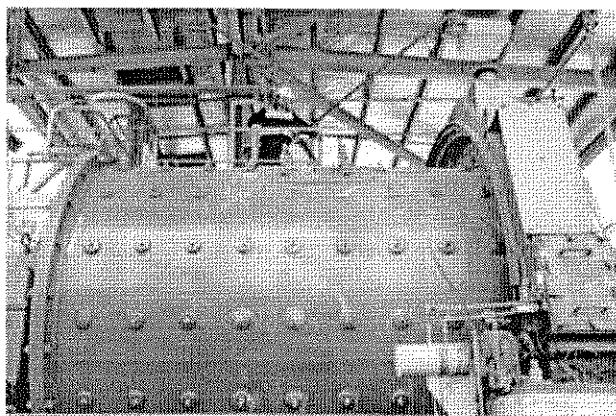


Predictive maintenance for large rotating equipment

By C van der Walt, Engineering Dynamics

Advancements in technology and methodology have made the ability to predict machine failure far simpler and more cost effective. Vibration monitoring technology, when adopted in a stepwise approach, cannot only prevent equipment damage and predict machine failure, but can also prevent production losses, which often run into millions. With increasing interest in proactive approaches to machine monitoring and maintenance, predictive maintenance systems have gained significant ground as the ideal method for monitoring rotating equipment.



With the pressures of today's competitive production-driven marketplace, an increased number of plant operation managers are realising that they can no longer afford the downtime and expense that inevitably accompanies reactive plant maintenance. By making the right maintenance choices and investments today, costly downtime and machine repair or replacement can be avoided in the future.

Very often a plant operation manager will underestimate the importance of implementing the correct monitoring and management strategy, specifically for a plant's critical machinery consisting of critical large rotating parts. All rotating equipment requires optimum installation, running conditions, and maintenance in order to deliver long life at the lowest cost. The breakdown of these large rotating parts would result in production losses and equipment damage that could easily run into the millions.

A stepwise approach adopting a full vibration protection system is the ideal monitoring and management strategy for a scenario whereby a plant operations manager is looking for piece-of-mind with regards to the mechanical condition of a milling plant's large rotating machines.

A stepwise approach to vibration monitoring in a milling plant

In the case of large rotating machinery in a milling plant, a three-phase installation programme would be recommended. Phase 1 would begin with the installation of permanent vibration sensors on the plant's most critical machinery. During a plant walk-down the best sensor positions would also need to be identified.

After power and conditioning are provided to the vibration sen-

sors, 4-20 mA overall vibration outputs would be connected to the resident programmable logic controller (PLC) system. Additional analog cards in your PLC system would need to accommodate the 4-20 mA vibration signals.

From there the SCADA software can be configured to allow for the trending, alarming and storage of the vibration signals. This will allow for 24/7/365 coverage of machine condition, however will not allow for troubleshooting capabilities, which will enter in Phase 2. At this point, a rising trend on the SCADA system would trigger a maintenance action.

In Phase 2 diagnostic capability would be added to enable a plant's vibration consultant to take detailed measurements from the installed sensors after his or her call-out was triggered by the rising trend on the SCADA system. In order to achieve this, the same sensors and cables will be used; however, the power and signal conditioning units with XM120 measurement modules in the same panel will be replaced.

The fact that these units are so close to the machines reduces the cabling costs drastically, compared to older rack-base systems that had to be in the switch room. These XM120 modules will provide the same capabilities as in Phase 1, but will now also provide a raw output of the vibration signal. The XM120 system will allow for easy scalability should you wish to expand the measurements to more machines with its modular approach.

An external data collection box is set up in a safe area away from the machines. This is where a plant's vibration consultant can hook up his portable data collector and capture detailed data from the installed sensors to give a detailed report on the cause of the high vibration as seen on the SCADA system by the operators in the control room.

In this situation, one would still need a consultant to come out to site to provide a report. Phase 3 can reduce this delay for quicker action. No new sensors or modules are required in Phase 3; instead options to improve analysis/troubleshooting, communication and a possible trip signal from the vibration unit, XM120 are made available.

A XM120 vibration module has a built-in relay. Plant operation managers that are confident about their vibration levels and have set warning and alarm levels in the XM120 units may use the relay output to shut down the machine when these levels are exceeded to avoid further damage. By adding a communications device and a modem, a plant's vibration consultant will have the capability to dial into the system and use Fast Fourier Transforms (FFT) or just plain vibration spectrums, time waveforms and overlaying Fault Frequencies to pinpoint the problem.

For this, a copy of Emonitor software must reside on a server where he can access it from, permitting the plant's firewall restric-

tions. If the manufacturer of the plant's PLC system supports DeviceNet, then four bands of data pertinent to areas of interest like pinion gearmesh frequency and others as single values to be trended in the SCADA system can be extracted.

Vibration monitoring for Metalloids' Ball Mill MM7

A new vibration monitoring system was recently installed by Engineering Dynamics on the main ball mill production machine at BHP Billiton's Metalloids site, in Meyerton, Gauteng. Ball mill MM7, which is used to grind ferrosilicon alloy into a fine powder, is operated by DMS Powders - a market-leader in the production and distribution of dense media ferrosilicon powders.

The highly-abrasive nature of the product created by DMS Powders, coupled with constant pressure on the mill's bearings and rotating parts, resulted in numerous breakdowns of the equipment. Mills can be a bottleneck area for many processing plants - if it shuts down, it has a knock-on effect on the entire operation. Due to the sheer size of the mill, it is important to keep them running at optimal efficiency by ensuring that they are constantly monitored.

Owing to the fact that the mill operates on advanced German technology; technical support in South Africa was lacking. In the event of any mechanical failure, DMS Powders would be faced with a waiting time for new parts of up to nine months - resulting in prolonged downtime periods and excessive financial costs.

After unsuccessfully attempting to source new gearboxes locally, DMS Powders realised that it needed to take a proactive approach, and monitor bearings and important rotating parts in the mill. Due to the amount of regular wear-and-tear inflicted on the parts of the mill, DMS Powders needed to take pre-emptive action and be able to establish the exact time that a part was going to break down.

After inviting companies to tender for the position, it was Engineering Dynamics that displayed a broad knowledge of the product and easy access to any parts.

The system provided by Engineering Dynamics consisted of vibration sensors on the motor, gearbox, pinion bearings and auxiliary equipment and was installed at the mill over a period of five working days.

Signals from the monitors are passed through the Allen Bradley XM161 vibration monitors in a panel in the Motor Control Centre (MCC). 4-20 mA Outputs from the panel then goes directly into their PLC system. Live

vibration data and trends from the PLC are displayed in a SCADA system in the control room. Provision is made, through a switch box, for a vibration analyst to access the raw data for scheduled or call-out situations from the safety and comfort of the clean and cool motor control centre (MCC).

Since the system was installed three years ago, it has already paid for itself. By detecting any faults or damage as early as possible, we have been able to schedule downtime to carry out inspections and minor repairs in the shortest time possible. As a result, DMS Powders have been able to save a girth gear - which can cost up to a million rand - on two separate occasions.

Although the process has been relatively-problem free, the biggest challenge in installing the system came from high-frequency sounds created in the ducting of the mill's fans. The ducting has 90o bends, which result in the air flow becoming unstable, and creating a high-frequency noise above the audible range.

The electronics in the transducers; however, are very sensitive to this noise. Initially, Engineering Dynamics could not understand why the readings were inaccurate. Luckily resources overseas allowed for another type of transducer - there have been no problems since.

Conclusion

Equipment failures have a significant impact on production schedules, product quality as well as other financial aspects. Most plants have fixed costs that they must carry regardless of how much they produce, so should

- Unplanned maintenance is costly and largely unnecessary.
- Careful investment now can reduce costly downtime.
- Predictive maintenance solutions, particularly on large rotating machines, are well developed and available.

FACTFILE



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a machine fail, costs such as rent and staff wages still need to be paid. With continued pressure to lower production costs, reduce downtime and increase productivity with fewer resources, plants need a maintenance strategy that is aligned to their production and business goals. Predictive maintenance systems on large rotating equipment, such as vibration monitoring systems, can help a plant meet business and production goals by extending maintenance intervals and eliminating unexpected downtime.

