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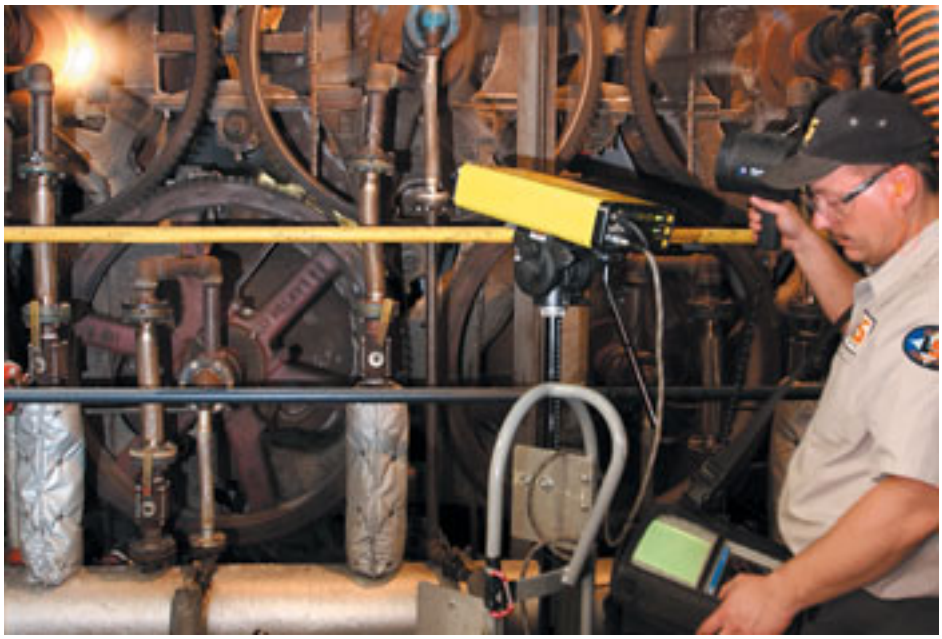
Machinery vibration monitoring and analysis are fundamental to predictive maintenance and continuous plant improvement. Here is information to help you with a vibration program.



Technician uses laser velocity transducer to take vibration readings on rear side dryer bearings. (Photograph courtesy L&S Electric Inc.) The principles of monitoring the health of plant machinery by checking vibration are straightforward. All operating machines vibrate. Since an increase in vibration almost always accompanies deterioration in running conditions, it is possible to gain information about a machine's condition by monitoring vibration levels.

The overall level of vibration indicates the general condition of the machine; vibration analysis can be used to determine the cause of vibration, including such factors as unbalance, misalignment, or bearing defects.

Today portable data collectors and online monitoring systems are used to gather data from hundreds or thousands of points to allow computer analysis of equipment health.

Ideally, this information could be integrated via a computerized maintenance management system or an enterprise asset management system with other asset health data for an overall picture of total plant and operations equipment condition.

With expanded use of the Internet and access to wireless technology, remote monitoring of machinery and data transmission is getting easier and quicker. All segments of an organization, including operations and management, can share information and access data. This works to ensure that assets are used in the best manner possible, with minimum costs, to provide continuous improvement in plant operations and maintenance functions.

Selecting technology

Terrence O'Hanlon of VibrationSchool.com suggests the following questions be addressed when a company is in the selection process for new technology:

- How do the vibration analysis and other PdM technologies fit into the overall maintenance and reliability program? Is there a systematic process for determining the most critical equipment to monitor?
- Can the data be interfaced with the primary information system (CMMS or other) to generate work orders?
- How much training is required to become proficient?
- How much is the total cost of ownership (TCO) for the life of the vibration analyzer? Companies may charge a significant sum of money for software maintenance year after year.

Approaching management

To purchase new vibration monitoring technology, maintenance managers have to present a business case for the equipment to upper management. Suppliers in this update offered helpful advice for strengthening managers' appeals.

A financial analysis or ROI study is imperative, noted OROS and the Vibration Institute. Nelson Watson of Watson Engineering, Inc. added, "Take the time and effort to perform an economic justification for the new investments. The investment must be cost effective and meet company return on investment requirements."

Further advice came from William E. Johnson of Engineering Concepts, LLC. He urged managers to "identify all costs associated with all maintenance functions, especially repeat repairs and/or breakdowns. How many items do you have to maintain in inventory to replace broken or failed equipment? Does mechanical electrical failure affect production rates or increased scrap rates? If it does, then determine the cost and how that affects your product cost margins.

“This is a lot of paper work, but it is extremely necessary to justify the added expense of new equipment or consulting services. You will be surprised how repeat failures and even frequent repairs will affect the bottom line.”

“The PdM manager should be able to demonstrate an increase in uptime/availability due to his vibration monitoring program,” noted Martin T. Morrissey of Monarch Instrument. “He must be able to show an improvement to the bottom line by being able to keep equipment running longer, safer, and without unscheduled downtime,” added Lou Morando of SPM Instrument Inc.

“All benefits must be presented in dollar terms. What can you learn or achieve with the new technology that you could not achieve before, and how can that help increase production, decrease downtime, or generally save money for the organization,” summarized Jason Tranter of Mobius North America.

Besides documenting current efforts well, Mary Ann Ford of SKF Reliability Systems noted managers should “relate results to key performance indicators, such as mean time between failure (MTBF) numbers, cost savings, unexpected failures over time, etc.”

Advancements in technology

The case to management may be made easier due to advancements in the technology in recent years. “Because of the simplicity of the new technology, useful and effective data can now be collected by lesser skilled personnel for reliability specialists to analyze. In addition, the new technology is more affordable and easier to use—providing for a faster ROI,” said Steve Reilly of Design Maintenance Systems Inc.

“Products on today’s market offer much more flexibility and power than those from the past. Vibration analyzers are now available offering over 100,000 lines of resolution allowing better detection of machinery faults. These tools have built-in features to help the user decipher different machinery problems, within the field machinery fault frequencies, bearing frequencies, and alarm levels. Software programs are now more user friendly and assist in the analysis of data,” offered Greg Lee of Ludeca Inc.

A simple piece of advice came from David Poffenbarger of Fastrack Technologies: “Start a small program that can be run efficiently. As successes come, expand as necessary.” And there is another benefit of a vibration monitoring program: “An important, but often undiscussed, benefit of regular condition monitoring is that it forces personnel to look at operating equipment. Many incipient problems are identified simply by having somebody stand and wait for a data collector to perform its job,” noted Doug Smithman of EMP Engineering Services, Inc.

As Skip Morrison of Prognost Systems, Inc. summarized, “Investments in (proper) on-line monitoring technology have proven that a clear reduction in the cost of operating and maintaining the overall process facility can be achieved in the short term. On-line monitoring will improve plant safety by mitigating the risk of catastrophic machine damage, improve production throughput by reducing unscheduled outages via early failure warning alerts, and allow a modern condition-based maintenance approach.”

Financial impact

It is vital for those responsible for the vibration monitoring and analysis program to establish a financial process that adequately shows senior management the impact the vibration program is having on the company’s profits.

A good monitoring system has the potential to save an organization considerable money as well as optimize equipment operation:

- A company in the chemical industry reduced its maintenance expenditures from $9 million to $7 million and has maintained expenditures at $7 million for the past two years by instituting a vibration and inspection program. (Design Maintenance Systems Inc.)
- A southern California paper mill was running at about 85 percent machine availability over the course of a year, largely due to unplanned outages. The mill implemented an aggressive predictive maintenance program using vibration data collectors as the key facilitator of the program. After 2 years, machine availability was up to 96 percent, and after an initial increase in bearing purchase, by the end of the second year purchases were down by two-thirds. (Ludeca Inc.)
- A large bearing manufacturing plant diagnosed a pending bearing failure on the main air handling unit. Failure of this bearing would have shut down the air conditioning system in mid-summer resulting in several days’ lost production. The estimated savings was $350,000. (Technical Associates of Charlotte)
- A paper company recently saved $3 million when a broken gear was identified in the gearbox of an outlet device. (Vibration Consultants, Inc.)
- An 8000 hp gearbox was put into a maintenance turnaround schedule when a large thrust bearing defect was detected by vibration monitoring the month before the turnaround. Extensive

damage and lost production were avoided. (Watson Engineering Inc.)

- A petrochemical company achieved significant cost savings when it reduced unplanned maintenance. A reliability centered maintenance study which identified the appropriate monitoring frequency, methodology, and machine priorities was conducted. Savings achieved was estimated at $2.4 million per year. (SKF Reliability Systems)
- A maintenance person at a wastewater treatment plant heard a strange noise from a blower bearing. A vibration survey confirmed that the inboard blower bearing was damaged with metal-to-metal contact. The noise was very subtle, but when compared to previous data from this same bearing, the trend was obvious and unmistakable. The bearing was changed and visual examination disclosed that one ball was severely spalled. The entire bearing would have operated for only a few more days. This analysis worked well because previous data from this bearing when it was in a known good condition was available. This analysis and repair avoided an unscheduled outage and possible fine of up to $10,000 per day for untreated sewage being discharged into the nearby river. (Machine Dynamics Inc.) **MT**