

This month's column is the third of three on gearbox lubrication. This installment will cover issues related to monitoring lubricant and gearbox condition using oil analysis.

Just as a doctor uses blood tests to monitor our health, oil analysis can be a powerful tool to monitor the condition of both gearbox components and the lubricant. Most companies send oil samples to independent labs to perform the tests, but many can be done on site. Regardless of who performs the test, it is important to compare the results with tests on new oil and to look at trends over time.

TAKING OIL SAMPLES

Selecting the proper location to take the oil sample and using the correct method to take the sample are the most important steps of an oil analysis program. Oil samples must be taken while the equipment is operating or immediately after shut down, and care must be taken to keep outside contaminants out of the sample. Typical tests include:

Elemental Spectroscopic Analysis—The typical spectroscopy test measures the quantity of approximately 20 different dissolved and small undissolved particles of inorganic elements present in the oil. It is used to monitor oil additive depletion, oil contamination, and wear particles. The standard spectroscopy test can only detect wear particles that are less than about five microns, so its use for detecting catastrophic wear is limited because these wear particles are usually much greater than five microns.

Viscosity Measurement—Ensuring that the gearbox has the correct oil viscosity is an extremely important proactive maintenance practice because, as discussed earlier, viscosity is the most important oil characteristic for gears and bearings. Viscosity that is too low could indicate the wrong oil being used, contamination by water or solvents, or excessive mechanical shearing of the oil. Viscosity above normal may indicate excessive oxidation.

Water Content—Ensuring that oil remains dry is very important to gear and bearing life. Tests by several bearing manufacturers

have shown that even small amounts of water in the oil can drastically reduce bearing life. Water content is usually reported in percent or parts per million.

Particle Counting—This measures the number of particles in specified size ranges per a specified oil volume (usually per ml or 100ml). The quantity and distribution of the different sized particles is usually expressed as a cleanliness code per ISO 4406. The test is performed either manually with an optical microscope or using pore blockage equipment or with laser counters. Special procedures must be taken when performing this test on high viscosity gear oils to avoid counting water droplets and air bubbles.

Total Acid Number (TAN)—This is a measure of the total acid concentration in the oil. The number is the milligrams of potassium hydroxide required to neutralize all of the acid in one gram of oil. Some gear oils have a high initial TAN number due to the additives, and as the additives are used up the TAN number drops. Then, as the oil ages and oxidizes, the TAN will increase slowly over time, which is considered normal.

Fourier Transform Infrared (FTIR) Spectroscopy—FTIR detects the presence of molecules as opposed to atoms, as in elemental spectroscopy. Infrared light is passed through a film of oil in the instrument's test cell. Different oil additives and contaminants absorb or transmit energy at different frequencies. The energy level at each frequency is graphed, and when compared with a reference graph from new oil it can be used to assess oil condition including additive depletion, oxidation, nitration, and many contaminants.

Patch Test—A specified amount of oil is filtered through a membrane filter with pore sizes usually in the range of one micron. After the membrane is dried, the contents are examined with a 100X optical microscope and the results are compared to reference photographs to determine the ISO

cleanliness code. This simple and effective test can be performed on site and used to not only determine oil cleanliness, but to analyze the wear debris.

Analytical Ferrography—A quantity of oil is allowed to flow across a sloping glass slide that is on top of a varying magnetic field. Ferrous particles of varying sizes are distributed along the slide. The sample is then heated and/or treated with chemicals to help determine the metallurgy of the particles and then examined with an optical microscope to analyze the metal particles.

Ferrous Density Tests—These tests measure the concentration of ferrous metal particles less than five microns and larger than five microns in size. One such test is Direct Reading Ferrography, where the results are added and then divided by the volume of oil to arrive at a Wear Particle Concentration (WPC) index number. The Percent Large Particles (PLP) number is calculated by subtracting the concentration of small particles from the concentration of large particles and dividing by the sum of both.

SETTING TARGETS AND ALARM LIMITS

Part of the process of monitoring oil and gearbox condition with oil analysis is setting target values and limits for each of the parameters measured. Most oil analysis labs have limits established and will show these on their printouts. Working with your lab and consulting the lubricant manufacturer regarding limits is a good place to start, but the operator of the equipment should be the final authority. Gearboxes, like people, have different personalities, and each one is going to have a unique set of operating parameters. The personnel that operate and maintain the gearbox on a daily basis are the ones who should determine what are normal and abnormal operating conditions.

For more information and training regarding oil analysis visit www.noria.com.

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