Where Has All the "Tribal Knowledge" Gone?

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Abstract

As demands on maintenance departments and inspectors have increased, some of the "tribal knowledge" of how specific items in the plant and or production process has been disappearing due to layoffs and early retirement of key people. Ultrasound technology can now provide inspectors with a complete range of inspection, recording, analysis and reporting capabilities. These new advances in ultrasound technology are ideally suited to help adopt methods and technologies to assist a new generation of inspection personnel.

This presentation will describe the basics of the technology, how it has evolved, and the latest advancements in digital instruments and software, which will help assure asset reliability, reduce unplanned downtime and improve system efficiencies.

Introduction

It used to be common in plants to have that one individual who could walk around a production area and adeptly analyze the health of equipment without the aid of anything more than a screwdriver. There were individuals who lived with the equipment from the day it was installed, and over the course of twenty some odd years would be able to pick up an anomaly as soon as it started. They are now part of a dying breed. They are more legend than not and might as well be relegated to the myths of ancient lore, along with the unicorn and the dragon.

While these champions of maintenance have gone, the demands for asset availability have increased with the pressures of global competition. Efficiency demands more and more equipment reliability. Productivity must be continually improved to keep costs down and profits up.

To meet these tough demands, predictive technologies have been embraced by many maintenance departments. These technologies offer the promise of improved asset availability by locating potential problems early enough to plan and administer corrective action. These wonderful tools are looked upon as the next step in the modernization of plant maintenance. There is only one problem though – the approach to acquiring these technological advances is often flawed. With little manpower, and large expectations, the equipment is often purchased with little research and, if purchased, the implementation of an effective program is often performed without a game plan. All too often, programs start with enthusiasm and eventually wither away until they are almost non-existent.

To avoid this, it is essential that a complete game plan is thought out. There are questions to be asked such as: What do I want to accomplish? How will I implement the program? Who will perform inspections? What technology or technologies will I need to use to be effective? How will I get the program off and running correctly?

Not one technology will perform everything effectively. It is important to look at integrating a few that will best meet the challenges of a particular plant. The most popular technologies like vibration, infrared, oil analysis and ultrasound will help to make any predictive program successful. When selecting a technology, training should be considered along with the purchase of the equipment to be assured that the equipment will be utilized correctly.

Of these technologies, ultrasound offers a unique position as an integrating technology in that it works well with vibration and infrared inspections. Many companies are looking at ultrasound as an effective tool for screening purposes since ultrasound translators will effectively inspect a wide variety of equipment to detect mechanical, electrical and leak conditions. Once anomalies are detected, the other technologies can be utilized for detailed analysis such as root cause, or to determine the need for corrective action.

Ultrasound Technology

Ultrasound technology has evolved through the years into two main inspection areas: pulse/echo and airborne/structure borne. Pulse/echo is commonly utilized for flaw and thickness inspections while airborne/structure borne ultrasound has become a popular technology for condition monitoring. As a predictive technology, airborne/structure borne ultrasound is extremely effective in assisting inspectors to identify problems in three main categories: leak detection, mechanical analysis and electrical inspection. Sensing sound waves in the 20kHz to 100kHz range, airborne/structure borne instruments filter out low frequency background noises, enabling users to work in loud plant environments, locate sound sources relatively quickly and identify potential failure conditions. To accomplish this, they incorporate two main sensing modes: contact/wave guides and scanning. The contact mode is used to probe structure borne sounds which are usually associated with mechanical operations while the scanning mode is utilized to sense air borne signals such as leakage or electrical emissions.

The advantages of airborne/structure borne ultrasound instruments are that high frequency waves are fairly directional in nature, making them easy to follow. They are a localized signal since the amplitude of an emission falls off rapidly as it moves from the source, enabling users to locate the point of origin quickly. As a small sound wave, subtle changes are detected long before they become major problems, providing early warning capability.

A Brief History

In the early years, most ultrasound instruments were analog. They were basically "point and shoot" with a sensitivity adjustment to help users locate a sound. The early instruments were used for leak detection purposes. Compressed gas leaks, steam leaks and vacuum leaks were the popular applications. At one point, they were used in almost the way an old timer would use a screwdriver to listen to bearings. The concept of baselines and trending were far off.

As with most technologies, ultrasound instrumentation has evolved from analog to digital and with that, the transformation of the technology has produced equipment and software that provides multiple layers of inspection capability. Ultrasound instruments can now be used to identify, trend, record sounds, analyze and report inspection results.

New Directions

Digital ultrasound instruments help inspectors log important test data such as decibel, test frequency, time and date. Some more advanced models include alarm levels so that inspectors will be alerted to an indication above a set alarm point which may require corrective action.

Other advancements in some digital instruments include sound recording capability. Sound samples can be taken and analyzed in spectral analysis software. It is now possible for maintenance departments to maintain a library of baseline sound samples to be played and compared with other sound samples.

As enhancements to the inspection procedure offered by digital instruments, software has been developed to allow users to analyze the data they have collected. The software provides for historical trending of equipment. Trend charts can be created, reports can be generated to include graphics such as images and spectral views, alarm groups can be created or printed to identify bearings in need of lubrication and bearings in the failure mode. The data can be uploaded to the equipment to perform inspection routes. In fact, some instruments enable inspectors to view current test data with baseline data as they store their data.

The ability to record sounds has expanded the effectiveness of airborne/structure borne instruments in that users can now record sound samples and play them back in either a spectral view or in a time series view. Inspectors can both hear and view the sound samples as they are played on the computer screen. This added dimension of hearing while viewing provides the inspector with the ability to better understand the sound sample as an aid to a diagnosis while analyzing the sample.

These advances can help maintain asset reliability by helping inspectors do their jobs quickly and effectively. To better understand this, let's review some of the basic applications.

Bearing Inspection

Ultrasound inspection of bearings is performed by noting only one test point. During the inspection process, data is recorded and if any deviations are noted, sound samples are also recorded. Back in the office, the data and sound samples are downloaded to the software for review and analysis. An alarm report can be created and reviewed. Sound samples can also be analyzed.

For those involved with condition-based lubrication programs, bearings in need of lubrication can be printed up in a report and assigned to lubrication technicians. Bearings which exceeded alarm levels can be played out on the spectral analysis software and compared with baseline sounds.

Valve Inspection

Valve condition can be tested. Upstream and downstream baseline sound levels can be logged for comparison with future tests. During routine inspection, should a valve indicate a leak or blocked condition, the data can be downloaded to the software and set up in a report. Charts of valve condition can be included in a report to help department managers further understand the problem. In some instances, valve performance can be trended to help identify early changes in valve operation which might affect system performance.

Electrical Inspection

While out inspecting electrical gear, whether in plant, in the substation or on distribution lines, inspectors cannot only detect the presence of corona, arcing or tracking, they can record the sounds, as well as decibel readings, download the information to the computer and review the information to analyze the condition and make recommendations. Some instruments allow for input of other relevant test data such as temperature, voltage and humidity conditions. Reports can be generated from the data management software with photos, and spectral and thermal images can be attached to assist others in understanding the status of the conditions.

Conclusion

Instruments based on airborne/structure borne ultrasound provide many opportunities to help fill the gap between the legendary, experienced inspectors and the demands of a competitive global marketplace. New advances in the technology make it even easier to jump-start a predictive/condition monitoring inspection program. Ultrasound technology integrates well with vibration, infrared, oil analysis and most other predictive technologies to help inspectors maintain asset availability and reduce inefficiencies.