

Tailings dams face pandemic pressures

Advances in tailings monitoring technology proved pivotal during the Covid-19 pandemic, finds Ailbhe Goodbody



A mine tailings reservoir in Madagascar

**Surface
Mining > Geomechanics-
ground-control**

Tailings storage facility (TSF) monitoring technologies and methods have evolved quickly during the Covid-19 pandemic, as lockdowns and travel restrictions impact critical operations such as manual dam inspections.

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Solutions providers stepped up their support of owners and operators to ensure that good practices in monitoring and management continued during the challenging time. Now, as the world starts to re-open and operations restart, operators are starting to look back on the critical role technology has played.



"The opportunity to operate systems remotely and obtain the information online to make timely and accurate decisions, especially during 2020-2021, was where the real impact of the progress was felt," says Patricio Monreal, senior mine measurement sales engineer at mining software company Maptek.

Regional associations also had to offer specific safety guidance to tailings dam owners and operators.

For instance, in April 2020, as the pandemic intensified, the Canadian Dam Association noted that operators need to account for the implementation of pandemic measures, such as reduced staffing levels and remote sensing and monitoring of instruments also managing the everyday challenges of ongoing operations.

"The fundamental principles of dam safety described in CDA Guidelines still apply [despite COVID-19], and monitoring and emergency planning activities are essential to the safe performance of a dam," write the CDA.

In February 2021, the United Nations Economic Commission for Europe (UNECE) launched an Online Toolkit and Training for Strengthening Mine Tailings Safety that took into account the pandemic's unique challenges.

The UNECE said it would help countries to improve management and safety around mining activities and the governance of disaster risks, because it can help "fill a gap in the current context when on-site trainings and in-person capacity development activities cannot take place due to the Covid-19 pandemic."



Nicholas Prevost, director of mining innovation at Inmarsat, said tailings management has "become increasingly complicated since the outbreak of the Covid-19 pandemic". He points to the ongoing impact of social distancing requirements while site managers are being tasked with devising a safety-first methodology

that maintains 'zero harm' best practice at all times.

"Mining companies can reduce risk if they can accurately monitor and manage from a distance, without workers having to visit remote areas in person. This is especially pertinent in the post-COVID work environment where remotely accessed real-time monitoring solutions can be leveraged to reduce the physical presence of workers on-site and help to prevent the spread of any virus."

Francesco Coppi, director of monitoring radar product management at IDS GeoRadar, comments: "During the pandemic, aside from remote assistance, we have offered online training and webinars to our customers to further strengthen the cooperation that distinguishes our relationship with our customers, especially in this difficult period. In this way, we have been able to make the remote deployment of our radar systems possible, overcoming the safety restrictions imposed by the Covid-19 pandemic."

Maptek's Monreal says: "Travel restrictions and social distancing mean that to provide security for our workers, we must allocate more time for a planned programme of inspections. This suggests that the technology implemented for tailings monitoring should take a further step towards greater interoperability between various solutions, to make remote monitoring more efficient and secure."

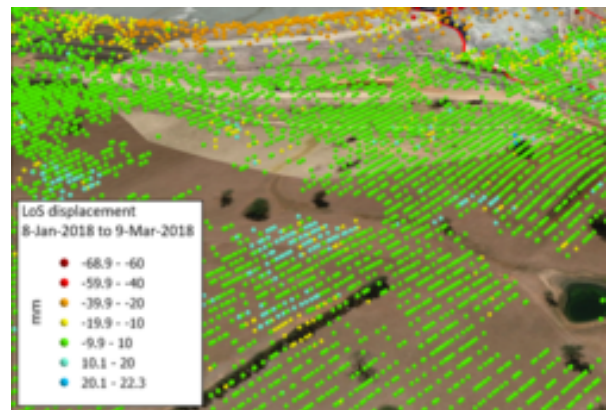
Eye in the sky

TRE Altamira provides monitoring services based on interferometric synthetic aperture radar (InSAR), delivering information about surface deformation. Its radar satellites can steadily monitor surface movements every 11 days, so it is not a real-time solution; Davide Colombo, customer solutions specialist at TRE Altamira, calls it "the first line of defence" that can monitor dams without the need for on-site visits or installations.

"The service is able to track displacement up to a millimetre and does not rely on any ground instrument," he explains. "In other words, it's ideal when you want to monitor vast areas, big structures and remote areas where it might be challenging to get access to install instrumentation."

The company also offers full client support for the interpretation and integration of InSAR results. Colombo says: "For every new image, the radar acquisition is processed, and a displacement map is produced, with the time series of deformation reported to clients via a web portal."

In December 2020, Glencore announced that it had entered a global agreement with TRE Altamira to expand satellite monitoring to over 110 of its dams worldwide, calling it "the largest industry monitoring agreement to date specifically focusing on tailings storage monitoring".



TRE Altamira provides INSAR monitoring services

Glencore noted that by taking measurements from both ascending and descending satellite orbit directions, it will be able to resolve any measured movement on its TSFs into both horizontal and vertical components. While the main focus of the agreement is monitoring Glencore's tailings dams, the company added that the data would also be used at some sites to supplement other terrestrial monitoring techniques, including open pits, waste piles and areas prone to subsidence.

In 2017, TRE Altamira teamed up with IDS GeoRadar to offer an integrated monitoring service for mining companies. IDS GeoRadar offers its IBIS slope monitoring radar systems globally; the technology can provide critical monitoring of fast movement, enabling the implementation of early warning alarms and the tracking of slow movement for long-term risk mitigation.

The companies' tailings monitoring technologies are complementary; TRE Altamira's InSAR is mostly sensitive to the vertical settlement of ground, while IDS GeoRadar's IBIS is sensitive to rock face movements of steep walls.

In March 2021, IDS GeoRadar and Geopraevent (both Hexagon companies) announced a new tailings dam monitoring solution called SLYX Slow Movement Analysis. Reliably monitoring slow movements at tailings dams over several months or even years can be very challenging.

"Tailings dams are fixed structures by nature, and the smallest detected movement can be a precursor of a progressive failure," notes Coppi. "A slope covered by vegetation is a challenge for obtaining coherent data and detecting real movement, which could have a potentially disastrous effect. The experience and know-how of Geopraevent in landslide monitoring, which is typically strongly affected by the presence of vegetated areas, has been exploited to develop SLYX."



SLYX Slow Movement Analysis monitors slow movements at tailings dams over several months

The algorithm is based on an automatic selection of the most suitable measurements from the IBIS radar data and on a tailored evaluation for slow movements. The SLYX algorithm detects displacements in the range of millimetres per week, per month or over longer time periods.

SLYX is fully integrated in IBIS Guardian with a dedicated interface for easier application. "All the results are automatically processed and visualised in the Guardian 3D user interface with the possibility to exploit most of the Guardian functionalities, like charting and exporting capabilities," says Coppi. "The user can easily customise the SLYX analysis parameters by means of a dedicated user interface."

So far, SLYX has been implemented mainly in South America, but Coppi adds that the solution will be offered to all mine sites facing challenges with tailings dam monitoring.

Scanning the slopes

Safety is the critical issue targeted by Maptek's Sentry solution, which can handle 24/7 continuous monitoring and is available in various configurations to meet operational needs. Sentry combines a Maptek laser scanner with sophisticated software and allows operations to monitor, analyse and report on rapid and gradual movements on tailings dams.

"Various analytics can be performed on the captured data," says Monreal. "Deformation can be determined at different points through the deformation curves, speed and inverse speed graphs. This allows risk to be evaluated and more informed decisions to be made, thus mitigating the risk to structures, equipment and people."

In addition, Monreal explains that the laser scanning approach provides reliable and repeatable monitoring of dam highwalls and enables survey of the TSFs. "Capturing structures and surrounding areas provides for a complete 3D visualisation of structures in the context of their setting," he says. "Geotechnical engineers can apply the resultant 3D topographic model to hydrographic modelling and failure simulations, conduct deformation analysis and plan mitigation work."



Maptek's Sentry solution can handle 24/7 continuous monitoring

In South America, Maptek was asked to monitor the upstream structure of three cascade tailings dams after a major failure event. Maptek Sentry was in place for about seven months, measuring the deformation and delivering alerts. Monreal adds: "Sentry was an important part of a comprehensive monitoring system that was implemented during the inspection, restructuring and improvement of the tailings works."

A large mine in Australia that consists of surface and underground operations initially rented three Maptek Sentry systems for continuous monitoring. The mine has now implemented five continuous systems, alongside another implemented for periodic monitoring; deploying additional mobile systems gave the operation greater continuous coverage across the walls. At this operation, the tailings dam monitoring is handled by a combination of Sentry systems with seismic sensors, geodimeters and visual inspections.

Another site in Australia, Gold Road Resources' Gruyere open-pit mine, deploys its vehicle-mounted Maptek XR3 long range laser scanner to expedite surface data capture of the 1.6km diameter TSF. The process previously required eight UAV flights, taking two days, but with the XR3 it takes less than half a day.

Meanwhile, satellite operator Inmarsat entered the tailings monitoring sphere in early 2019, teaming up with consulting firm Knight Piésold to provide a remote tailings dam monitoring solution with complimentary audit consultancy services.

The second generation of Inmarsat's IoT tailings management offering features two distinct solutions: Tailings Insight - Cloud and Tailings Insight - Plus.

"Tailings Insight - Cloud is a software-as-a-service application that harnesses the power and agility of cloud computing to aggregate real-time tailings data from multiple sources," explains Prevost. "This has been developed for those mining organisations that have existing connectivity infrastructure but disparate approaches to tailings monitoring at different sites, and need a way bring all of this data together in one place."

Tailings Insight - Plus incorporates Tailings Insight - Cloud but adds components like sensor integration, edge connectivity, satellite connectivity and ongoing service monitoring and management. Prevost says: "This means Inmarsat oversees the entire end-to-end process by offering service level agreements (SLAs) to ensure the continuous gathering of data and real-time monitoring."

Tailings Insight - Plus uses Inmarsat's L-band Broadband Global Area Network (BGAN) global satellite service, which Prevost states has 99.9% uptime connectivity and global coverage. "This guarantees uninterrupted real-time data transfer and there are a variety of options to link the sensors to the satellite backhaul," he says. "BGAN is ideal for operations that lack access to reliable on-site connectivity but need to demonstrate their commitment to safe tailings management, whereas Tailings Insight - Cloud is better suited to operations that already have connectivity infrastructure but need a platform to unify all of their TSF data."

Inmarsat has been working with a number of tier 1 mining companies to provide them with its Tailings Insight solution, but couldn't give more details at this time. Prevost concludes: "We also continue to work with companies such as our launch partner Knight Piésold and Strategia Worldwide who provide geotechnical auditing and risk management solutions respectively."