Predictive Maintenance: Diagnosis For Machinery Health

By Dave Staplesl
t used to be a relatively common practice for plants to wait for equipment to fail, and then repair it. But with greater pressures to realize improved productivity and profitability, such reactive approaches to maintenance have largely fallen by the wayside in favor of more proactive strategies.

A range of predictive technologies can be implemented to detect developing machinery faults at an early stage—before they become problematic. These predictive technologies can include performance parameter sensors, specialized monitoring devices, and analytical and data management software to capture, trend, diagnose and report timely information on the operating conditions of machinery assets. The key to choosing appropriate predictive technologies is to understand how a particular machine fails, what symptoms would be visible and detectable before it fails, and how fast that machine would deteriorate.

Among the parameters to monitor, the analysis of machinery vibration and lubricant can help chart mechanical integrity and operational health.

Measuring Effects ?Of Vibration

Many machinery problems manifest as vibration, which is widely considered the best operating parameter to assess a machine’s condition. Vibration can detect machine fault conditions, such as:
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Vibration measurements are also quick and fairly non-intrusive since the operating equipment is undisturbed.

Typically, the user compares the overall vibration level to a predetermined alarm level and, if the alarm level is exceeded, action can be taken before equipment failure occurs. There are also industry standards, such as ISO, which provide allowable vibration severity levels for specific types of equipment and operating speeds. These standards can be used as guidelines to establish equipment vibration alarm levels.

A variety of hand-held vibration monitoring tools can also do the job, ranging from low-cost vibration pens and meters measuring overall vibration levels, to more sophisticated portable analyzers that collect time and frequency content of vibration, along with other predictive information. These are packaged into a feature-rich compact size with loads of storage.

Most pens and meters measure overall vibration velocity over a frequency range of 10 Hz to 1 kHz (ISO vibration standard 10816-1), which is considered the best range

for judging rotational and structural problems (imbalance, misalignment, looseness and stress applied to components). More sophisticated portable data collectors/analyzers collect and store machinery vibration data over several different frequency ranges (some times up to 20 kHz), and display high-resolution FFT frequency spectra and time domain waveforms on a high-definition LCD screen.

Collected vibration measurements can be analyzed on the spot or downloaded to a specialized software application on a computer work station or network for analyzing, long-term trending and reporting abnormalities. The ability to both detect vibration problems and diagnose specific machinery faults with a portable data collector/analyzer is greatly enhanced due to their FFT spectrum analysis capabilities.

Online surveillance monitoring systems (available in hard-wired and wireless configurations) can complement these efforts, facilitating a proactive approach to reliability with around-the-clock monitoring of machinery, regardless of location. These systems collect data continuously, or over a predetermined data-collection period, from permanently installed sensors, and then relay the findings to a host computer for analysis and/or directly to a plant’s controls system for immediate action.

Detecting Defects ?In Bearings

The vibration measured at a machine’s bearings can open a window into equipment health because most machine problems have distinct vibration symptoms. For example, as a bearing deteriorates, there are specific vibration symptoms easily recognized by an experienced analyst.

A bearing can degrade due to:

The good news is that a failing bearing produces vibration symptoms that are detectable well in advance of failure. If these symptoms are detected and properly analyzed, and the progression of the damage is monitored accordingly, these signals provide maintenance personnel adequate time to correct the cause of the bearing problem (effectively extending the bearing’s service life), or if necessary, time to replace or repair the bearing during scheduled downtime.

A two-step approach is recommended to detect and analyze bearing faults: early detection and in-depth fault analysis.

Analyzing Condition ?Of Lubricant

Lubricant inspection and analysis serve as a particularly practical method to help detect problems with machinery assets, especially since many characteristics can be examined visually. ?
Beyond the day-to-day observations, though, lubricant analysis as a predictive maintenance activity should target at least four critical areas:

Before embarking on any predictive maintenance program, a clearly defined

maintenance strategy should be in place. Decisions to apply related technologies should be prioritized according to the risks associated with equipment failure, the possible financial consequences, the impact on the safety of personnel, production processes and the environment. As an essential first step, a benchmark assessment of equipment at facilities can contribute effectively to the most appropriate design, implementation and management of machinery assets. l

?Dave Staples is operations director for SKF® Reliability Systems. More information is available via www.skf.com.