

The future of tailings

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New technology to improve tailings standards



Devastating tailings disasters in the last 10 years have brought the needs for improved tailings regulations to the surface.

The industry has responded, working with international organisations to craft the Global Industrial Standard on Tailings Management (GISTM). Mining companies across the world have welcomed the clarity in expectations but are concerned at the increase in costs required to meet these standards.

However, miners cannot afford to ignore these new tailings standards, as investors are becoming ever more insistent that these standards are met. The question then becomes, how can mining companies – assailed by the growing costs of exploration and equipment, and by diminishing ore grades – manage to balance the need for top-notch tailings safety practices while also remaining profitable?

The answer may lie in technology, in using technological advancements to further optimise the entire mining process, diminish the amount of tailings, and use technological advancements to lower both the cost and the risk of tailings storage facilities.

In this white paper, we talk to the shapers of the GISTM, as well as leading original equipment manufacturers on technologies they offer to improve tailings management. We also speak to companies developing new technologies to bring TSF management to the next level.

The future of tailings

As global tailings regulations become clearer, miners are looking to increase investment in technologies to meet these new baselines



It has been three years since the Global Industry Standard on Tailings Management (GISTM) was released, and it has already had a substantial impact on how mining companies are approaching their tailings storage facilities (TSF) management and planning.

In a recent survey commissioned by Aspermont, a overwhelming 98% of survey respondents said the Global Industry Standard forms a core part of their tailings strategy.

The International Council on Mining and Metals (ICMM) will be collecting substantial data sets from its 25 member companies, which were required to publish their progress on their most high-risk facilities in the first week of August. Member companies have been working on conforming to the Global Industry Standard for tailings facilities with the highest potential consequences in the event of a dam failure.

When companies adopted GISTM in August 2020, they agreed to disclose the status of conformance for their top two most critical categories, ICMM chief operating officer Aidan Davy said. There are around 250 of those.

The first round of disclosures “is an important milestone, but it’s just one stop on the journey”, Davy said. “Our expectation is that not all members will be in full conformance but will be really well-advanced and fully transparent.”

KEY FIGURE

98% of respondents to an Aspermont survey said the Global Industry Standard forms a core part of their tailings strategy



There are an estimated 900 tailings dams facilities worldwide, but the first round will only apply to the most critical categories. Many companies have launched unique websites to showcase their findings for the first round of tailings conformance. Newcrest Mining indicated that the GISTM has already resulted in “transformative improvements” in tailings management, governance and monitoring, while elevating tailings management to the “highest levels of company oversight and accountability”.

Newmont also hailed the GISTM “as a necessary step towards the safer management of tailings facilities”.

Davy said there was some debate about how to measure the highest-priority TSFs, and it came down to deciding between consequences and risk.

The global standard “focuses on consequence rather than risk, as risk is a function of consequence and of likelihood,” Davy says. “For instance, you could have a high consequence and low risk. By focusing on consequence, even if risks are really low, we said let’s use consequence as a guiding light and what we should prioritise our efforts on.”

ICMM member companies have committed to improving TSF safety and transparency for the remaining dams – around 650, Davy said – by August 2025.

There is substantial support across the sector for the global tailings standard. Another group, the US Society on Dams (USSD), is also working on its own standard that would be compulsory for mining companies operating in the US.

There is no competition with the GISTM said Del Shannon, Kiewit Engineering Group chief dam engineer and, until recently, USSD President.

“We just don’t have these guidelines in the US,” he added. “The dam world is complex here. Every state has their own individual regulators, but the state of Alabama does not – so 49 of 50 states have a dam safety program. We also have all these dam safety organisations, but currently tailings dams don’t fall under all the state regulators, which means they’re the orphans of regulation.”

The USSD is trying to close this loophole and bring TSFs under regulation, he said.

“We’re preparing these guidelines to offer to states to adopt for oversight and regulatory purposes,” Shannon said.

One of the biggest concerns he has about the recently published GISTM is the need for an Engineer of Record (EOR) to be assigned to each tailings dam.

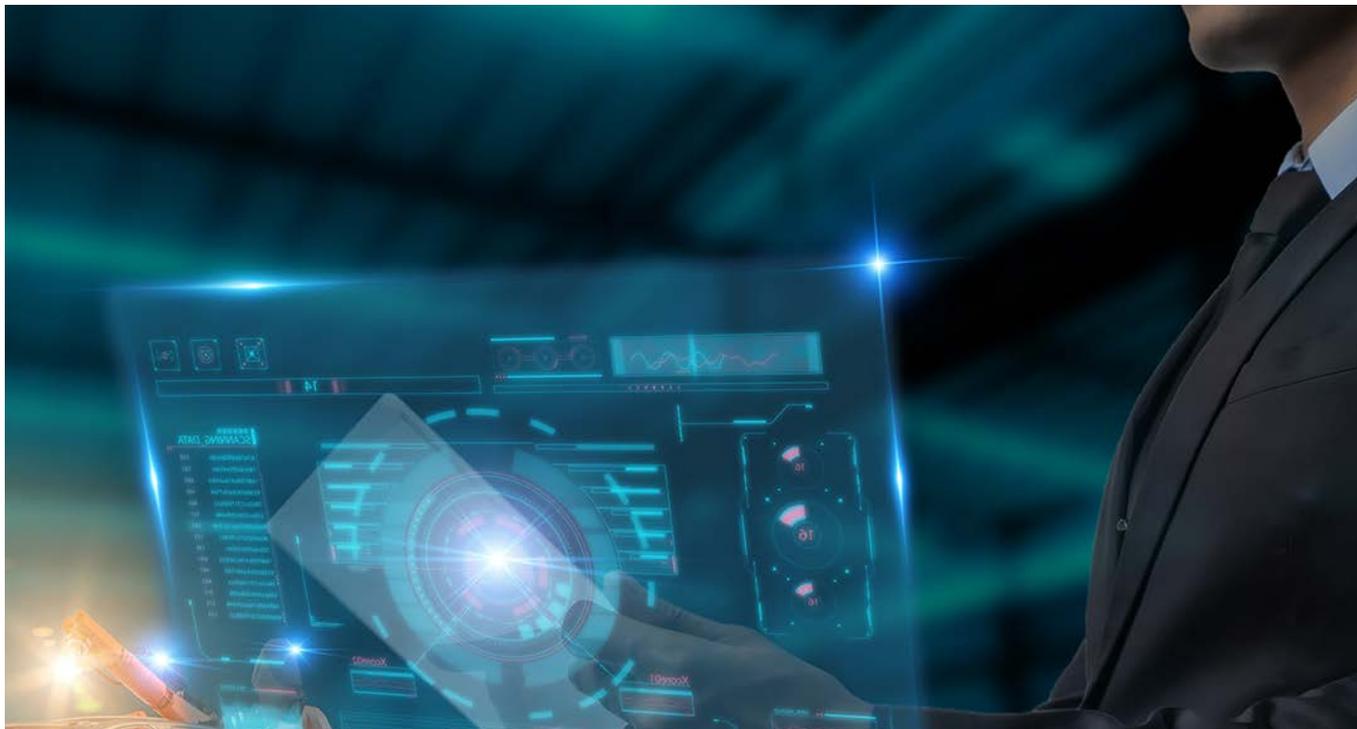
“I fully support the need for an EOR. We need the EOR to be responsible for these structures. But where are we going to find them?” he said, pointing to global staffing shortages.

“From my perspective, that’s one of the critical elements in the changes to the tailings standard.”

The ICMM is also focused on improving innovation across operations, with the goal of ultimately decreasing the amount of tailings that will need to be stored.

“The dam world is complex [in the US]. Every state [except Alabama] has its own individual regulator. We also have all these dam safety organisations, but currently tailings dams don’t fall under all the state regulators, which means they’re the orphans of regulation”

Del Shannon, Kiewit Engineering Group



“Back in September 2022 the ICMM published a tailings reduction roadmap, and we’re working collaboratively with partners to bring about a step change in either how we mine or process materials, such that we significant reduce the quantity,” Davy said.

“We can’t lose our laser-like focus on the standard, but equally important, [in order] to progress in parallel, we need fewer TSFs,” he said.

As for new technologies, a substantial number of respondents in the Aspermont study – 34% – believe that Digital Twin Technology will have the most impact when it comes to enabling companies to meet the standards in the GISTM.

Kiewit’s Shannon agreed.

“This is complex stuff,” he said, pointing out that engineers and the industry at large still don’t fully understand static liquefaction in tailings ponds, which is believed to have led to the Brumadinho tailings dam disaster in Brazil which killed 270 people in 2019.

But digital twins could be a turning point for managing these complex processes, he said.

“Let’s say you have a tailings dam that has 3-4 million cubic yards of material in it. To be able to model that and to understand the variability in the soils, tails, the variability in the strengths – to absolutely accurately model that” would be helpful, he said. “It’s not as precise now as maybe one thinks it is.”



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Aidan Davy, ICMM

Top-to-tail process overhaul

Minimising tailings and improving overall tailings practices begins early in the process, with mine service companies taking a closer look at optimising flow sheets.

According to FLSmidth director of tailings solutions Kenneth Rahal, combining technologies over several processes is key to improving the characteristics of tailings.

FLSmidth launched its tailings-focused group seven years ago to brainstorm and deliver technologies aiming to improve tailings stability, Rahal said.

“Companies are now looking at the total cost of operating costs” for tailings management systems, with an interest in incorporating new technologies to optimise overall processes, he said.

“For instance, we’re looking at optimising the designs of the larger filters,” Rahal said. “We’re doing a lot of research on how we can optimise the operation through plate design to run the filters better. There’s been a push within our digital group to improve both the expert control systems as well as the sensor technology,”

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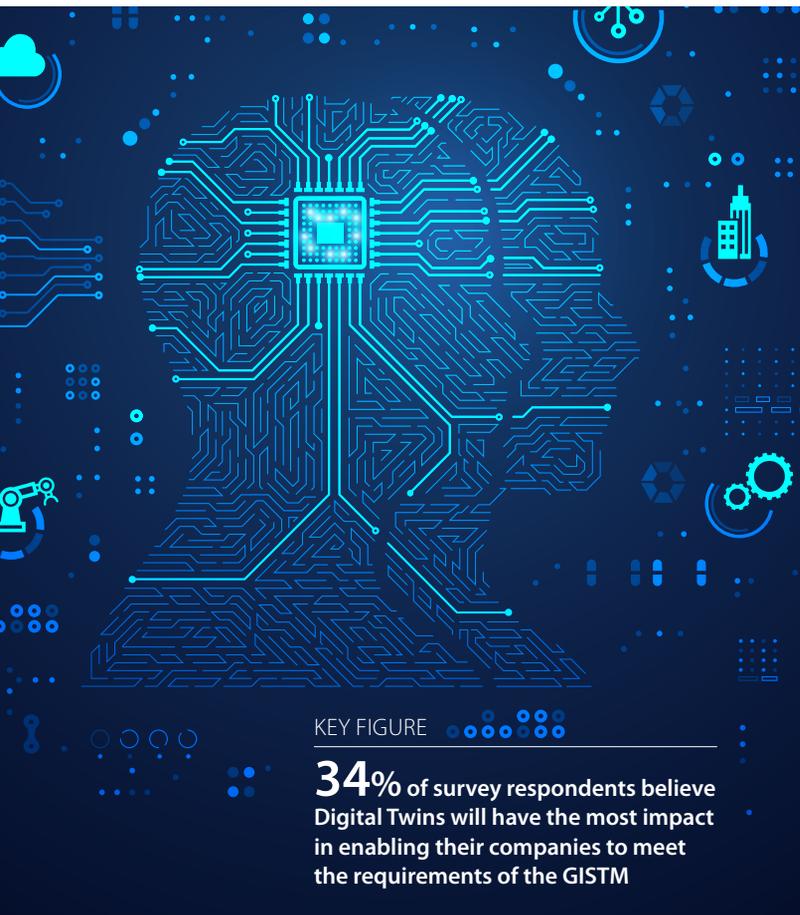
Kenneth Rahal, FLSmidth



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Rahal said. “This means we can get the necessary data to provide a more consistent operation and really achieve better results.”

While 34% of survey respondents believe Digital Twin technologies will have the most impact on meeting the requirements of the Global Industry Standard on Tailings Management, another 24% of respondents say interferometric synthetic aperture radar technologies will have the most impact.

In that vein, FLSmidth has also branched out into digital twin technology to improve its belt conveyor system to increase productivity, pinpoint potential bottlenecks, and extend the life of conveyor components.

The digital twin for the conveyors provides operators with a digitised overview of the system, which allows users to see which sections and components can be improved, identify potential problem spots before full production is in full swing, and improve productivity and continuity.

The digital twin technology provides real-time data on how compatible the belt conveyor is with its components, applying a physics-based model. It also has the capacity to adjust immediately in response to operator feedback.

The system also enables mine operators to simulate the process off-line before any action is taken at the actual mine.

The technology also provides information on load levels’ current and power requirements, in addition to the stress in each component as well as any tension experienced on the belt. This allows operators to reduce the expenditure of non-essential energy in transporting materials, FLSmidth said.

Cyclones have also received special attention from original equipment manufacturers.

These technologies are helpful when scaling up operations, Weir Minerals global manager for tailings and backfill Erik Vlot said.

“We’ve now developed Cavex DE cyclones, which is where we combine two features of a cyclone in one, and we are able to take out the core tailings from the fine tailings” he said.

“The advantage of this is that you no longer need to process your core tailings in your fine tailing circuit.”

Weir has added an Air Core Booster to the top of each hydrocyclone. These ACBs improve cyclone efficiency and capacity by producing more air within the hydrocyclone. This improves volume flow split to the overflow, reducing total pressure across the unit as well as the amount of back pressure at the discharge point.

It also cuts down on the bypass of fines.

Mining companies also need to reconsider slurry as a viable alternative for tailings waste, Vlot said.

There remains a perception that any liquid form of tailings is dangerous, he said. However, Weir has been developing technology that significantly lowers the risk related to liquid tailings. Weir's GEHO PD slurry pumps produce tailings slurry with a high yield and viscosity to generate medium to high pulp friction losses.

The GEHO PD filters up to 90% of water, with up to 98% availability. This technology also enables operators to feed slurry to a process at high temperatures.

The thickened slurry leads to less volatility and movement within tailings storage facilities, Vlot said.

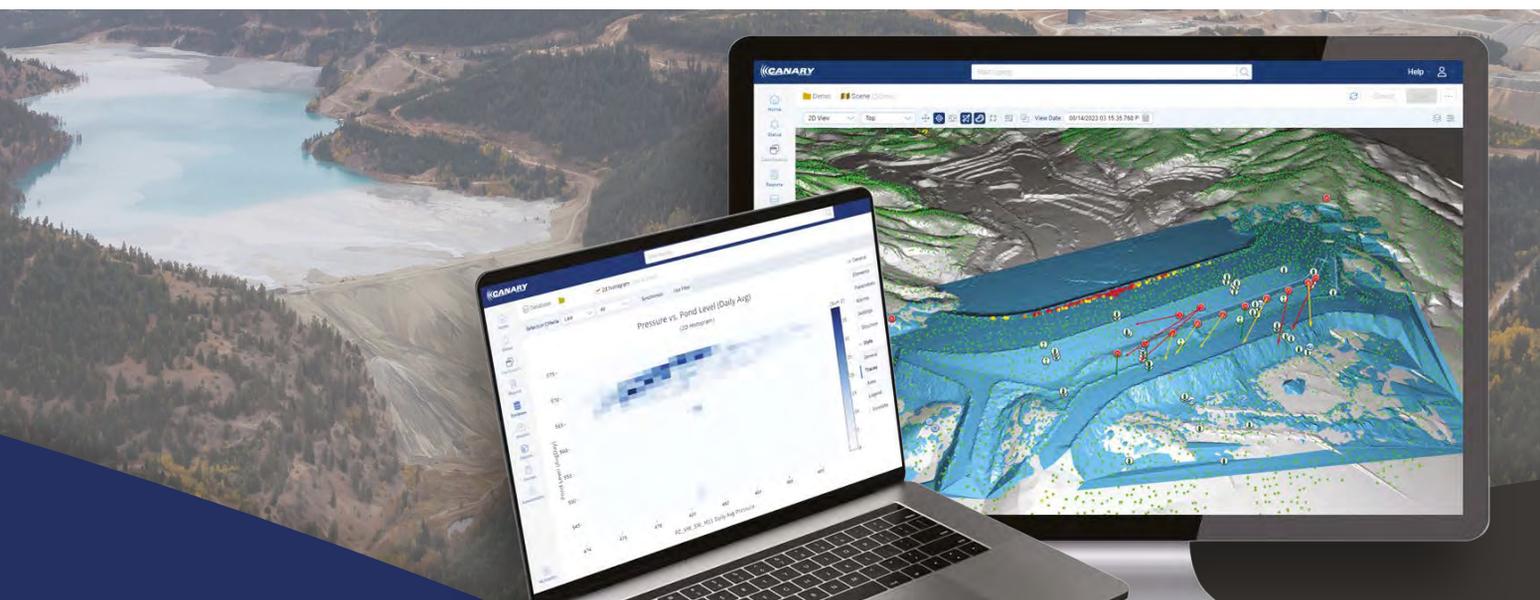
"It's pretty stable," he said. "It's a slurry, so it doesn't release water. It dries up, and then it starts opening up and cracking. You leave it there to dry for a number of days, and then you dispose of the second layer and you dry it again."

The finished product leads to a dry substance that is no longer mobile and is stable, reducing the likelihood of dam instability and collapse.

Climate will determine how effectively these thickened slurry technologies function, Vlot said.

"In areas where the net evaporation rate is positive – where there's a wet climate – [thickened slurry technology] will have a bigger effect"

Erik Vlot, Weir Minerals



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“There [are] a lot of developments going on in the monitoring of tailings storage facilities on the dam walls with satellite technology, and that is really awesome”

Erik Vlot, Weir Minerals

“It’s more suitable to climates where it’s drier and you have more evaporation than precipitation,” he said. “No one technology will fit all mining projects.”

FLSmidth has also refined technology in this space, developing a thickener spiral rake blade to increase raking capacity, improve mud bed residence time, and reduce overall consumption of energy and water. The rake blade increases the power while at a lower torque, while managing densities under the flow to improve the efficiency of the thickening agent.

The rake blade also helps mining companies to sidestep a common issue in tailings flows – controlling the speed at which tailings materials flow out to the pond unevenly. FLSmidth has designed the spiral inner blade to even out distribution of the flow, with the spiral blade directly pulling the outflow along the tailings facility floor.

The process has also been designed for a maximal use of water. By substantially lowering the torque requirements, the rake assembly creates a denser material in the thickener. Because less water is used during the thickening process, more water has been made available to be recycled into the plant.

Looking to the future, Weir’s Vlot would love to see more technology monitoring key components of tailings storage facilities.

“There [are] a lot of developments going on in the monitoring of tailings storage facilities on the dam walls with satellite technology, and that is really awesome,” he said. “It would be great if there was a possibility to measure the tailings area to understand the stability of the stack.”

He believes that such technology could also be applied to slurry, and to determine when the tailings storage facility reaches a point of acceptable stability. “This is something that really needs to be developed,” he said.



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New technologies in development

There is technology in the works that is aiming to provide much more detailed and comprehensive information about tailings in tailings storage facilities, with the aim being the prevention of disastrous failures like that in Brumadinho.

UK-based Geospatial Insight has teamed up with a technology spin-off from the University of Nottingham that has developed a monitoring system combining satellite inputs and radar into a user-friendly dashboard.

This satellite infrared technology maps out very small relative changes in ground height over any land surface.

“Imagine radar, which needs to hit a metal object and reflect a beam of energy back,” Geospatial Insight managing director Dave Fox said, describing traditional radar technologies.

“When this hits vegetation, you’ve got grass and trees blowing, which means you’re going to get a different response, as opposed to when you have a constant surface like buildings that don’t change.” The new technology developed by Nottingham can use all of these radar signals and interpret them, even when there is no solid surface, to provide a solid signal back to the satellite.

“This technology is able to cut out noise, reduce error, and provide a good estimate for any location of relative ground surface movement,” Fox said. “We’re going to take that technology and apply it exclusively to the mining sector” to help improve tailings facilities management.

A dashboard built by Geospatial Insight visualises the data provided by the satellite.

“If you have a mine in Brazil, chances are there [is] lots of vegetation, you’ll have an earth dam that’s vegetated,” Fox said. “With normal technology, you don’t get much of a return from that dam at all, whereas with this data you do. You can look across the whole structure and see if there’s any movement.”

The radar is designed to specifically pick up movement in the tailings themselves, and not the water in which tailings are submerged, Fox said.

If such data had been available, managers at the Brumadinho mine would have been able to see changes in the tailings structure 40 days before the disaster, Fox said.

Geospatial Insight has been analysing the Jagersfontein tailings dam collapse in South Africa in September 2022, to determine if this technology would have been able to predict problems.

“The big difference in the technology that we’re applying a response from the tailings materials,” Fox said. “What we’re actually seeing is prior movement in the pond itself, seeing the movement of the tailings material, which contributed to the eventual collapse.”

By using the data generated by the infrared satellite, it is possible to pinpoint where changes in surface elevation accelerate, Fox said. This allows engineers to identify a coming landslide long before the landslide becomes inevitable.

Fox acknowledged the technology cannot prevent all tailings dam failures.

“There [are] always going to be events like earthquakes that you can’t predict,” he said. “But if there has been an earthquake and the tailings storage facility hasn’t collapsed, it’s another method to see if there’s any movement, if any trends have accelerated because of the event.”

Another company is making progress with digital twin technology to improve subsurface modeling.

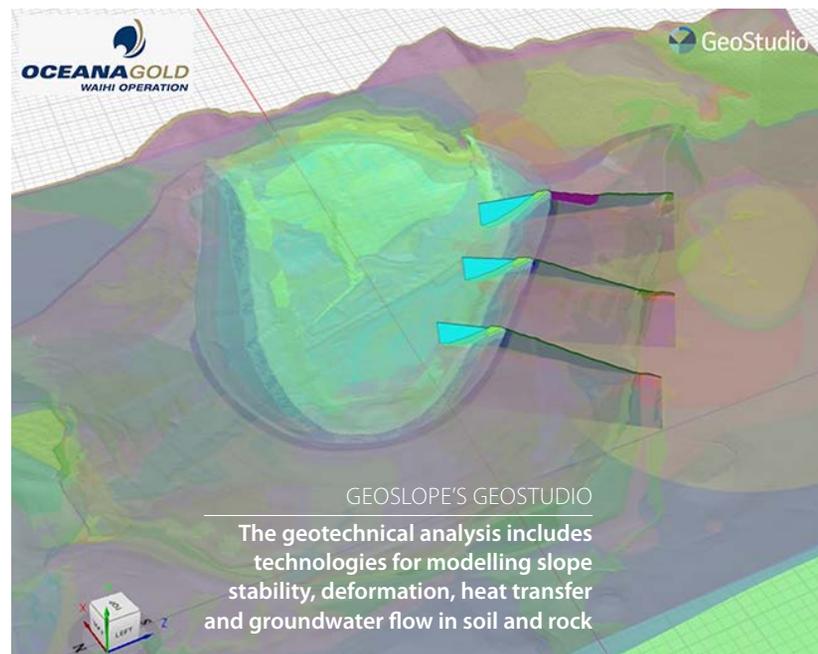
New Zealand-headquartered Seequent has been working on its geotechnical platform since its founding in 2004. Now a part of Bentley Systems, it is upgrading its signature Leapfrog technology to help mining companies meet the new global tailings standard.

The technology uses Seequent’s modeling program with a third-party agnostic central platform software to collect all the information and create the digital twin of the subsurface area, Seequent segment director for mining operations Pieter Neethling said.

The upgraded technology also includes Geoslope’s Geostudio geotechnical analysis, which includes technologies for modelling slope stability, deformation, heat transfer and groundwater flow in soil and rock. Seequent acquired Canadian company Geoslope in 2019.

“The programme takes the original design files of the Engineer on Record, then puts it into Leapfrog which builds out the digital twin,” he said. “This creates a dynamic replica which gives a continuous update, depending on the frequency that you choose to update it.”

The system enables tailings management staff to easily access exact points of reference.



“Running the entire workflow [through the Digital Twin] is a part of good governance, plus it also picks up on weather and seismic events”

Pieter Neethling, Seequent



“When you’re driving the process with real-time monitoring, you can see it all in context. You can send an email to the EOR and ask the EOR to check a particular area. The programme will then take him to a direct view of the area in question, all through the Central platform,” Neethling said.

There are several benefits to this updated programme, Neethling said.

Seequent has launched a 3D capability for analysis, which is a further value-add, he said.

The combination of the platform software and Seequent’s sensor monitoring technologies allows for the continuous evolution and updating of the Digital Twin. “That puts all the context for geological modeling and water modeling in one place,” he said.

The Seequent programme can also be used to improve oversight and identify concerns in the subsurface area.

“There’s powerful data coming into Central on a routine, once-per-quarter basis,” Neethling said. “Running the entire workflow [through the Digital Twin] is a part of good governance, plus it also picks up on weather and seismic events. All of that is good data to have, to look at developing trends.”

This collection of technologies in one centralised location also simplifies collecting data for auditing processes.

Seequent’s Digital Twin technology is unique from other technologies currently on the market, he said.

“Our experience is that there haven’t been very many Digital Twins generated,” he said. “What they do is take drone imagery and create a model from a drone image, so it’s not a true Digital Twin. They might have the topography, but they don’t have what’s lying underneath.”

Seequent’s technology is also the first time a Digital Twin has been incorporated into a workflow.

In addition, the updated Leapfrog programme prevents critical information on tailings storage facilities from being lost. Even if key personnel leave a company, all the necessary data is embedded in the central platform.

The upgrade to Seequent’s technology is now delivering actionable intelligence that is automatically entered into the database, Neethling said.

The technology, while not yet on the market, is in final trial stages with an unspecified mining company’s facility. This trial will enable Seequent to identify where any gaps exist between the technology and the requirements of the Global Standard.

FLSmidth: helping miners improve their entire mining process to lower tailings output



As mining companies come under fire for their tailings practices, and investors make demands for substantially safer tailings safety measures, miners are striving to find every way possible to lower their risk of tailings incidents.

This means they are open to considering a slew of technologies that can help reduce their tailings output, and substantially increase their safety.

FLSmidth has been proactive in this approach, forming a tailings-focused subdivision within

its company seven years ago, director of tailings solution Kenneth Rahal said.

“So many of our customers are just looking at all the different options” when it comes to tailings technology, he said. “They want to better understand the costs associated with different technologies – whether it be just normal thickening or paste thickening or filtered tailings – as well as the different technologies that would go into the flow sheets.”

As a result, rather than just receiving general



FLSmidth's LoadIQ® sensor technology will allow operators to determine how full the mill is at any moment

presentations from OEMs (Original Equipment Manufacturers) about potential technologies, “some customers are now looking at pilot-scale technologies” to explore the scalability of these new technologies, Rahal said. “They want to collect more data to become familiar with these alternative tailings solutions.”

Optimising flow sheets

One technology that FLSmidth has been working on is an improved overview system for mining operations.

“There’s been a push within our digital group to improve both the Advance Process Control [APC] systems as well as the sensor technology,” Rahal said.

The APC system stabilises key processes in the mining flow sheet and manages and corrects unforeseen process disruptions. This technology also works to minimise wear of equipment, extending its life, while reducing the overall operational and maintenance costs.

The system will also optimise mill load targets, meaning that it will automatically adjust the mill load according to both the weight target set by customers and the process conditions.

FLSmidth has employed model predictive control and fuzzy logic rules to maximise the efficiency of this new process tool. The model predictive control undertakes calculations to optimise performance and how different machine parts interact with each other. The APC system works with targets as set by the customer, and ensures that the process is adjusted to meet these specified targets.

The system also employs artificial intelligence (Symbolic and Non-symbolic) in its optimisation strategy for processes.

The various ‘symbolic technologies’, as termed by the company, are used for high-level problems that are readable by humans. These include fuzzy logic, which delivers rules-based, intelligent fuzzy control. The ‘non-symbolic technologies’ include providing raw data to the machine and allowing it to recognise patterns. These include machine learning and deep learning.

The APC system also incorporates a soft sensor known as the Kalman filter to generate readings in situations where signals cannot be interpreted or are unavailable.

With these benefits, no challenge is too difficult for the APC system to manage – whether it be a mining company implementing extensive upgrades to their plant or testing new strategies for process control.

Comminution upgrades

FLSmidth has also been hard at work stepping up its offerings for the all-important comminution cycle.

Sensor technologies have been critical in improving efficiency and reducing waste, Rahal said.

“Our digitalisation efforts are looking all the way up into the combination circuit, where we’ve developed our LoadIQ® sensor technology,” he said.

The LoadIQ® sensor technology aims to enable miners to increase mill throughput without investing in costly upgrades for the grinding mill. The technology developed by FLSmidth will allow operators to determine how full the mill is at any

moment, as well as where charges are located in the grinding mill. The LoadIQ® software can also determine where the cascading material is most impacting the liner, to better protect the liner from excessive wear and tear and extend its life.

The software also decreases the amount of time required to process changes in ores and liners, and to determine optimal load targets. LoadIQ® will enable miners to calculate these targets efficiently, and has the option of being set to manual for operators to control it directly. Otherwise, LoadIQ® also offers the option to feed these factors into any system via Open Platform Communications to enable real-time optimisation.

By using AI-based software, FLSmidth is able to efficiently calculate optimal loads, work with installed expert systems, and ensure that point changes set by these expert systems – the DCS/PLC response – is never interfered with.

SmartCyclone™ technology

Focusing on improving the flowsheet from start to finish will ultimately improve the end product and tailings production, Rahal said.

This goal is further advanced by the development of FLSmidth's SmartCyclone™ technology, he added. This technology not only improves mineral recovery rates - an important outcome for all mining companies - but also increases overall production capacity and improves wear part monitoring.

The technology reduces – and at times, eliminates altogether – coarse particle bypass to the cyclone overflow, by lowering the number of variations in flotation particle size distribution. This will lead to

FLSmidth's SmartCyclone™ technology reduces coarse particle bypass to the cyclone overflow. This will lead to fewer fines in the overall tailings process



fewer fines in the overall tailings process. Reducing standard deviation for particle size variation is critical to the overall improvement of the mineral recovery systems.

SmartCyclone™ also expands production capacity by monitoring the roping process, Rahal said. Often in processing, cyclones can become overloaded and experience roping, which ultimately leads to a greater number of coarser solids winding up in the overflow. By reducing the amount of roping, the SmartCyclone™ stabilises the entire secondary grinding circuit, FLSmidth said.

The SmartCyclone™ technology reduces over-grinding in the mill and means there are fewer fine tailings that are generated, Rahal said.

The SmartCyclone™ package comes in two forms: 'Basic', which includes roping and wear sensors along with associated alarms, and 'Expert'. The Expert package includes the roping and wear technologies, along with condition-monitoring based operation, sump-level control and pump optimisation. It also includes cyclone overflow particle size estimation, cyclone inlet pressure optimisation, cyclone overflow optimisation, cyclone inlet density/solids optimisation, circuit production maximisation, and cyclone balancing based on wear and operating time.

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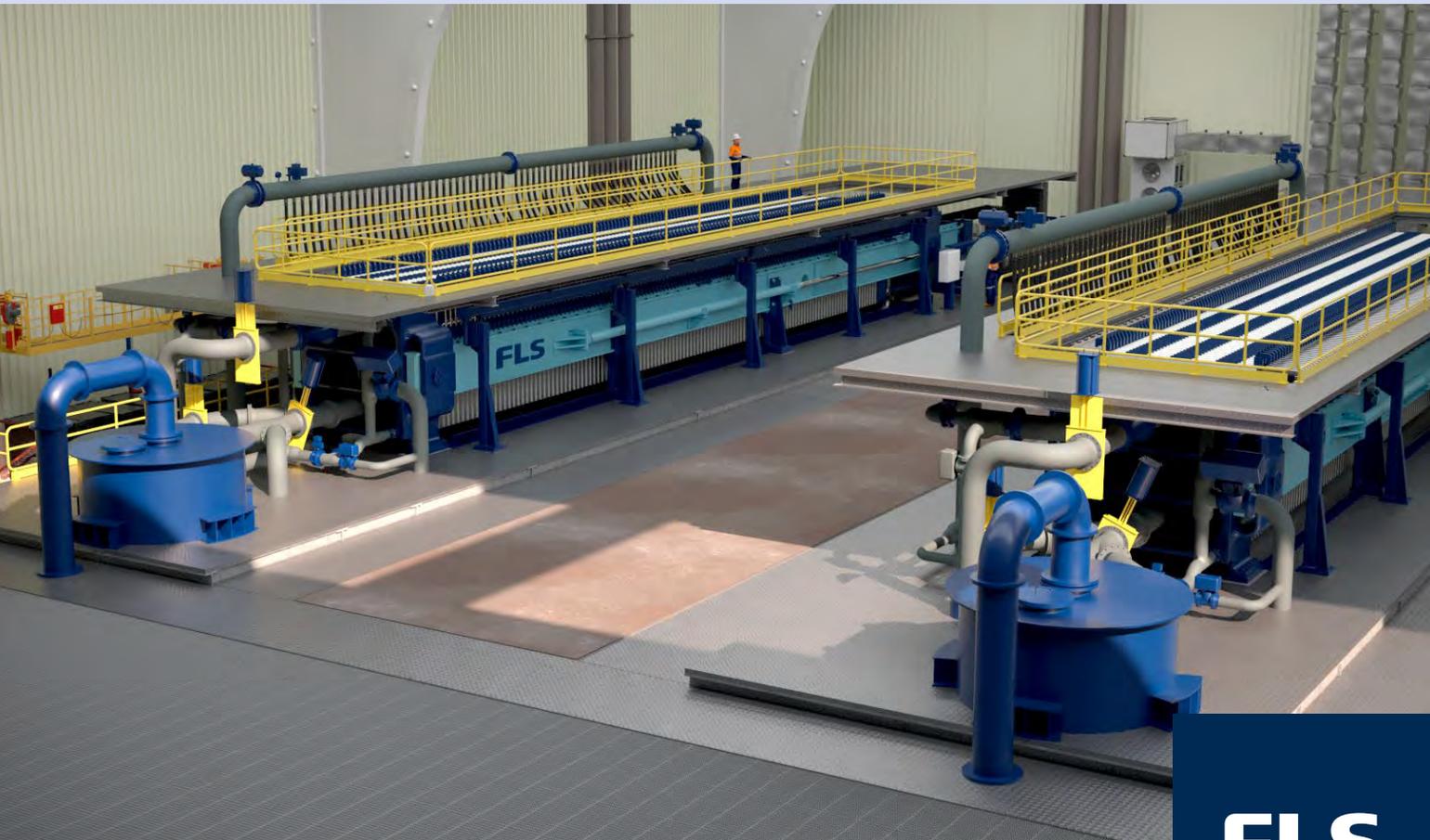


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Rethink, reduce and repurpose tailings waste

The Global Tailings Review calculated that 12.7 billion metric tonnes of tailings are produced every year, making it the largest waste stream in the world. The trend towards mass electrification has led to a growing demand for minerals needed to transition to a low carbon economy. This trend, coupled with declining ore grades, means the amount of tailings – as well as the capacity to process and store them safely and sustainably – is only going to increase in the future.

It's important to be clear-sighted about the nature and the scale of this challenge if the industry is going to develop safe and sustainable solutions that are also economically viable, according to, Weir Minerals global manager of tailings and backfill Erik Vlot.

"There is no 'one-size-fits-all' solution because each operation has to contend with unique climatic, topological and geological conditions, as well as the metal being processed, all of which influence the nature of the tailings and the possible solutions," Vlot said. "Innovative technologies and, equally as important, creative, future-focused thinking will play a vital role in overcoming some of these challenges.

"There are three pillars that guide our thinking and the conversation we're having with our customers. Firstly, let's rethink the basic assumptions the industry has about tailings; secondly, how can we reduce risk, the environmental impact and the total cost of ownership; and, thirdly, can we repurpose tailings in a way that transforms the current value proposition?"

Rethink

Weir Minerals is re-evaluating many of the most basic assumptions about tailings that have long been taken for granted.

"We're developing solutions that harness existing technologies and this begins in the pit, rather than focusing exclusively on the product that leaves the concentrator," Vlot said.

"For instance, ore sorting – typically utilised to deliver higher grades – can also minimise downstream tailings problems by removing problematic gangue phases



that might require adjustment to how the tailings are treated. In addition to the benefits in terms of tailings storage, this also reduces water and energy consumption and increases throughput because less non-valuable metal is processed.

"Similarly, our Enduron high pressure grinding rolls (HPGRs) with air classification deliver inter-stage beneficiation, while coarse particle flotation (CPF) reduces the quantity of fine tailings. These and other technologies help improve the geotechnical stability of the tailings, allowing for safer storage [and] improving the effectiveness of dewatering," he said.

Vlot said he believes Weir Minerals is uniquely placed to offer this approach and these solutions because of its all-of-mine capabilities.

"It is important that we listen to our customers' challenges and requirements and deliver solutions accordingly, rather than forcing technologies on them that align with our product portfolio. Where we have gaps, like with CPF technology, we seek industry partners – as we've done with Eriez – that help us tailor solutions to our customers' needs," he said.



“GEHO hydraulic driven piston pumps have solids handling capability up to 90% concentration, making it one of the most reliable tried-and-tested piston pumps on the market today”

Erik Vlot, Weir Minerals

“Our product offering is backed by a team of experts who not only know the equipment inside out, but also have process experience, while the Weir Technical Centres allow us to carry out test work and partner with miners to develop solutions based on their specific needs and unique site requirements. And this work isn’t limited to the laboratory. We also support our customers with full scale demonstrations, from circuit design through to on-site sampling and reporting.”

Reduce

When it comes to tailings management, while the means must be bespoke and site-specific, the ends are broadly the same across the industry. Simply, how can tailings be processed, managed and stored in a way that reduces the environmental impact, risk, energy and water consumption, the tailings storage facility (TSF) footprint, and the total cost of ownership.

There are obviously a multitude of variables that go into getting this balance right and there are often various stakeholders, shareholders and local communities with competing views.

In navigating these challenges, Weir Minerals take a Life Cycle Management (LCM) approach, which allows miners to analyse the tailings system from cradle to grave, while considering the subsequent impact of the tailings system on the environment, Vlot explained.

“LCM ensures all variables relevant for the tailings disposal system are considered and factors that may be detrimental are recognised upfront. Total investment costs and liabilities are also weighed up when selecting the tailings disposal system, enabling the selection of the best techno-commercial method and system,” he said.

“As a case in point, there is sometimes a misconception in the industry that filtered tailings solutions are the most environmentally friendly. While that is certainly the case in some instances, what LCM analysis does is encourage miners to think about the challenge and sustainability more holistically.

“Filtered tailings solutions are extremely energy intensive; once the filter press has produced the cake, it then needs to be transported, spread and compacted.”

Weir Minerals’ Integrated Solution for thickened tailings management and transportation – where the waste stream is dewatered to remove up to 76% of the water, which is then recycled back to the process – creates a stable tailings stream that can be moved with positive displacement pumps.

Weir Minerals’ proprietary Terraflowing™ technology, which is based on this thickened tailings methodology, strikes the perfect balance between water stability and emissions, according to Vlot.

“Compared with filtered tailings, Terraflowing technology produces two to four times less CO2 emissions, providing a lower total cost of ownership and providing an end result very close to filtration.

“With our GEHO technology, Weir Minerals can effectively pump these dense pastes over very long distances if required, allowing miners to store their tailings a significant distance from the mine without having to use trucks for transportation. More generally, the paste produced via Terraflowing technology is relatively stable and requires substantially reduced

storage volumes, thereby extending the life of existing TSFs," he said.

"Moreover, our Synertrex intelligence platform provides a holistic view of our equipment's capabilities and performance in various applications, resulting in valuable and actionable insights. It employs different tools such as composable digital twins, which can eventually lead to a fully autonomous system, focused on improving Overall Equipment Efficiency and reducing the environmental footprint of our customer's sites significantly."

Vlot added that "the future of the Synertrex intelligence platform includes the benchmarking and optimisation of individual equipment and eventually extends to entire processes, focusing on aspects such as performance, sustainability or any key performance indicator our customers deem critical to their future."

Repurpose

"I think the holy grail for the minerals processing industry would be to transform tailings from a loss-generating waste product into a revenue-generating resource," Vlot said.

Weir Minerals already has several technologies that have been integral to implementing these 'tailings-as-a-resource' solutions in different parts of the world.

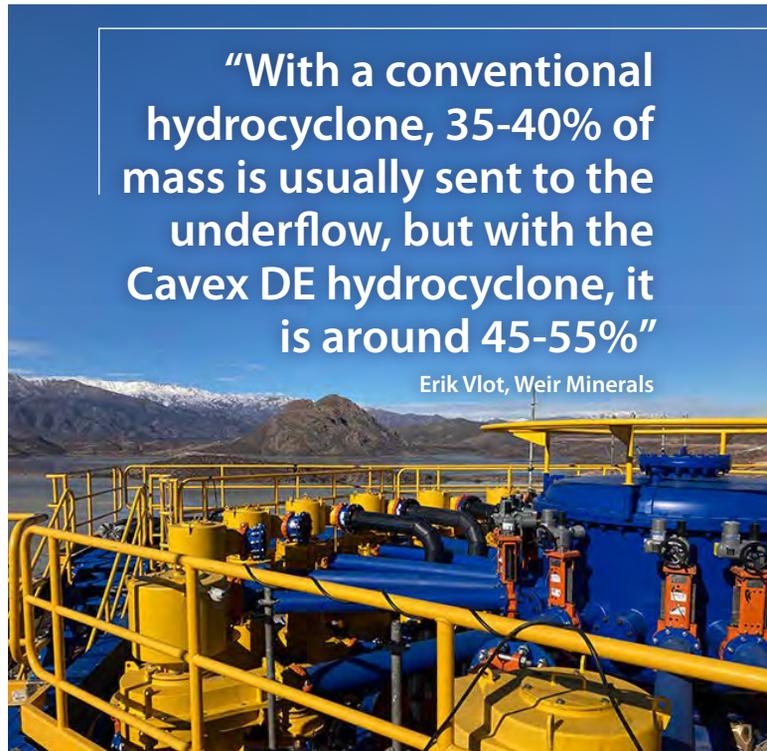
"The development of the Cavex DE hydrocyclone – a two-stage classification and separation system incorporated into the one piece of equipment – was born out of close collaboration with a customer – a South American miner located in an earthquake-prone region – that wanted to utilise its tailings to construct its TSF dam wall.

"Ensuring the structural integrity of the wall was paramount, which meant that the sand had to have relatively free-draining characteristics – or, in other words, sand that's 15% passing minus 200 mesh (75µm).

"This requirement helps prevent liquefaction, the process by which water-saturated, unconsolidated sediments are transformed into a substance that acts like a liquid. Typically, tailings would have to pass through several stages of hydrocycloning to achieve this sand quality; however, with the Cavex DE hydrocyclone, it can be achieved in a single stage," Vlot said.

"With a conventional hydrocyclone, 35-40% of mass is usually sent to the underflow, but with the Cavex DE hydrocyclone, it is around 45-55%"

Erik Vlot, Weir Minerals



"With a conventional hydrocyclone, 35-40% of mass is usually sent to the underflow, but, with the Cavex DE hydrocyclone, it is around 45-55% – making it 10-15% points more efficient than any other hydrocyclone on the market."

Similarly, declining ore grades are leading to higher demand for mining backfill solutions to increase recovery, reduce the amount of tailings stored on the surface and stabilise the mine, providing a safe working environment and facilitating further exploration, Vlot explained

"Paste backfill is a high-density, viscous slurry and, for that reason, one of the most demanding pumping applications. GEHO hydraulic driven piston pumps have solids handling capability up to 90% concentration, making it one of the most reliable tried-and-tested piston pumps on the market today," he said.

"Ultimately, Weir Minerals' aim is to be a reliable partner able to provide miners with the equipment and tailored solutions they require, while also doing [its] part to drive technological development to make tailings management safer, more sustainable and less of a cost burden."

DON'T WASTE ON WASTE

Don't spend more on tailings than you have to.

Weir Minerals' unmatched technology and expertise means you can find a solution that's built to your operational and site requirements. We've reduced customer energy consumption by 51%, average water usage by 76% and lowered TCO all while safely improving the stability of tailings and reducing the tailings footprint. Plus, we can even help re-purpose waste into useful materials for dam wall construction and backfill that saves valuable resources and increases efficiency.

Now, it's your turn to re-think tailings with a Weir Minerals tailored solution.

global.weir/rethink_tailings



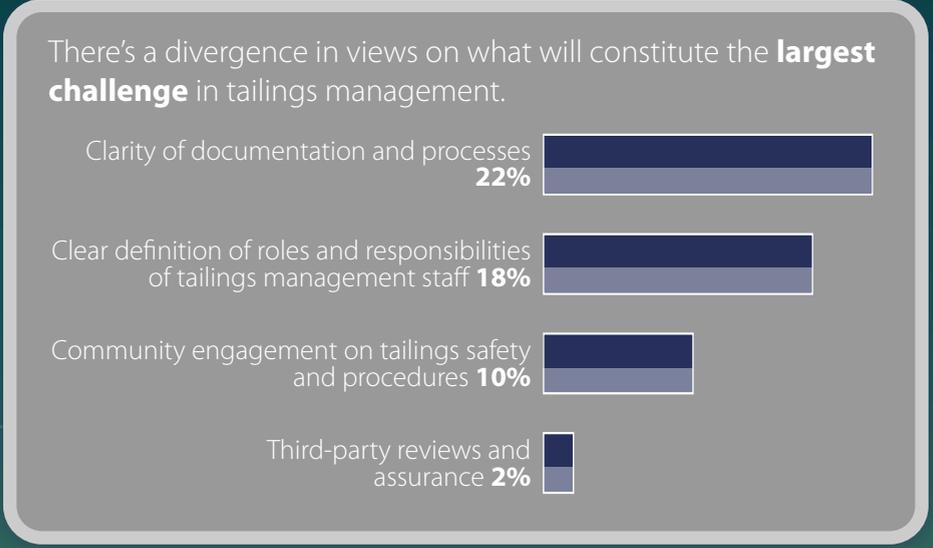
Technology in meeting new tailings standards

In July 2023, *Mining Magazine*, *Mining Journal* and *Australia Mining Monthly* conducted a research survey among 50 global respondents from mining organisations varying in size. The sample was pulled from across senior management levels in mining operations and mining waste/waste management. Here's a snapshot of their responses:



66% **strongly agree** that investors will reward companies that use new technologies, including drones, machine learning, InSAR, digital twins, in their tailing management practices

34% estimate that their organisations will **spend more money** on new technologies to improve tailings performance



82% An overwhelming percentage said that it was **very important** for their companies to reduce the cost of Tailings Storage Facilities (TSFs), while only **18%** said it was **important**

66% believe that adopting digitisation in TSF management is having or could have a **highly significant** impact on TSF asset performance, while **34%** said it would have a **significant** impact

34% believe that **Digital Twin** technology will have the most impact in enabling their companies to meet the requirements of the digital standard, while only **24%** thought **InSAR technologies** would have the most impact. Only **4%** believed **drones** would be the decisive technology in meeting the global standard



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