The mining industry is going through a significant transition. The evolution of technology, from advanced data analytics to artificial intelligence (AI), has always had the potential to transform the mining industry by achieving operational efficiency improvements, enhancing productivity, and improving safety performance. The sector is very different than it was 20 years ago on multiple fronts.

Digitisation and technology adoption has been a big topic over the last few years, in an attempt to improve efficiency. The industry needs technologies that are sustainable, environmentally friendly, can offer remote access, and help mines improve their productivity and safety.

**The trouble with tailings**

One issue that still challenges mining companies is the sustainability of mining tailings. Tailings are a common byproduct of the metals and minerals recovery process. It usually takes the form of a liquid slurry, made of fine metal or mineral particles and water, that is created when mined ore is crushed and finely ground in the process of milling. The generation of tailings is inherent to mining and metals processing, and will remain so for the foreseeable future.

The safety and environmental integrity management of tailings, both during and after mining, is the long-term responsibility of mining companies and is subject to varying regulatory regimes. Tailings management needs to be effective throughout the life of an operation, from initial feasibility, through to closure, and post-closure.

The type of aftercare can vary greatly depending on the nature of the tailings. In cases where tailings do not contain harmful substances, water is drained from the tailings storage facility to safeguard its physical stability, and it is then reshaped, covered with soil, and vegetated to create a stable landform. In other instances, longer-term measures may need to be put in place to safeguard the physical stability, chemical stability, and subsequent land use of the tailings storage facilities.
Tailings dam failures serve as stark reminders that there is still more to be done if the industry is to reach its ambition of zero harm.

**Performance monitoring**

According to the International Council on Mining and Metals (ICMM), performance monitoring of tailings facilities is a key element of responsible tailings management. Monitoring is also a critical input for informing the timely implementation of emergency response plans. Triggers of events that are identified can help operators to respond more efficiently.

The analysis also anticipates that the sector will further grow to US$22.4 billion in 2021. The DPO's market is expected to see substantial growth fuelled by increasing investment and critical development undertaken by prominent players to include optical sensing technologies. Growing demand for the highly integrated, cost-effective, and accurate measurement of centralised monitoring systems is expected to drive demand throughout the decade.

**Integrated fibre optic sensing**

Silva's DamPulse™ solution is an integrated fibre optic-sensing based tailings dam monitoring system that addresses dam integrity, public safety, and environmental protection. It identifies operators to identify potential problems in time to facilitate timely maintenance and intervention before failure occurs. The system provides high-quality distributed strain, strain, and acoustic measurements in real-time, using a purpose-built optical fibre cable optimally placed for the entire structure coverage.

DamPulse provides actionable insights into the state of structural risk for the entire life of dam (including post-operation). The optical fibre sensing network can be readily extended enabling an expandable installation to provide a comprehensive lifetime structure monitoring solution. Flexible installations with no power requirement on site also makes this technology beneficial. The cable and additional information is laid out, covered, and surveyed during construction or expansion. Alternatively, retrofit can be completed using trench and cover or borehole completion methods with no need to manage extra cabling for power or communications. Temperature, acoustic, and strain data can be collected on the same fibre optic cable. This allows for the implementation of multiple monitoring techniques for identification of increasing seepage flow zones, structural deformation, and material changes through time with large spatial and high measurement resolution. Specific application modules include seepage detection, deformation monitoring, seismic event detection, surface and subsurface imaging, and dam breach detection. It is possible to also detect early signs of liquefaction with a proper system design and analysis. Alarms can be generated from the application module and output for integration with operator control systems or a web-based platform.

The system will alert the operator of abnormal seepage flow rates which can be an indication of erosion, one of the most common causes of dam failure. For condition monitoring, the system records acoustic data continuously on demand to image the sub-surface through advanced seismic techniques. Variations in seismic frequency and velocity highlight any material changes in the dam to aid identification of structural changes.

Seismic surveys can be active (use of external energy sources) or passive (analysis of natural noise or seismic events). Active seismic surveys can be used to image the subsurface, applying techniques such as multi-channel analysis of surface waves (MASW) and other tomographic methods. Applying passive ambient noise interferometry (ANI), shot and power than to reconstruct wave trains between two receivers, can help image a dam with high precision. Small seismic events, termed microseismic, caused by movement on faults or by mining blasts, can be also detected using DAS technology. DAS microseismic monitoring can be used to detect seismic movement in cans or induced seismicity in the area surrounding dams where seismic hazard is often an important safety consideration.

Using distributed strain sensing (DSS), local movements can be detected at an early stage using the same optical fibre cable. This has identified early signals of liquefaction which are not normally used to detect movements.

A combination of dynamic and static strain changes offers a better understanding of potential structural changes, and makes early decision-making possible. The system can detect movement changes in the dam and can therefore be used as an early-warning system with continuous monitoring, or as an investigation tool to measure movements regularly. When it comes to a breach, any change that causes damage to the cable can be detected in real time, irrespective of the interrogator, to activate alarms and trigger ERP. Using purpose-built software, it is also possible to analyze the signal losses along the length of the cable. Temporal signal loss changes then be detected before a full cable breach will occur.

**Conclusion**

By providing early alerts of potential problems, these solutions can help mine operators tackle one of the biggest challenges they face in managing water in tailings dams and maintaining the safety of dams. The system can detect even the smallest changes in the dam structure that could otherwise go unnoticed with conventional technologies, thus helping to reduce the number of 20 or so tailings dams that fail every decade.

**References**


---

**Eliminate Carryback.**

Richwood Bolt Cleaners Provide Immediate Return on Investment.

Even in severe environments, Richwood bolt cleaners provide a real return on investment through increased bolt uptime, decreased clean-up costs, low maintenance and longer component life.

What would it mean for your productivity if carryback issues were eliminated?

Contact Richwood today for an on-site evaluation +1 (304) 525-3434

www.richwood.com

(800) 237-6691

+1 (304) 525-3434

info@richwood.com

©Richwood, 2017