What You Need to Know About Ultrasound CBM

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For those who are just getting started, here's a primer on the use of ultrasonic condition-based monitoring technology.

Condition-based monitoring (CBM) is a maintenance process where the condition, or "health," of plant equipment is monitored for the earliest signs of impending failure. Equipment can be monitored using sophisticated instrumentation such as vibration, infrared analysis equipment, or ultrasound technology.

Ultrasound technology uses high frequency sound waves to pick up potential performance malfunctions in mechanical, electrical, and fluid systems that are ordinarily indiscernible.

An effective CBM program offers several benefits, ranging from improved asset availability to the significant reduction of energy consumption. Instrumentation used as part of the CBM process should provide critical and accurate data needed to optimize the scheduling of downtime, labor, and materials; increase productivity; and reduce overall costs.

The health of equipment can mean the difference between meeting production goals and total chaos. For example, if one critical bearing fails during a production run, the consequences can be catastrophic: potential equipment damage, cancelled production, possible product damage, parts that must be ordered for repair, and considerable man-hours wasted. CBM programs help eliminate potential disasters through a proactive and disciplined approach to predicting the possibility of failure, while administering maintenance techniques as needed to prolong this inevitability.

A program for CBM does not have to be extremely complicated, nor does it have to require a large investment of capital to purchase the appropriate instrumentation to analyze, report, and trend effectively the data logged during the monitoring process.

The most commonly used technology for CBM, especially for pumps and other rotating machines, is vibration analysis. Measurements are taken of the bearing casings or the rotating shafts. The level of vibration can be compared with established standards to assess severity. Using Fourier algorithms, frequency and harmonics help locate the cause of the vibration and point the way to eliminating it. For example, high vibration that increases with the speed of rotation can be traced to imbalance, which machine design modifications can rectify.

Another CBM technique is thermography, or infrared, involving the detection and measurement of infrared emissions as related to heat. Excessive heat is indicative of component failure, especially as in the degradation of electrical contacts and terminations, and in the later stages of bearing failure.

Vibration and infrared analysis are complemented by still another inspection technique – that of airborne/structure borne ultrasound. Ultrasound is produced by friction, ionization, and turbulence, which is why ultrasound instruments are so effective in testing mechanical, electrical, and fluid systems. These instruments identify early warnings of

With energy costs increasing, ultrasound instruments can also be used to locate faulty steam traps and compressed air leaks.

mechanical failure, locate arcing, tracking, and corona in electrical gear and detect all types of leaks.

Most ultrasound instruments are lightweight and portable. They translate high frequency sounds produced by operating equipment down to the audible range where they can be heard through headphones and viewed as intensity levels (decibels) on a display panel. Some ultrasound instruments log test information, while others have onboard sound recording along with data logging capability.

By matching the instrument to the application, a program for CBM does not have to be extremely complicated, nor does it have to require a large investment of capital.

The ability to view sound levels while simultaneously listening to sound quality enhances the monitoring effectiveness – allowing inspectors to quickly identify changes in equipment (e.g., bearings) that occur from increases in decibel levels or by changes in sound quality as they collect data along their routes. Ultrasound also allows inspectors to pick up fault conditions that can't always be detected by vibration or seen by infrared technology (i.e., enclosed switchgear and transformers).

Sensing high frequency sounds through ultrasound has its unique advantages. Sound emissions are localized to the point of origin, making it easy to identify or monitor the location of a problem sound with no "cross-talk" from other mechanical components. When monitored, subtle changes can be detected and trended before they ever reach the critical failure stage.

Because friction is one of the major contributors to bearing failure, bearing lubrication programs are enhanced with ultrasound technology. Many lubrication programs are based on "preventive" maintenance in which equipment is lubricated according to a time-based schedule, with pre-determined amounts of lubrication applied. If this approach is followed without any feedback regarding the condition of the application, it may lead to over-lubrication or lubrication starvation, which will eventually lead to failure.

To avoid this, many maintenance departments are now switching to ultrasonic CBM programs in combination with preventive maintenance procedures. In order to implement an effective program, aside from the technology used, it is necessary to create strategies that utilize available manpower efficiently.

Documentation is all-important. A method of recoding all test data and a method for analyzing that data is critical to the success of any condition based program. Routes must be planned that are manageable and logical. A route should consider a logical sequence so that an inspector is not wasting time. Scheduling of inspection should depend upon such criteria as criticality, potential for failure, and safety.

Regarding safety issues, if the instrument is to be used in potentially explosive or reactive environments, look for an intrinsically safe rating. It is also smart to use accessories such as detachable modules that easily pull away from the front-end of a detection instrument should its sensor (instrument probe) get caught in rotating equipment.

When selecting an ultrasound instrument, you should also consider how it will be used. As an example, if sound analysis is important, the instrument should have sound recording capability and be supported by spectral analysis software. For a problem with no data needed, a basic analog instrument will suit your purposes. If the instrument is to be used to test both airborne emissions such as gas leaks and structure borne equipment such as valves, pumps, and motors, frequency tuning can help make subtle sounds more apparent.

If data is important for trending and reporting purposes, look for a digital instrument with data logging. Software that accompanies the instrument is an important feature. Be sure to consider whether the software will support your ultrasound CBM program. Is software capable of displaying all relevant information with data fields appropriate for your applications? Will you need to produce trend charts? Do you want to export data to other software such as MS Excel? If you are looking to integrate both data and sound analysis, will the software be capable of doing this for you?

Above all, consider company reputation when shopping. Some suppliers offer inexpensive simple products, but don't realize the limitations of these types of instruments. If you need a simple or sophisticated probe, the supplier should be able to assist you in meeting your inspection needs. Look for well-established suppliers who understand the technology and have a reputation for product support.

The benefits of ultrasound condition-based monitoring are quite substantial. The initial investment is relatively inexpensive, while the return on investment is potentially immense. To help push your program along, it is advisable to attend a training course. There are certifiable courses available that cover all the major applications and provide the information necessary to implement a successful program. When choosing technology to monitor equipment, ask your chosen company about training opportunities to assure a quality ultrasonic CBM program.

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