When is CM the objective?

by Jack Poley

In previous columns we have identified a number of the popular methods and techniques for analyzing wear metals and other particulates. These inspections are the backbone for fluid analysis, regardless of the component under scrutiny.

Prior to the introduction of wear metals monitoring (ca. 1948) lubricants were tested primarily for monitoring their integrity using tests for contamination and degradation. Included were tests for viscosity, neutralization number (acid or base), color, fuel dilution, solids (soot in diesel engines), water and glycol. Odor, too, was a consideration.

These tests and inspections are still important but now provide greater perspective when particulate analysis, including wear metals, is added to the testing suite.

PHYSICAL PROPERTIES

VISCOSITY – Perhaps the most important inspection for a lubricant, but viscosity should be carefully assessed in a used fluid since various lube conditions can affect viscosity, sometimes damping or even canceling the net effect.

Factors that can lower viscosity:

- Mistakenly adding make-up fluid of a lower viscosity than is specified.
- Fuel contamination (liquid-fueled engines) in the lube.
- Free water in the sump—the lubricant may briefly assume the film strength of water since the lube has not interacted with it.
- Shearing of lube-thickening polymers in multigrade oils.

Factors that can raise viscosity:

- Mistakenly adding make-up fluid of a higher viscosity than is specified.
- Oxidation of the fluid (oxygen-containing compounds formed with the lubricant base stock, a type of lubricant degradation).
- Nitration of the fluid (nitrogen-containing compounds formed with the lubricant base stock, a type of lubricant degradation).
- Emulsified or entrained water.
- Air entrainment in the lube—although the viscosity may be higher when this occurs, film strength is certainly lower.
- Significant fuel soot contamination (diesel engines).
- Glycol interaction with the lubricant to form a tacky, resin-like substance capable of causing bearing or piston seizure—usually a problem associated with liquid-cooled engines and transmissions, where glycol is routinely used.

COLOR – Most lubes darken over time. Diesel engine lubes, of course, darken immediately owing to fuel soot contamination. Although relative darkening is fairly easy to notice, color shades are not so easy to discern in lubricants, limiting the effectiveness of this type of observation with the unaided eye. Light-measuring instruments, of course, offer consistency and sensitivity well beyond the human eye and should be employed if color is a critical requirement.

If a lubricant darkens with time in use it is usually the result of progressive oxidation, the most common color observation that can be put to practical use. Emulsified water is another problem easily detected by eye, wherein the sample appears cloudy and/or milky.

ODOR –
While sniffing a lubricant may provide one with such key information as the burnt smell of oxidation, it can also put one in the hospital. A sample from an ammonia compressor, for example, should never be sniffed.

CONTAMINATION – The ingress of harmful materials into the lube sump, usually as the result of environment, operating conditions and effects or mechanical malfunction, but occasionally from poor lubricant storage and handling practices, including:

- Abrasives.
- Fuel, Fuel Soot (diesel).
- Water.
- Glycol.

DEGRADATION – Refers to the chemical (usually irreversible) deterioration of the lubricant:

- Oxidation.
- Nitration.
- Additive depletion.
- Glycol effect (interaction with the lubricant to form tacky, resin-like compounds).

Following is a table showing the instrumentation used for Contamination and Degradation testing of lubes: **<<**

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Contamination Type	Test Instrument
Abrasives	Direct-Reading Spectrometer (DRS),usually for the element, Si
Fuel Dilution	Viscosity and/or Gas Chromatography and/or Vapor Density and/or Flash Point
Fuel Soot	Infrared or other light transmission blockage and measurement device
Water	"Sputter test" (hot plate) or Karl Fischer titration or Infrared Analysis
Glycol	Direct chemical test and/or detection of coolant additive metals via DRS
Degradation Type	**Test Instrument**
Oxidation	Infrared Analysis and/or
Nitration	Infrared Analysis
Additive Depletion	Infrared Analysis
Glycol Effect	Infrared Analysis and/or Viscosity and/or Acid Number