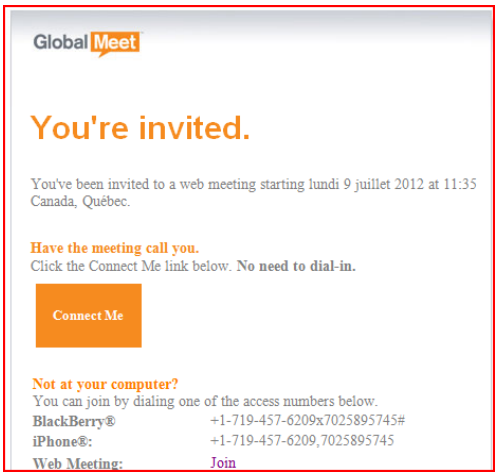
For industrial engines **TBN** is always performed. The **Particle Quantifier Index (PQ)** test will be added when necessary**.** The PQ test measures the mass of ferrous wear debris in a sample and displays this as PQ index regardless the particle size. The larger the index the greater the ferrous wear content.

Spectroscopy, FTIR and viscosity are also prescribed as routine testing on industrial engines.

PRESCRIBED TESTS	Mobile Engines	Mobile Plus	Industrial Engines	Industrial Plus
Color, Odor, Clarity	x	x	x	x
Spectroscopy (ASTM D5185)	x	x	x	x
Viscosity @ 40 °C (ASTM D445)				
Viscosity @ 100 °C (ASTM D445)	x	x	x	x
Oxidation (FTIR)	x	x	x	x
Water (FTIR)			x	x
Sulfate (FTIR)	x	x	x	x
Nitration (FTIR)	x	x		
Soot % (FTIR)	x	x	x	x
Water by Crackle test	x	x	x	x
Fuel Detection	x	x		
Glycol detection	x	x		
TBN (ASTM D4739)		x		x
Particle Quantifier				x

Contact your rep for additional information.

Friday August 17 WEBINAR : Why test your Equipment with Tribologik®?



Learn why by attending this webinar by **Jeremie Verdene**

When: Friday August 17, 2012

Time :

- **Ontario-Manitoba : 11:00 AM, Toronto time**
- **Saskatchewan-Alberta : 10:00 AM, Calgary time**

Duration : 30 minutes

Reserve now with Jeremie : jeremie@tribologik.com

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