Used oil analysis determines the condition of the lubricant; ferrography determines the condition of the machine.

You have a sound preventive maintenance program in place. You have even added some predictive maintenance elements to it, but you are still getting unplanned catastrophic failures. Adding ferrography to the mix can give adequate warning of possible failures so repairs can be planned.

Ferrography is a microscopic examination process developed in 1971. Initially, it looked only at ferrous wear particles in lubricating oils. Advances in technology now allow ferrographers to classify wear particles from many substances, both magnetic and nonmagnetic. The process is not limited to ferrous metal or oils-greases also can be analyzed.

Don't confuse a used oil analysis program with ferrography. Used oil analysis determines the condition of the lubricant; ferrography determines the condition of the machine.

The spectrographic component of oil analysis provides an incomplete profile of the wear metal in the system. Because laboratory instruments can sense only particles smaller than 8 microns and the onset of abnormal wear initially is revealed by an increased concentration of particles greater than 8 microns, the ability of spectrographic oil analysis to provide useful information on your machines is limited.

A comprehensive lubricant analysis program will contain elements of both techniques. It is important to know the condition of the lubricant and its ability to perform as designed, as well as the presence of contaminants and wear particles.

Conducting wear particle analysis

Typically on a monthly basis, lubricant samples are taken from a machine and sent to a laboratory specializing in ferrography and lubricant analysis. Used oil tests, such as viscosity, and spectrographic and chemical analyses are conducted. Additionally, in the first phase of ferrography, wear particle concentrations are routinely monitored and

compared to detect wear trends. This establishes a baseline for the earliest possible detection of abnormal wear onset. The second phase begins when the onset of abnormal wear is detected.

Trained analysts with a thorough knowledge of the equipment being monitored and the metallurgy of its components analyze the deposited particles through a microscope up to 1000X. Detailed microscopic analysis identifies the wear mechanisms that are causing the particle generation, identifies the probable source of the particles, and determines which components are experiencing the wear. Fig. 1 illustrates normal machine wear when viewed at 500X. The strings of particles in the image are made up of many flat platelets of less than 15 microns that are lined up on the magnetic lines of flux as the microscope slide is prepared. Fig. 2 illustrates larger laminar platelets viewed at 1000X that indicate rolling contact failure of a bearing. Through heat treatment and chemical reactions on the slide, the actual metallurgy of the particles can be determined.

Recently, a large chemical plant was able to avoid a catastrophic failure and save $100,000 by effectively using a combination of used oil analysis tests and ferrography. The machine, a General Electric turbogenerator, had been operating normally. A lubricant condition report, based on chemical and spectrographic analysis, showed normal degradation; continued use of the lubricant was recommended. However, an equipment condition report rated the machine condition CRITICAL. This evaluation was based on an increasing wear particle concentration and the presence of lead/tin babbitt particles ranging up to 90 microns (see Fig. 3). It was recommended that the machine's bearings be inspected at the earliest opportunity.

Examination of orbit plots and vibration time waveforms indicated possible journal impacting. The machine was shut down and the subsequent inspection revealed that the babbitt lining had been wiped and there was minor scoring on the shaft which could be polished out. This fault could have gone undetected until vibration alarms signaled an impending failure, and the subsequent additional damage to the shaft may have required removal and repair or replacement. Ferrography provided the early warning necessary to prevent a potentially catastrophic failure. **MT**

Information supplied by Predict/DLI, Cleveland, OH; telephone (216) 642-3223.