

FEEL THE vibe

Romeu Kleinubing, Emerson, USA, discusses mining's smart shift to predictive maintenance.

With every vibration telling a story, mining operations are learning to listen – and it is changing how they manage equipment, improve safety, and protect the bottom line.

The global mining industry has always operated under challenging conditions, with reliability and safety taking centre stage. Mining equipment must withstand extreme environments, handle heavy loads, and function continuously to meet production demands. However, margins in the mining industry were high in the past, so even though the environments were extremely tough on equipment, mining

operations could afford to take a 'wait and see' approach. When equipment broke, the team would stop operations and fix whatever was wrong.

However, over the last decade or two, those high margins have steadily declined as global competition became much stiffer. Nearly every company began to feel pricing pressure from competition, and suddenly, every minute of downtime was tremendously costly. To meet these new challenges, many mining operations needed to find a new way to operate to ensure they could stay profitable. In most cases, that meant finding ways to keep running without spending too much money.

In addition, removing ore has become increasingly difficult. Operations have been forced to expand to sites that are more remote, and mining equipment is working deeper than ever. Every element of mining has become more complex and more costly. If a site is remote, technicians may need to travel hundreds of miles to check on equipment. Logistics also become more complex, as it is nearly impossible – or at least, extremely costly – to quickly ship parts to the most remote locations.

A real-world example

For one South American mine, ore extraction takes place over 40 miles away from where it is processed. Transportation is performed by an extremely long conveyor that continuously moves tonnes of ore across those 40 miles.

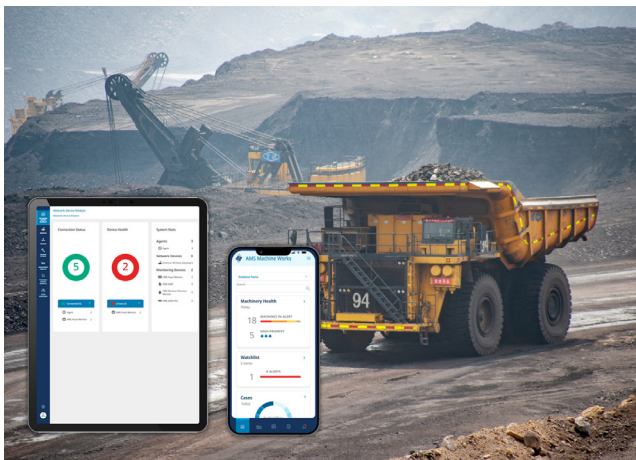


Figure 1. Advanced machinery health software, like Emerson’s AMS Machine Works, seamlessly integrated with wireless, online, and portable condition monitoring equipment, empowers reliability teams with intuitive diagnostics and deep analysis tools – streamlining decision-making and keeping operations running safely and efficiently.

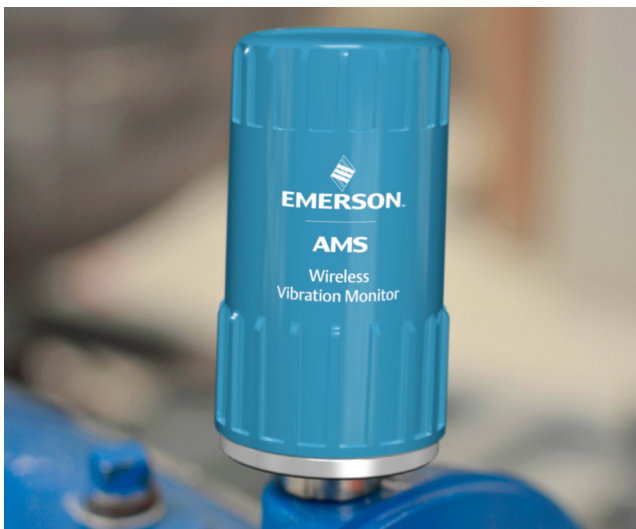


Figure 2. Built-for-purpose, rugged wireless vibration sensors, such as Emerson’s AMS Wireless Vibration Monitor, help mining teams monitor the health of critical equipment, including large-scale conveying systems, enabling predictive maintenance even in the harshest and most remote environments.

The conveyor operates across a hot, dry, dirty environment. Everything about its operation is ripe for potential failure. If the conveyor fails, operations on both ends must stop, as there is no way to transport that much ore via truck in a timely manner.

A change in approach

As mining organisations investigate ways to reduce costs, one of the most obvious places to close the gap is in maintenance because for most mines, upwards of 50% of operational costs are directly related to maintenance. Moreover, of the remaining 50%, another 30% can easily come from energy consumption, which is related to maintenance because rotating and mobile equipment in good condition uses less energy, especially when shutdowns and startups related to unplanned downtime are reduced. The savings can be significant; a SAG mill can consume an average 30 – 50% of the total energy used in a mineral processing plant, ball mills can consume 10 – 25%, and crushers and pumps can consume 5 – 15% of energy on average. As a result, equipment reliability has gained immediate attention as a place where efficiency is paramount.

Ultimately, mine operators now understand that they need ways to anticipate equipment failures, both to intervene early and reduce overall cost of repair, and to eliminate unplanned outages that can cost hundreds of thousands or millions of dollars per day. To achieve these objectives, vibration sensors and monitoring systems have become indispensable. These technologies enable predictive maintenance, which can be used to reduce downtime, ensure safety, and increase operating efficiency of equipment – revolutionising how mines manage their equipment and assets.

The role of vibration sensors

Vibration sensors play a critical role in detecting anomalies in both rotating and mobile equipment, both of which are central to mining operations. By implementing vibration monitoring on mining equipment, both operations and reliability teams can gain greater insights into how equipment is performing, and gain access to early detection strategies that let them intervene – by adjusting operating practices, performing repairs, or both – well before poor performance turns into equipment failure.

Vibration sensors provide critical predictive maintenance for rotating equipment. Mining machinery – such as crushers, mills, conveyors, pumps, and motors – faces wear and tear during operations. Vibration sensors detect early signs of malfunction, allowing planned repairs to avoid costly breakdowns.

In addition, monitoring vibration also provides health monitoring for mobile equipment. Haul trucks, excavators, shovels, and loaders are vital to mining operations. Vibration monitoring ensures these vehicles remain operational, optimising performance, extending their lifespan, eliminating unplanned failures, and decreasing energy use (see Figure 1).

One of the most critical elements of vibration monitoring is impact detection. While all vibration provides insight into asset health, impacting is a much better indicator of overall asset health than most. Impacting cuts through the complexity of vibration analysis to provide a simple, reliable indication of equipment health via a single trend. Using that trend, technicians can quickly identify the most common failures in rotating

machinery, while helping ensure operations stay within safe thresholds to prevent structural or mechanical failures.

Vibration detection also helps reduce the safety risk inherent in reliability activities. Nearly 70% of the accidents in mining environments happen during human/machine interactions. Vibration sensors help mitigate these risks by identifying hazardous conditions early and reducing technician time in the mine area.

Wireless vibration monitoring changes the game

Wireless vibration monitoring has revolutionised mining by eliminating the need for cabling. This innovation offers numerous benefits.

First and foremost, wireless vibration sensors provide remote monitoring at a reasonable cost. Operators can track equipment performance from a centralised control room or via mobile devices. This capability not only streamlines oversight, it also dramatically reduces safety risk by allowing the collection of data without needing human interaction with moving equipment.

Moreover, wireless vibration sensors offer cost-effective maintenance. Early detection of faults reduces the need for emergency repairs, cuts down on spare parts inventory, and minimises unplanned downtime.

Wireless sensors also offer nearly endless scalability. The best wireless vibration monitors are easy to deploy and can be installed in minutes by a site's own technicians. Fast installation makes it possible to quickly deploy remote monitoring across entire fleets of rotating machinery, putting comprehensive monitoring in the hands of technicians, wherever they may be (see Figure 2).

The best wireless vibration monitors also offer additional tools that translate raw data into actionable information. In fit-for-purpose modern sensors, AI-powered algorithms analyse vibration data, providing insights to help predict failures and optimise asset utilisation.

Predictive maintenance with vibration sensors

Predictive maintenance using vibration sensors offers a data-driven approach to enhance operational efficiency. Using the data from vibration sensors, reliability teams can more easily minimise downtime, identifying potential issues early to prevent unexpected equipment breakdowns.

A constant stream of data from online sensors also makes it easy to optimise maintenance schedules. Vibration data comes in at a regular cadence, so there is no worry that data collection will be missed because critical personnel are offsite or busy with more pressing tasks. In addition, vibration data, and the associated analysis offered by sensing equipment, helps teams prioritise maintenance tasks, ensuring resources are allocated efficiently.

Because equipment that runs to failure typically experiences excessive damage and additional wear – especially in the case of a catastrophic failure – monitoring vibration can be an essential strategy to extending equipment lifespan. As potential failures are caught early, they can be remedied before they cause additional wear and tear, lengthening the life of critical machinery.

Most importantly, addressing issues early reduces the risk of accidents caused by equipment failure. As the number of

unplanned failure incidents go down, safety levels typically increase.

In the South American mine example offered above, many of these benefits became the new reality for operations. As the reliability team implemented wireless vibration monitoring across the over 40-mile conveyor, they instantly saw results. First and foremost, the team saved time. Technicians no longer needed to drive the length of the conveyor, stopping every couple of miles to perform manual checks. Moreover, because the team did not have to manually interact with the moving conveyor to take readings, technicians were safer.

In addition, easy-to-understand conveyor health information came into the maintenance office at a regular cadence, not only ensuring the team had continuous visibility into the health of the conveyor, but also eliminating the time necessary for analysing raw data. Technicians could spend their time on higher-value tasks than collecting data, and analysts could spend their time and energy on other, more complex problems.

Challenges and future outlook

While vibration monitoring offers immense benefits for mining operations, several challenges remain. Harsh conditions require sensors that are robust enough to withstand the high temperatures, dust, and impacts typical of mining environments.

Data integration is another key area that requires focus when implementing vibration monitoring solutions. The more sensors a site has, the more data it must manage. Seamlessly combining data from stationary and mobile assets is complex but critical for unified monitoring systems.

Cybersecurity is also an increasing area of concern. Wireless monitoring systems must be secured to prevent data breaches and ensure reliable, safe operation.

Many of these issues can be solved by working closely with a trusted automation partner with deep expertise in the mining industry. An experienced automation solutions provider can help perform the initial assessments necessary to build a more successful vibration monitoring roadmap to navigate challenges.

Additionally, advances in IoT, machine learning, and cloud computing are poised to address these challenges. Recent developments – such as AI-driven diagnostics, enhanced sensor durability, and automated failure prediction – will further transform mining operations, improving efficiency and sustainability.

Drive competitive advantage

Vibration sensors and monitoring systems are transforming the global mining industry. By improving the reliability of rotating and mobile equipment, organisations enhance operational efficiency, reduce costs, and bolster safety. With the continuous advancement of wireless vibration technologies, the industry is moving toward a future of predictive, connected, and efficient maintenance practices. As technological advancements continue to emerge, mining companies that invest in cutting-edge vibration monitoring solutions will secure a competitive edge, driving sustainability and profitability, while simultaneously ensuring mines remain productive, safe, and available in the face of growing demand. **GMR**