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Fuel Dilution : a Lethal Intrusion into your Lubricants… and Engines

This article is the second 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. It is available on the Tribologik® website :* *http://www.tribologik.com/predictive.php?section=PAST_ISSUES*

As mentioned in the June 2011 article, there are four contaminants extremely harmful to oil. Being primary causes of the degradation of motor oils and equipment failures, they must be monitored closely and analysed on a regular basis.

Together with water, glycol and diesel fuel dilution in oil, figure on the top of the list. The problems generated by these forms of contamination cannot be overcome by a simple oil change. When, for instance dilution is associated with leaking fuel nozzles or a crack in the cylinder head gasket, it is likely to **cause major failures**.

This second article will deal specifically with the problems associated with diesel fuel dilution, its causes, consequences and the tests recommended to detect it.

Fuel Dilution

The dilution of a lubricant by fuel is determined by the percentage of fuel present in the used oil. Dilution indicates that part of the fuel (diesel or gasoline) has not been burned.

This type of fuel dilution is the most frequent cause of **oil thinning** in diesel engines. Excessive fuel dilution lowers lubricant load-carrying capacities, promotes lubricant breakdown, decreases viscosity, and increases the risk of fire or explosion.

Causes of Dilution

There are many factors causing fuel dilution, including:

- Frequent engine starts;

- idling and
- cold running conditions.

Excessive idling and low compression affect the fuel delivery system. **Severe dilution is associated with leakage, fuel injector problems and impaired combustion efficiency.**

Consequences of Fuel Dilution

Fuel dilution can **decrease the viscosity** of a lubricant and reduce oil film thickness. A thinner oil film loses its protective properties and ultimately results in **premature wear of the combustion zone** and **bearing**.

Dilution resulting from **defective injectors** will cause **« wash-down » of oil** on cylinder liners and accelerate ring, piston and cylinder wear. Oil combustion will be increased as well.

Diesel dilution in **cold weather** operating conditions can cause **cylinder waxing**, resulting in low pressure and poor lubrication during engine start up.

Generally speaking, dilution will cause the total base number (TBN) of the lubricant to drop, thickening by oxidation, deposits and poor lubrication.

Severe dilution also dilutes the concentration of the additives and therefore their effectiveness.

Problems generated by diesel fuel dilution include oxidation stability, filter plugging issues, deposit formation and volatility resulting in crankcase accumulations.

Detection and Quantifying Methods

Different methods are recommended in quantifying fuel in oil according to the type of equipment:

1. **Viscosity Testing**

Viscosity is the measure of the oil's internal resistance to flow. The viscosity of used lubricants must be interpreted by comparison to new oil of the same type. A drop in viscosity either indicates a shear of the lubricant or a strong presence of unburned fuel.

2. **Flash Point**

The Flash Point test determines the temperature at which the lubricant sample flashes when exposed to an open flame. As with viscosity, the flash point of used oils must be compared to samples of new oil of the same type (at 200° C). A lower flash point indicates the presence of unburned fuel or the abnormal presence of solvents in the lubricant.

3. **Oil Stain Test**

A drop of oil is heated to 250°C, put on special absorbent paper and placed in an oven. The shape, colour and spread of the stain on the paper provide information on the residual dispersivity of the lubricant, engine fouling, oil oxidation, and presence of water or fuel.

4. **Fourier Transform Infrared Analysis (FTIR)**

The result is expressed in absorbance, detected at 790 cm-1 wavelength. FTIR is a semi-qualitative method and quantified at 50 % as well. This method is very effective with diesel engine oils.

5. **Gas Chromatography**

Gas chromatography (GC) is one of the most widely used fuel-in-oil detection methods. In compliance with ASTM D D3524 method, the lubricant is injected directly into the chromatograph. Gas chromatography is a very accurate and reliable method of determining fuel dilution.

Unlike FTIR, which can only detect fuel dilution at two per cent (2%), GC will make a difference where changes in viscosity can be compensated by the presence of soot.

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

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