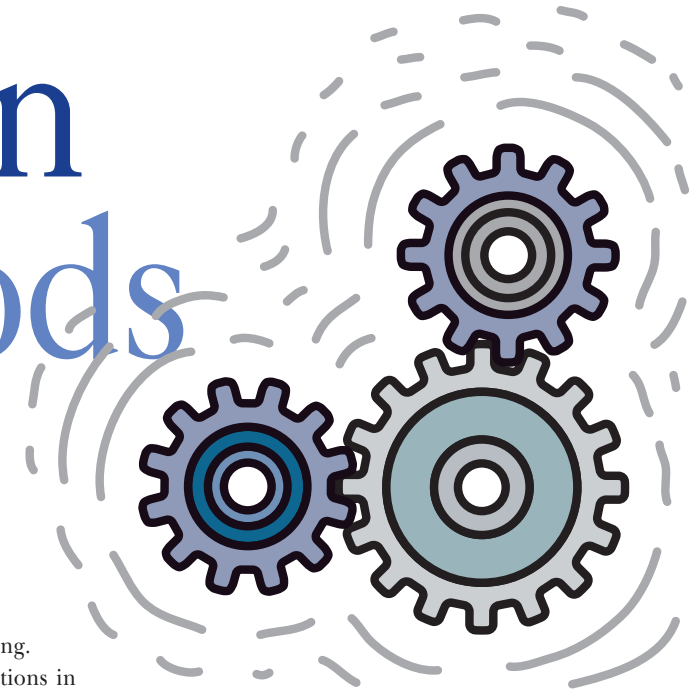
Choosing vibration monitoring methods



Grinding mill finds continuous online surveillance of vibration to be cost effective after conversion from offline system.

BY FLORIAN BUDER

Semi-autogenous grinding mills, also known simply as SAG mills, grind materials from large chunks into small, usable pieces for processing. The ones used in mining operations in Canada are essentially autogenous, but use grinding balls to aid in grinding, like in a ball mill. A SAG mill is generally used as a primary or first-stage grinding solution. Attrition between grinding balls and ore particles causes grinding of finer particles.

SAG mills are primarily used at gold, copper and platinum mines with applications also in the lead, zinc, silver, alumina and nickel industries. These mills are characterized by their large diameter and short length, as compared to ball mills. The inside of the mill is lined with lifting plates to lift the material inside the mill, where it then falls off the plates onto the rest of the ore charge.

The monitoring of this type of equipment is crucial for modern mining operations. Breakdowns lead essentially to a complete shutdown of the operation, unless enough redundancy exists. Most mining operations have moved away from breakdown maintenance to reliability-based maintenance concepts.

Aside from ultrasound, oil analysis and visual inspections, the vibration monitoring of rotating equipment plays an important role among these modern programs. Handheld FFT analyzers are commonly used and route-based data collection programs help a modern reliability engineer to keep track of the health status of his machine park.

In times of tight money, the biggest challenge remains the management of resources. To collect vibration data in a route-based monitoring program requires a big portion of a maintenance employee's time, meaning they are not available to work on something else. For this reason, more and more companies have recognized that modern continuous monitoring concepts are more cost-efficient; they free the time of employees, increase the amount of monitoring data, reduce reaction time and eventually increase the reliability of a plant's equipment.

Online monitoring system prices have dropped over the past decade and have become affordable for most companies. They also lead to direct cost savings by eliminating route-based data collection time. As well, they also increase the consistency of the vibration data as the sensors are permanently mounted and data is always recorded at the same position on the machine in a much more frequent manner than using offline, manual methods.

Case study

Let's have a look at a tangible example. A Canadian mine that runs a couple of SAG mills was struggling with breakdowns of its gearbox over and over as its route-based monitoring concept was not sufficient enough to capture the fault in time.

The staff missed important information between the data collection intervals, and the fault developed faster and more unexpectedly than the route and time-based measurement program could follow. As a consequence, the maintenance team started to collect data on a weekly instead of monthly basis – and at the end, even on a daily basis.

Another difficulty remained to capture data during the same load and rpm conditions – under similar operating states.

This waste of manpower and energy lead to neglecting of other parts of the plant. Eventually it was decided to convert this offline-based data collection method to an online condition monitoring concept.

To evaluate the new system, three accelerometers were installed on the machine train, along with an RPM sensor, so the mine could compare vibration amplitudes to the actual RPM. A 4-20 mA or 0-10 V load signal was available, which was tied into the online system as well.

The monitoring and processing unit was installed close to the machine to minimize the cable length between sensors and the online system. Linked into the company's local area network (LAN), the unit can be accessed via Wi-Fi or an Ethernet connection, as it has a specific static IP address, which had been assigned by the mine's information technology (IT) department.

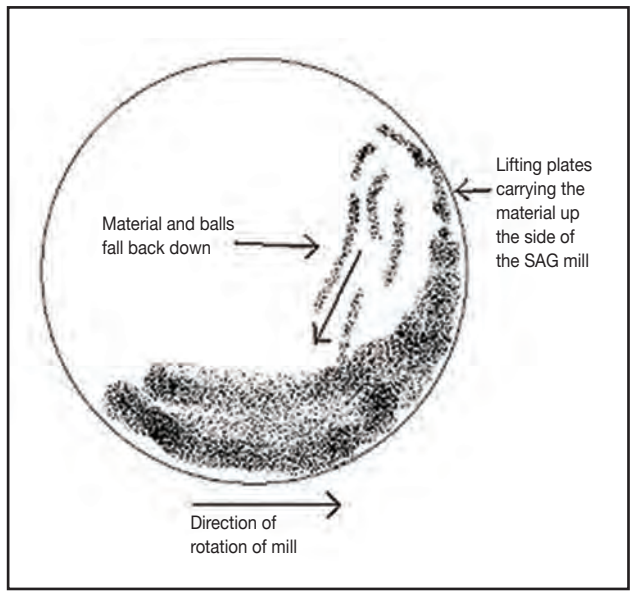
After the evaluation of the system, the plant equipped the monitoring system and machine with nine additional accelerometers to use the full capability of the online system. Data now is recorded on up to 12 channels in a multiplexing process.

FFTs, time signals, demodulated envelope spectrums, as well as high-frequency acceleration spectrums, help to determine common faults, such as bearing problems with the outer and inner races, balls and cage. Gearbox tooth wear, misalignment between motors and gearboxes, as well as others — such as unbalance, resonant states and looseness — can now be tracked and monitored sufficiently.

Data is automatically pulled into an SQL database residing on a local server, which is backed up on a regular basis to avoid data loss. The users can open the Omnitrend administration and analysis software from any PC in the plant where the software is installed, log in with their credentials and monitor the machine status at any time.

Images: Prüftechnik Canada

This installation setup is for the online system and accelerometer.



Here's how semi-autogenous grinding mills work.

This is a SAG mill installation in a Canadian mine.

At the same time, the control room has the overall vibration values and alarm states (Blue = Good, Yellow = Warning, Red = Alarm) permanently on their screen to notify them, or even to stop the machine in time if a fault was detected.

Another key feature is that the system sends warning and alarm e-mails to several configurable receivers in case of a threshold violation.

The return-on-investment (ROI) calculation for the mine was positive after several months of system operation. It has been decided that the most important machines of the plant will be equipped with online systems step-by-step.

The modernization of the predictive maintenance program from route-based vibration analysis to continuous online surveillance has been successfully started to make the plant state-of-the-art and competitive. **O/G/M**

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