TRIBOLOGIK®
NEWSLETTER

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In this issue:

Soot Contamination: a Combustion Problem

This is the last article of a series of four on the most harmful lubricant contaminants. ***Water : Oil's Public Enemy Number One,*** *the first of these articles, was published in the June 2011 issue of the Tribologik® Newsletter. The second one, on* ***Fuel Dilution****, has been published in September and the third one dealt with* ***Glycol contamination****. All are now posted on the Tribologik® website: http://www.tribologik.com/predictive.php?section=PAST_ISSUES*

Soot is composed of a number of chemical components resulting from incomplete fuel combustion (gasoline, diesel, bunker, kerosene). It is present in the form of dark, carbon-rich tar-like solid substances called ***carbon soot*** or ***black carbon***.

These substances take the form of spiral graphite micro-crystals agglomerated into particles measuring approximately twenty nanometres in size. Soot particles emanating from diesel engines are made of organic compounds. In fact, soot is present in all diesel engines.

The Formation of Soot

The presence of soot in oil is totally normal given a certain number of kilometers or hours of operation. When not exhausted into the atmosphere through the exhaust system, soot is absorbed by the lubricant. A soot **concentration** or **state** which grows **beyond normal** signals a problem with the engine and/or that an oil change is required.

There are many causes to soot contamination. Poor **ignition**, dirty air **filters** or **piston** wear all lead to high soot levels.

Soot Related Problems

Soot in oil causes many problems:

- New diesel engine injectors are designed to reduce atmospheric emissions. Higher injection pressure causes **abrasive wear** on shaft and rocker. New exhaust gas recirculation (EGR) units on diesel engines increases the quantity soot and its abrasive properties.

- Oil **viscosity** increases with soot build-up. High viscosity creates cold-start problems and poor lubrication.

- Soot deposits on engine surfaces **reduce combustion effectiveness** and increase fuel and oil consumption.

- Soot **removes oil's anti-wear protection film**.

- Carbon build-up related to soot behind piston rings lead to **rapid wear** of the cylinder walls and rings. Damage can be severe in cold start conditions.

Briefly said, soot reduces the lubricating capacities of oil, decreases performance, accelerates engine wear and at the end of the day, increases costs. These are as many reasons why your lubricants should be tested for soot.

Testing for Soot

Four tests are usually used to measure the soot load of lubricants, some with direct results, some indirect. Each method has its pros and cons.

- **The blotter test** allows a visual evaluation of the residual level of dispersant and soot. This type of evaluation remains subjective and is limited to qualitative results.

- The **total insoluble** test is a qualitative indicator of soot. This test requires solvents, a centrifuge instrument and an oven. It is slow and complex when other by-products of combustion are also present in the oil.

- T**hermogravimetric analysis** (TGA) is a thermal analysis technique method which measures changes in mass in relation with temperature. This test is simple to perform and provides a direct reading of the percent of soot. It is the only direct method suitable for measuring soot's carbon elements. It only requires a few drops of oil on a reading surface.

- **Infrared analysis** is a simple, quick and precise testing method, especially for low soot concentrations. Results are **comparable with** TGA's. It is widely used by the JOINT OIL ANALYSIS PROGRAM (JOAP) developed by the US army for production and routine testing.

- Many additives, detergents and dispersants are added to diesel engine oils to prevent soot from forming sludge that would deposit on the surfaces of the metallic organs of the engine. It is then important to test these oils frequently and make sure that these additives maintain their level of effectiveness. The **TBN test** (Total Base Number) is an indicator of the level of detergent in the lubricant.

Soot Elimination Methods

It may be urgent to change the oil before the level of soot becomes critical but oil changes do not improve combustion.

Soot formation is related to the mode and effectiveness of combustion. In other words, complete combustion leaves no residues. The percent of oxygen and combustible in the fuel mixture can only be controlled by a precise engine tune up in order to reduce emissions.

For additional information on the tests and test combinations recommended for your equipment, please contact your technical representative.

PMC Tribologik® Renews its ISO 9001-2008 Certification

Quality Control has always been a priority at PMC. In this respect, we have renewed our ISO 9001-2008 certification as of October 31st, 2011. In parallel, we have undertaken the **ISO 17025** certification process and all our procedures have been adjusted to this new standard.

PMC/Tribologik® Selected by the Royal Canadian Navy

We are proud to announce that PMC/Tribologik® has been selected by the Royal Canadian Navy for lubricant analysis.

PMC/Tribologik® ranked first on a point based evaluation method that included quality control, experience, laboratory automation, qualifications of personnel, testing methods, quality of instruments, etc.

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