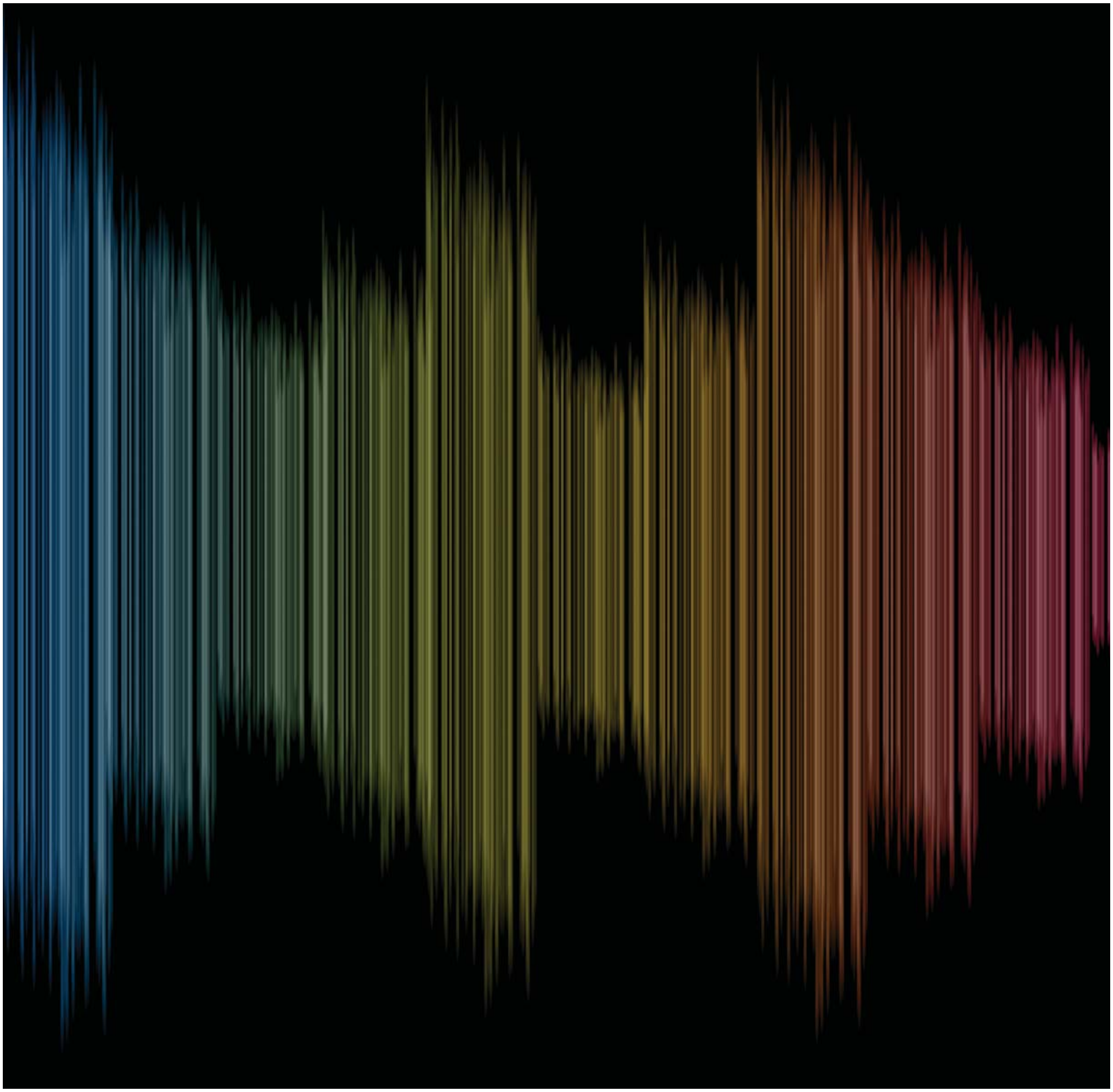

SGS OIL, GAS AND CHEMICALS
SPECTROCHEMICAL ANALYSIS AND FERROGRAPHY

SGS

SPECTROCHEMICAL ANALYSIS

Spectrochemical Oil Analysis is a method used to analyze and identify trace metals.

The identification of these trace metals contained in an oil sample taken from a piece of equipment is of prime importance in Condition Monitoring. These trace metals indicate the relative wear condition of lubricated equipment parts.

Typically, an Atomic Emission Spectrometer is used to identify common wear metals, contaminants and inorganic additives found in lubricants. This analysis is typically both rapid and inexpensive.

COMMON SOURCES OF TRACE METALS

WEAR METALS

Wear metals are the result of components in the system making contact and creating an undesirable wear regime. Common sources of wear metals are:

- Iron – Cylinders, liners, pistons, rings, valves, valve guides, anti-friction bearings, gear train, accessory gear drives, shafts, clutch plates, rust.
- Aluminum – Pistons, bearings, blower/turbos, pump vanes, thrust washers.
- Chromium – Compression rings, chromate from cooling system, anti-friction bearings, shafts.
- Copper – Bearings, bushings, thrust washers, valve guides, injector shields, oil cooler core tubes, some clutches. Additive in some oils, anti-seize and gasket compounds.
- Lead – Bearings, platings, leaded gear lubes, leaded gasoline.
- Tin – Bearings, platings.
- Nickel – Shafts, valves, anti-friction bearings.
- Silver – Silver solder, wrist pin bushings (EMD).
- Vanadium – By-products of heavy fuel oil and occasionally a wear metal.

CONTAMINANTS

Contaminants are usually the result of outside ingression of undesirable elements in the oil.

- Silicon – Sand, dirt, dust. Also contained as Silicone in new oil as anti-foam agent in low concentrations, as well as anti-freeze and gasket sealing compounds.
- Sodium – Contained in some new oils. Also contamination from anti-freeze, salt water.
- Boron – A contamination from anti-freeze. Is also used as an additive is some gear oil formulations.

ADDITIVE METALS

We also measure certain metallic elements that are found as additives in a variety of lubricating oils. The primary purpose of analyzing for these additives is to ensure that the appropriate additives are present and that there are no other inorganic additives that indicate that cross-contamination has occurred. Performing an analysis on the fresh unused lubricant will show which additives are there and which are not. Subsequent oil samples can be compared to this baseline.

- Zinc – Is a component of the lubricant additive ZDDP (zinc-dithio-dialkyl-phosphate), which is an anti-wear (AW) additive for hydraulic oils, engine oils, transmission fluids and some circulating oils.
- Phosphorus – Is the other component of the lubricant additive ZDDP (zinc-dithio-dialkyl-phosphate), which is an anti-wear (AW) additive for hydraulic oils, engine oils, transmission fluids and some circulating oils. Phosphorus can also be present in some turbine type oils and gear oils as an anti-scuff additive.
- Calcium – Engine oils, hydraulic oils, transmission fluids and some circulating oils contain calcium in the form of calcium sulfonate or calcium phenate. It is formulated to act as a detergent /dispersant.
- Barium and Magnesium – These inorganic additives are sometimes used in place of/or combined with calcium for the same purpose.
- Molybdenum – Most often molybdenum is in the form of molybdenum disulfide, which is intended to act as a mechanical friction modifier.
- Cadmium – Contained in some new oils as an additive.
- Manganese – Contained in some new oils as an additive.
- Titanium – Contained in some alloys.

HOW IT WORKS

The oil sample is ionized in a control chamber; the light from this burning process is separated by a diffraction grating (much like a prism). Each element emits its own characteristic wavelength of light (energy). Photomultiplier tubes are positioned to collect this light from the specific metals. With the aid of a computer, the intensity of light is compared to a standard and converted to parts per million.

The value of emission spectroscopy is well known. With the results of this analysis, the laboratory can evaluate trends in wear rates, cross contamination with different lubricants (additives) and contamination from silicon (dirt) and coolant additives.

FERROGRAPHY
(WEAR PARTICLE ANALYSIS)

Condition Monitoring is imperative to proper machine functioning. The oils and lubricants in your machines constantly pick up particles, additives and contaminants as they course through the parts and gears. If enough of them accumulate, you could be looking at expensive maintenance or full replacement. That's why proper Metals Analysis and Wear Particles Analysis is needed to accurately evaluate the condition of your oil.

FERROGRAPHY

Wear particle analysis is a powerful technique for non-intrusive examination of the oil-wetted parts of a machine. The particles contained in the lubricating oil carry detailed and important information about the machine. This is determined from particle shape, composition, size distribution and concentration. The particle characteristics are sufficiently specific to determine the operating wear mode within a machine, allowing the prediction of imminent problems. Action may be taken to correct the abnormal wear problem without overhaul. Alternatively, timely overhaul can prevent costly secondary damage and unexpected down-time.

DIRECT READING (DR) FERROGRAPHY

Experience shows that the entry point of the oil sample onto the ferrogram (where the largest particles are deposited) and a position some 5mm down from the entry (where 1-2 micron size particles are deposited) are the most sensitive locations for detecting a changing wear situation. The Direct Reading (DR) Ferrogram was designed to quantify particles in these two size ranges.

ANALYTICAL FERROGRAPHY

Analytical Ferrography uses a high gradient magnetic field to attract and hold particles from a fluid sample which flows down a specially prepared microscope slide / substrate inclined at a small angle. At the entry, where fluid first touches down on the substrate, larger particles are deposited. As the sample flows down the slide, smaller magnetic particles are pulled out of solution. After preparation, the substrate is mounted on the microscope stage for optical examination using a bichromatic microscope. The wear mechanisms present in the sample are then analyzed by a trained ferrographer.

TYPES OF WEAR IDENTIFIED

- Rubbing Wear
- Severe Sliding Wear
- Cutting Wear
- Rolling Element Fatigue (Rolling Element Bearings and Gear Systems)
- Fatigue Spalls
- Spheres
- Laminar Particles

These types of wear almost always precipitate out at the entry, and can range from 5 to 200 microns. Sources of roller bearing fatigue are often ultimately due to incidental abuse during installation or maintenance, poor lubrication, abrasive contamination, arcing, fretting, false brinelling or material / manufacturing defects. All of these cause deformations which cause fatigue. Some gear problems include high load / low speed, fatigue, misalignment, high speed / high load (sliding wear), abrasives and corrosion.

- Red Oxides
- Dark (black) Oxides
- Non Ferrous Metals
- Corrosive Wear
- Inorganic Contamination
- Organic Contamination
- Friction Polymers
- Solid Lubricant Additives
- Heat Treatment of Ferrous Metals

SGS experts can recognize which of many mechanisms of wear are occurring in a worn component and along with the analysis of the used lubricant will define the problem and suggest a solution. Typical wear mechanisms include (but are not limited to);

- Scuffing
- Abrasion
- Corrosion
- Contact
- Fatigue
- Fretting
- Corrosion
- Electrical Damage

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