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“Fundamentally, investors want to see firms with exposure to future-facing metals,”

Mick McMullen, CEO: Metals Acquisition

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Chief Executive Officer

David Ashdown
 e: david.ashdown@wearevuka.com

Editor-in-Chief

Laura Cornish
 e: laura.cornish@wearevuka.com

Senior Editor

Gerard Peter
 e: gerard.peter@wearevuka.com

Online Editor

Richard Jansen van Vuuren
 e: richard.jansen@wearevuka.com

Brand & Advertising Specialists

Rochelle Botha
 e: Rochelle.Botha@wearevuka.com

Vuyisa Mfobo

e: Vuyisa.mfobo@wearevuka.com

Production Manager

Mandy Rust
 e: Mandy.Rust@wearevuka.com

Design & Layout

Catherine van Dyk
 e: clearimpressions@outlook.com

Head Office

2nd floor, North Wing, Great Westerford,
 240 Main Road, Rondebosch, 7700
 PO Box 321, Steenberg, 7947,
 South Africa
 t +27 21 700 3500
 f +27 21 700 3501
 www.wearevuka.com

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Technology in mining

Exploring below the tip of the iceberg

My last editor's comment for 2021 – where did the time go? COVID-19 has definitely accelerated many things: one is time and the other is technology!

Bridging the divide between collaboration and isolation may have been a challenge when this pandemic gripped the world, but the world has overcome it, and this is certainly the case when looking at the mining industry.

We've collectively been quick to innovate because, let's be honest, we've had to. Nonetheless, the mining industry has taken technology by the horns and is running with it. There are many examples I could offer to demonstrate this but that needs a magazine of its own. However, in saying that, let me get to my point quickly since my space here is limited.

The mining industry's technology adoption can be compared to seeing an iceberg in the artic.

What do I mean? In essence, our industry has uncovered its own technology iceberg, but only above the water. What lies below the water represents the true extent of how far technology can take this industry and so, while we've started this journey, I believe we still have a long way to go and a lot more to explore at depth. But it's good to know we are well on our way towards a new destination designed to make the mining industry of tomorrow more sustainable, profitable and adaptable to ever-changing circumstances.



Image: 123rf.com

It's good to see us tackling our iceberg head on!

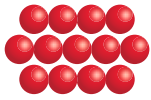
If you haven't naturally concluded that this edition of *Mining Review Africa* explores technology in mining, then let me confirm it now. We have provided you with a wealth of great content that showcases where the industry stands on its technology journey, successes and areas that need more work.

Let it be said that this publication is travelling right alongside the industry and is committed to providing platforms – print, digital and social media – from which you can learn, share and gain great insights.

I'm so committed to technology that even my photo reflects it! Wishing you a December period of recovery, relaxation and reflection. **MRA**



Laura Cornish



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Choosing a fire suppression system

Long-term approach required

Over the past 18 months, mining companies have been increasingly investing in fire protection systems to safeguard their operations. According to **GRANT WILKINSON**, sales director at Alien Systems & Technologies (AST), this is primarily due to a growing reliance on automated systems to protect mining operations. **GERARD PETER** finds out more.



The Pyroshield gaseous fire extinguishing system leaves no residue, making it environmentally friendly

Wilkinson starts by explaining that COVID-19 lockdown regulations have had an impact on workforce numbers at mines. Subsequently, companies are turning to increased automation to run their operations. Such systems also need to be protected and this has resulted in an increase in the need for automatic fire detection and extinguishing systems.

At the same time, however, Wilkinson states that it is important to install a system that will benefit the company in the long run. "When purchasing these systems, we encourage mines to look

at technology that will ensure that the system is effective over the next 15 to 20 years. This ensures that you get real value for money that is not associated with using outdated, less effective technology," he adds.

Wilkinson cautions against opting for older spec fire suppression systems. "For example, some of the control panels contain microchips and electrical components that are being phased out. As a result, a company will have to replace that system in about three to four years' time because of limited support."

Notwithstanding the above, it is encouraging to note that mining companies are taking automatic fire detection and extinguishing systems

seriously, Wilkinson continues. He points out that 15 to 20 years ago, such systems would have to be retrofitted after a mine had already built significant infrastructure. These days, however, there has been a change in mindset and companies often engage with specialised fire engineering consultants at the beginning of a project. "Whether it's for an underground conveyor belt system or a containerised control room, these days we find that mines have already drawn up their fire protection specifications and measures before commencement of construction."

System must be fit for purpose

One of the key factors that needs to be considered when implementing an automatic fire extinguishing system is ensuring it is 'fit-for-purpose'. This takes into account the environmental



The new Sigma ZXT fire control panel with event logger

factors as well as what is most likely to cause a fire.

To explain this concept, Wilkinson uses the example of conditions in an iron ore mine. "While you might think that optical sensing methods like smoke detectors would be your first port of call, these would not be effective in an iron ore mine where the prevalence of red dust could lead to many false alarms. So, in this instance, the fire detectors are not fit-for-purpose. Instead, what is required is cloud chamber sensing technology which can discriminate between fire particles, dust and humidity."

In addition, an iron ore mining company would also need to ensure that its fire extinguishing system is fit-for-purpose. "It goes without saying that the old bucket of sand method will not work in this environment. Rather, what is required is an automatic gaseous flooding system like AST's Pyroshield," explains Wilkinson.

Pyroshield uses an inert gas mix that is present in the air we breathe. The system will extinguish surface and deep seated burning fires by lowering the oxygen content below the level that supports combustion without obscuring exit routes or endangering human life. It leaves no residue nor damages the environment in any way.

In the event of a fire, AST will cover the cost to refill a Pyroshield cylinder over the lifetime of the system. Also, the company will conduct a free mandatory hydrostatic pressure test of the system, which is done every 10 years. This is covered under AST's Lifetime of Free Policy.

New products offer better protection

To ensure that its products are fit-for-purpose, AST continuously undertakes R&D and technology advancement to enhance its offering. Recently, the company launched the Sigma ZXT fire control panel that features a secure 1 000 event logger board. As a result, if anyone decides to press a button or operate the system or disable it, all of this information will be recorded in the event logger. The Sigma ZXT has two 1A extinguisher outputs, thereby allowing it to handle from very small extinguishing systems to the largest automatic extinguishing systems.

“

When purchasing fire extinguishing systems, we encourage mines to look at technology that will ensure that the system is effective over the next 15 to 20 years.”

GRANT WILKINSON



AST has completed the field trials of the Sigma ZXT with Kentec and has selected this fire control panel to be used together with its Pyroshield System. The Sigma ZXT can also be used with other fire extinguishing systems.

Another product that the company recently launched is the Cirrus CCD air sampling system, which is well suited for fire detection in mines. It features an onboard touchscreen with a user-friendly interface that makes it easier to determine if there is a fire. It also provides instructions to the user in the case of a fire. "The Cirrus CCD can also be connected via TCP/IP to an ethernet connection, and it can then be viewed remotely from a control room. So, detector readings can be viewed on the person's computer screen. Also, if there is internet access, it can be viewed remotely anywhere in the world," states Wilkinson.

Already, Cirrus CCD detectors have been installed in Debswana's Orapa mine in Botswana where they have replaced laser-based optical air sampling detectors. The Cirrus CCD can easily discriminate between dust and genuine fire particles, thereby making it perfect for conditions at the mine.

In order to ensure that its clients enjoy all the benefits of its solutions, AST offers training on all its products. In addition, the company provides installer and service training to anyone who wants to install and maintain AST products. "We also have a technical support line where we

log in remotely and assist clients who might be experiencing difficulties with our products," states Wilkinson.

Finally, while there is still some concern about pirate installers using inferior products, Wilkinson believes that mining companies are becoming more aware of the dangers of going this route. He points out that there have been health and safety incidents on mines where pirates have been operating and have put people's lives at risk. "This has raised the alarm and now companies are being a lot more careful by ensuring that automatic fire extinguishing systems comprise genuine parts and are installed by competent people," concludes Wilkinson. **MRA**



↑ The New Cirrus CCD fire detector allows for remote viewing anywhere in the world

Mineral resource exploration

The linchpin to attract international investment into South Africa

Considering South Africa's rich endowment of mineral resource wealth, exploration is a key opportunity through which the country could attract capital investment into its mining sector. Undertaking new exploration programmes may lead to the discovery of some of the critical metals needed to help the world decarbonise – metals that may have been overlooked in the past. This would allow South Africa to reap the benefit of the current commodity supercycle, which is dominated by these future-facing commodities, writes **CHANTELLE KOTZE**.

During a panel discussion at the virtually-held Joburg Indaba in October, speakers from some of the top international resource investment firms explored the topic of prospects in South Africa's mining sector.

Mick McMullen, CEO of newly-formed green metals special purpose acquisition company Metals Acquisition, who was a former executive at Stillwater Mining, understands that large investors remain risk averse. Mullen therefore advised that before large investors begin dipping their toes into the waters of these future-facing metals, such as lithium and rare earths, they ensure their balance sheets are bulletproof. "Fundamentally however, investors want to see firms with exposure to future-facing metals," he said.

Investment management corporation BlackRock natural resources MD Olivia Markham said that while there is merit in creating options in some of the future-facing metals, which would in turn necessitate going into some of the more risky jurisdictions and taking earlier stage options, it is an imperative that investments being made result in dividends to shareholders. "Once we have seen some successful assets in high risk jurisdictions, then maybe some of the majors will follow," she said.

Fiona Perrott-Humphrey, a London-based senior adviser within the mining team at independent financial advisory firm Rothschild & Co, who acted as chair of the panel discussion, questioned how South Africa, a country that only hosted a few future-facing metals like other countries, could remain on the right side of short and medium term developments.

Brett Beatty, partner and head of Australia at mining specific investment fund Resource Capital Funds, highlighted exploration as the main driver by which South Africa could attract investment. "South Africa has great geology and

Exploration is key to reviving South Africa's mining industry

infrastructure and generating a pipeline of new projects will attract capital investment," he said.

He further noted that South Africa would however be required to demonstrate to the investment community that it is a reliable partner capable of attracting capital.

This sentiment was shared by McMullen, who reiterated the importance of having a stable mining environment in which to operate as a prerequisite to attracting capital investment. In the short term, Mullen said one of the ways for South African mining companies to gain exposure to future-facing metals would be through outward investment, as confirmed by Sibanye-Stillwater and its recent battery metals acquisitions overseas. "It will take a fair bit of time to generate projects in South Africa and for the political system to mature sufficiently to provide a stable system capable of attracting large amounts of capital," he says.



“It will take a fair bit of time to generate projects in South Africa and for the political system to mature sufficiently to provide a stable system capable of attracting large amounts of capital,”

MICK MCMULLEN

On the topic of energy in South Africa, McMullen said there was also no reason why South Africa could not get behind the green energy revolution, including green hydrogen.

"A rethink of the energy system in South Africa could potentially unlock

a huge amount of inward investment," adds McMullen, noting that South Africa needed a green energy proponent, such as Andrew Forrest of Australian iron ore company Fortescue Metals Group, to push this along. **MRA**



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MAELGWYN MINERAL SERVICES AFRICA

Asante Gold's newly acquired Bibiani

Reawakening a sleeping giant

When the opportunity to acquire the Bibiani gold mine in Ghana came knocking, the board at CSE-listed **Asante Gold Corporation** didn't have to think twice about buying it. Now, plans are afoot to fast-track the mine back to production by Q3 2022. President and CEO **DOUGLAS MACQUARRIE** explains to **GERARD PETER** the significance of reviving this historically significant mine.



Bibiani main pit

IN SHORT

Bibiani is expected to produce 100 000 oz of gold in its first year of production and then ramp to 200 000 oz in 2023.



ocated in the western region of the country, Bibiani is one of Ghana’s main historical mines and has been in existence for over 100 years, having produced +4 Moz over this period. The mine was closed in 2006 – while under the ownership of Ashanti Goldfields – following a pit wall failure.

It was acquired by Resolute Mining in 2014 and placed on care and maintenance following the acquisition to complete exploration activities designed to enable the development of an economically viable, long-term, large scale underground operation. In 2018, Resolute published a JORC-compliant mineral resource of 21.7 Mt at 3.6 g/t for 2.5 Moz.

Bibiani remains fully permitted with available mining and processing infrastructure on site, consisting of a 3 Mtpa mill and processing plant and existing underground mining infrastructure.

In August this year, Asante Gold acquired Bibiani for US\$90 million. Resolute received the initial \$30 million cash payment with the balance payable in two equal instalments over a 12-month period.

MacQuarrie explains that the deal was made possible following investment from two UAE-based companies, Emiral Resources and Fujairah Holding. Both companies have a 19.9% shareholding in Asante

Gold. “We now have two cornerstone investors who are both interested in securing a long-term gold supply, as they are in it for the long haul. This is very different to having an institutional investor that buys shares and then exits your company once they have made a profit,” MacQuarrie adds.

An asset in pristine condition

With Bibiani on care and maintenance for a number of years, one could pose the question: Is it worth investing to restart the mine? MacQuarrie’s answer is a resounding yes. “Bibiani has the mill, the permits, all the infrastructure and housing and a 2.5 Moz gold resource at 2.7 g/t. All we need to do is change a few pipes, add a bit of grease and oil, change the rubber components, open the old pits and we are ready to start mining.”

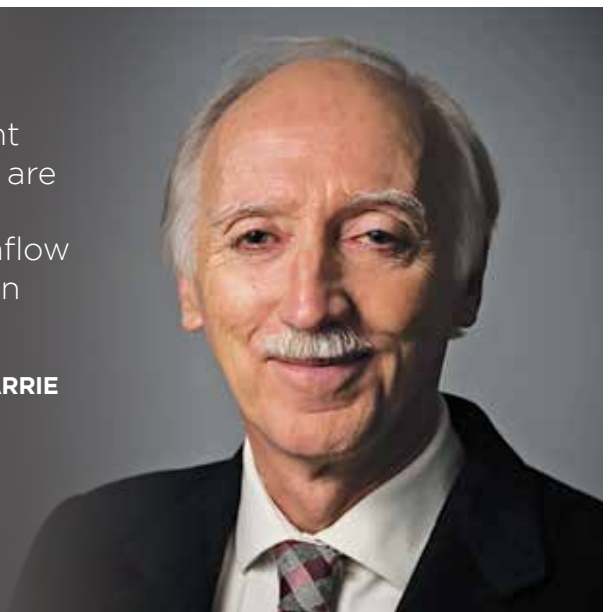
Asante Gold is aiming to start production by July 2022. In order to meet its deadline, the company has appointed Dave Anthony as its COO. Anthony has an excellent track record in Africa having built three mines for Barrick in Tanzania and has been involved in many other projects on the continent, and elsewhere.

The company has outlined a number of key deliverables in order to achieve its production date. This includes rehabilitating the process plant to original service levels, completing the open pit mine design, initiating exploration and

“

With the current gold prices, we are hoping to build significant cashflow once production starts, ”

DOUGLAS MACQUARRIE





↑ Dewatering the satellite pit



↑ Process plant and office

confirmation drilling of satellite pits, and initiating open pit mining to deliver 2.4 Mtpa of ore to the plant.

MacQuarrie adds that the company also intends to lift the tailings dam by 11 m to create an additional four years' storage capacity. "There is a fair amount of stripping to do and we will use the waste from the stripping to build up the tailings facility."

In September Asante Gold appointed local company Harlequin International to initiate the refurbishment of the processing plant. The project is a boost for local employment and will employ up

to 300 people, including subcontractors, and is expected to be completed by June 2022. Furthermore, a new substation was recently installed to help meet the operation's power requirements.

Plenty of upside potential

Asante Gold intends to use contractor miners to operate Bibiani. MacQuarrie states the plan is to start producing 100 000 oz of gold in the first year and then ramp this up to 200 000 oz in the second year. However, the beauty of Bibiani is that it has great exploration potential. "We have identified a few satellite pits

and have already commenced ground geophysics on the property; and we are also conducting a drilling programme to identify more surface targets. The underground potential is massive, with UG development likely in Year 4. As such, I believe that Bibiani will have a 50-year lifespan."

A further boost to Bibiani is work currently being undertaken at the company's Kubi project which is 100 km away from the mine. "We are currently looking to drill out some of the near surface oxide resources at Kubi and this could be early satellite feed to Bibiani," MacQuarrie adds.

In a country with a 35% unemployment rate and an average age of just 24 years, the revival of Bibiani will be a boost for Ghana's economy and a key employment driver. Currently, the mine employs 45 full-time staff and 400 contractors. This is expected to increase significantly once production starts. In a further show of commitment to the country, Asante Gold has also applied to be listed on the Ghana Stock Exchange.

In a little over a year from now, Asante Gold will transition from an exploration company to a gold producer. However, MacQuarrie is still keen on carrying out an aggressive exploration programme in Ghana. "With the current gold prices, we are hoping to build significant cashflow once production starts.

"We have access to a number of concessions in Ghana and with modern exploration techniques, I believe it is entirely possible to discover another 5 or 10 Moz deposit in the country," he concludes. **MRA**

ASANTE GOLD EXPANDS ITS WEST AFRICAN INTEREST

In September, Asante Gold announced that it had made a US\$5 million strategic investment in West African gold explorer, Roscan Gold. Proceeds will be used to fund Roscan's ongoing exploration programme towards developing maiden resources on multiple high potential targets, including its Kandiole project in West Mali.



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Newfield Resources' Tongo

Brimming with diamonds

ASX-listed diamond junior **Newfield Resources** is Sierra Leone's new rising star. The company's flagship Tongo asset will in the early months of 2022 officially start production, representing the conclusion of its construction journey and the start of another – to reach nameplate capacity and thereafter rapidly expand through organic growth, executive director **KARL SMITHSON** tells **LAURA CORNISH**.

The Tongo diamond project, which previously belonged to a small, London listed company called Stellar Diamonds of which Smithson was CEO, has travelled a long journey under his direction and leadership. Between the years of 2007 and 2012 exploration was prioritised, enabling Stellar to

IN SHORT
With a bright pricing forecast for diamonds in the near future, Newfield Resources' imminent production start-up at Tongo could not be better timed.

deliver a maiden JORC-compliant resource of 660 000 carats initially. This was later increased to 1.1 million carats. In 2017 Smithson then saw the opportunity to consolidate the Stellar Diamonds licence with the larger, neighbouring mining licence owned by Octea Mining, and which had a resource of 3.4 million

carats, under a royalty tribute mining agreement. Stellar then became the operator of the enlarged 4.5 million carat prospect. "We then knew we had a great project but needed the funds to move it into development. Stellar's market cap was small, meaning our ability to secure the initial US\$25 million needed for the first construction phase would be near impossible," Smithson starts. The process to find a suitable partner to overcome this challenge resulted in a



5 tph plant in foreground and civil works for 25 tph in background



↑ 25 tph foundations with 5 tph in background

deal struck with Newfield Resources. “The company had a diamond exploration footprint in Sierra Leone and a good shareholder base. A merger of the two businesses made perfect sense,” Smithson continues.

A brief visit to Australia secured the deal and Newfield Resources acquired Stellar Diamonds in 2018. Newfield has since invested over \$60 million to further the development and exploration of Tongo. And the rest, as they say, is history.

Having recognised the value Smithson brought to the project – with his long-term

and thorough knowledge of the asset and the area – he was asked to stay on and oversee Tongo’s development. “It has been a story of persistence and survival, but we will soon fully reap the rewards of our efforts,” Smithson highlights.

Fast-track focus

Following conclusion of the acquisition, a front-end engineering design (FEED) study was initiated, focusing on understanding the technical aspects of the project – including mine plan, mine schedule, operating expenditure and capital expenditure.

In 2019 the FEED study was concluded and through further drilling the resource was increased to 7.4 million carats from four kimberlites, of which 1.1 million carats was declared as a probable ore reserve. The FEED study outlined an initial eight-year life with peak annual diamond production of →250 000 carats forecast in the fifth year from the upper 100 m of the two kimberlite dykes in ore reserve. Numbers from the study are based on a \$222/ct average realised price and operating costs of \$115/ct (real). “The diamonds recovered to date have revealed and are confirmed to contain a very high percentage of quality D and E colour crystals.”

2020 then saw the company increase its 7.4 million carat defined resource in 2019 to 8.3 million carats across five kimberlites.

“After securing an additional \$30 million (via corporate debt) we were

MAJOR POWER INFRASTRUCTURE PROJECT TO BENEFIT TONGO

For now, Newfield Resources is using gensets to power Tongo – however, this will only be temporary. A major hydroelectric transmission line project covering various West African countries stands to benefit the project and deliver cleaner, more cost-effective power. The line passes directly next to the mine site and therefore provides the opportunity for Tongo to tap in at relatively low cost.

In essence, this is an interconnector project between hydroelectric power plants in Guinea and Mali and incorporates a 225 kV, 340 km transmission line that will then link two hydroelectric power plants, with a total capacity of 690 MW, as well as other facilities, to the West African Power Pool. It will include long-distance transmission links to Mali, Senegal and Gambia to the west and north, and Côte d’Ivoire, Liberia and Sierra Leone to the east and south.





“ We are confident that the Tongo mine has the capacity to significantly increase future production levels through systematic and successful exploration and development, ”

KARL SMITHSON



↑ Lando diamonds

in a position to move this project into construction,” Smithson highlights.

With the box cut already established, underground development at Tongo commenced in December 2020 and to date 800 m of tunnelling has been achieved. “We are on track to reach and start mine face operations by the end of Q1, 2022 after which we will be firmly in production start-up and ramp-up mode,” Smithson confirms.

While a small 5 tph plant is processing kimberlite from the development work, a bigger 25 tph plant is expected to be completed by Q1, 2022 as well, which will provide sufficient capacity for production build-up. With a bigger vision in play, the design for a 100 tph plant has already been completed.

Expansion potential

Newfield Resources’ 8.3 million carat resource resides within five defined kimberlites – there are however a total of 11 known kimberlites on the property, “which I believe could see us increase production upwards of 400 000 carats in a phase 2 expansion with longer-term potential to go beyond this volume as well,” Smithson enthuses.

For now, the company plans to continue drilling and evaluating its known kimberlites to increase the mineral resource and proportion in reserves, as

well as conduct technical studies over the Tongo Dyke-1 and Panguma kimberlites (combined 2.3 million carats resource) to determine if these can be brought into the future mine plan.

An exploration target range over a number of kimberlites on the

concession of between 3.6 and 8.4 Mt has been outlined at grades of between 90 and 400 cpht, depending on the kimberlite. The current resources extend to 230 m below surface for the two kimberlites which will be mined initially (Kundu and Lando). Reserves for these two ore bodies extends only to 110 m below surface but drilling has already intersected these kimberlites at depths beyond the current resource, suggesting continuity of the ore bodies with depths of 297 m at Kundu and 391 m at Lando.

“Based on the number of kimberlites we have yet to build into our resource, reserve or mine plan, we are confident that the Tongo mine has the capacity to significantly increase future production levels through systematic and successful exploration and development, as mentioned,” Smithson confirms. **MRA**

300

The number of local employees required to operate Tongo once in production



↑ Decline entrance



↑ Inside the mine

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An aerial view of the plant being constructed

Lindi Jumbo

Restoring confidence in Tanzania’s mining sector

The construction of the Lindi Jumbo graphite mine in Tanzania is a true testament to ASX-listed **Walkabout Resources’** resilience and commitment to developing its project – especially when many other companies turned their backs on developing projects in the East African country. Now, as global flake graphite prices soar and Tanzania legislation continues to see positive change, the company’s determination is bound to reap handsome rewards. **GERARD PETER** finds out more from executive director and CEO **ANDREW CUNNINGHAM**.

Located in south-eastern Tanzania, Lindi Jumbo hosts some of the world’s highest grade, coarse flake graphite deposits. Walkabout Resources took the project from discovery in 2015 to the completion of a definitive feasibility study (DFS) within 16 months and has been granted a mining lease over the deposit.

In 2018, the company announced a mineral resource of 41.8 Mt at an estimated grade of 10.8 % Total Graphitic Carbon (TGC). The measured,

IN SHORT
From Q2 2022 Lindi Jumbo will produce 40 000 tpa of high-grade screened graphite concentrate over a 24-year life of mine.

indicated and inferred mineral resource contains a super high-grade core of 5Mt at 22.5% TGC for 1.1 Mt of contained graphite, making this the highest grade reported ore reserve within Africa. In 2019, the company announced an updated DFS based on an annual production of 40 000 t of graphite concentrate with a high-grade feed to the plant at an average of 230 000 tpa over a 24-year life of mine.

Cunningham explains that apart from its high ore reserve grade, what sets Lindi Jumbo apart from other

graphite miners is the size of its graphite flakes in final concentrate. “The larger the flake size, the higher the price it will fetch. Almost 75% of the graphite in final concentrate is above 180 microns. And while we still supply smaller graphite flakes to traditional sectors including the battery market, our focus will be on supplying large flakes to those parts of the world where we have off-take agreements,” he explains.

Realising its immense potential, in 2019 Walkabout Resources commenced an early start on the mine. The company spent US\$2 million preparing the ground works, including clearing the area for the tailings storage facility

and the plant as well as to secure long-lead items through its EPC contractor in China. Following this, Cunningham explains, the company embarked on a campaign to raise funds for further development of the project. To that end, Walkabout Resources secured a \$20 million debt funding facility from CRDB Bank of Tanzania in May this year, and together with \$12 million in companion equity funds, the company is funded right up until the start of production at the mine.

Construction gains momentum

Walkabout Resources is aiming to start production at Lindi Jumbo in Q3, 2022 and despite the challenges brought about by the COVID-19 pandemic, development of the mine is progressing to schedule.

Already the company has appointed a local contractor to undertake the earthmoving and civil works on site. "Currently, the contractor is putting all the civils in place so that once the plant arrives from China it can be installed. We have also made an initial payment to our EPC contractor (Yantai Jinpeng Mining Machinery Co. LTD) so that they can now finish the equipment that we purchased two years ago. We expect the first shipment of the plant to arrive in Tanzania in December," explains Cunningham.

Furthermore, with travel restrictions in place in China, Walkabout Resources has appointed Axis Group International in Beijing who is working with the EPC contractor to ensure the plant is delivered on schedule and for quality control purposes.

Cunningham adds that the company intends to outsource the services it requires to local contractors. To that end, the company is looking to sign agreements with a logistics company as well as a company that will build and operate the mine camp.

Lindi Jumbo will be an open cast mine with the feed to the plant expected to be around 650 tpd. The operation comprises a crushing and



“ We didn’t retrench any of our staff and just kept on going because we knew that at some stage, there would be renewed interest in the country’s mining sector, ”

ANDREW CUNNINGHAM

grinding circuit that includes various stages of flotation and attrition after which the graphite is dried, screened and bagged. While the current plan is to produce 40 000 tpa of graphite concentrate, the company

is considering the option to increase production should there be more demand for the product. "We have also designed

the plant to preserve the flake size throughout this process in order to ensure that our product sells for a higher price," Cunningham adds.

Currently, Walkabout Resources has signed off-take agreements with graphite end-users in China. At the same time, however, it is also looking to supply markets in Europe and USA. "We have signed a memorandum of understanding with a company in Germany and once we are closer to production, we hope to sign an off-take agreement with the company," states Cunningham.

Power to the mine will be supplied by diesel-powered generators – this will account for around 25% of the total operating costs. It is for this reason that the company is exploring the option of a hybrid power system that comprises diesel, solar and batteries.

Q3, 2022

The scheduled period Lindi Jumbo is aiming to start production



↑ Construction in full swing at Lindi Jumbo



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Commitment to Tanzania pays off

With a high-grade product and favourable market conditions, Lindi Jumbo has all the makings of a successful operation. However, the mine holds greater significance in the Tanzanian mining sphere.

The construction of the mine is the first serious attempt at developing a project since the introduction of the contentious 2017 Mining Act Amendments in the country. The legislation was a major blow for Tanzanian miners as international investors were dissuaded from investing in projects in the country. And while many mining companies pulled out of the country, Walkabout Resources continued to develop Lindi Jumbo while adhering to the new regulations.

Now, since the appointment of President Samia Suluhu Hassan in March this year, there has been a concerted effort on behalf of the government to create a more investor-friendly environment and to engage with international mining companies



↑ Almost 75% of the graphite in final concentrate is above 180 microns

to expedite projects in Tanzania. "We didn't retrench any of our staff and just kept on going because we knew that at some stage, there would be renewed interest in the country's mining sector. And while we started much later than some of our peers, the work that we have done over the past few years has ensured that we are now ahead of them," adds Cunningham.

Lindi Jumbo will also benefit local communities and create much needed employment opportunities. Walkabout Resources has already committed to prioritise giving jobs to individuals from nearby villages and is confident that eventually 99% of the staff employed at the mine will be Tanzanian.

Furthermore, the company has set up a trust that comprises nearby villages that will have 5% ownership of the mine. "Dividends payable will go into the trust, so money can then be distributed to the various communities who can use the funds to invest in social projects that are required," states Cunningham.

The development of Lindi Jumbo has already received support from the top echelons of the Tanzanian government. "Everyone is keeping a close eye on us but we are happy with our performance to date and are confident that we will bring the mine into production in 2022, concludes Cunningham. **MRA**



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Reviving Kilimapesa

East Africa's new kid goes for gold

There is a new mining player on the block in Kenya, and this player means business. **Caracal Gold** is its name and production is its game. The company assumed operational control of its 100% owned **Kilimapesa gold mine** in September 2020; restarted processing in September 2020, and the underground mine in January 2021; and concluded the acquisition of the mine in April 2021. But this is just the start for this small company that has major organic and acquisition growth aspirations in the pipeline, CFO **JASON BREWER** tells **LAURA CORNISH**.

Who is Caracal Gold?

Caracal Gold is the brainchild of dealmaker Brewer, CEO Robbie McCrae and Gerard Kisbey-Green, the former CEO of Goldplat – the original owner of Kilimapesa. Together, the three executives have formulated a strategy that entails the establishment of an East African, gold-focused mining business which will deliver Group production of 50 000 ozpa of gold and a resource in excess of 2 Moz in the next 12 to 18 months.

“Kilimapesa is our starting point: the leverage and catalyst to help us execute our strategy quickly and effectively, and the key to showcasing our ability to deliver

IN SHORT
Welcome, Caracal Gold – a newcomer to East Africa which has already well exceeded the traditional output and deliverables of a new junior start-up mining business.

on our operational commitments,” starts Brewer.

For context, the Caracal Gold vision started some 15 months back and was initially born under Mayflower Capital Investments – the business which acquired Kilimapesa’s gold mining and processing operations (on care and maintenance) from AIM-listed Goldplat. The deal facilitated a planned reverse takeover of mining focused investment company Papillon Holdings by Mayflower to create Caracal Gold.

The process saw Caracal Gold raise £2.7 million prior to listing and another £2.8 million upon listing – giving it the flexibility to deliver on its strategic objectives.

Why Kilimapesa?

Why acquire an operation that produced minimal volumes of gold and was ultimately placed into care and maintenance in 2019? “Easy,” says Brewer. “Kilimapesa’s true potential was never fully exploited under its former Goldplat owners, who were focused on its waste and recycling portfolio. Consequently, minimal capital investment was injected into the Kenya mine.

“Second to this, we were able to restart an existing mine and processing plant with existing licences and a substantial JORC resource and realise production growth through minor optimisation work. This is a smart move for a junior looking to realise value in the shortest timeframe.”

Fully exploiting Kilimapesa is expected to deliver significant upside for Caracal Gold. The mine is situated in Narok

County, about 230 km west of Nairobi and 20 km north of Tanzania on the eastern end of the historically producing Migori Archaean Greenstone Belt. This is responsible for most of Kenya's gold production and represents an extension of the granite-greenstone terrain of the Tanzanian Craton/Lake Victoria Gold Fields which have been the subject of extensive modern gold mining activities.

"At present, the mine has an existing mineral resource of 8.7 Mt at 2.4 g/t of gold for 671 446 oz at a cut-off of 1 g/t, but there is significant exploration upside considering our location. Several exploration targets have been identified on our licence – based on past mining activities, artisanal mining, surface mapping, and exploration drilling programmes," Brewer reveals. The intention is to build Kilimapesa's total resource upwards of 2 Moz.

"With the existing infrastructure already in place, this would support an operation capable of producing 25 000 ozpa, but our approach is to walk before we can run, and this would likely be considered a longer-term objective for this operation," Brewer highlights.

Aside from the mine, Brewer confirms Kenya is an investment and company-friendly jurisdiction to operate in. "The country's regulatory environment is simple, meaning far less political risk. From a gold perspective it is not nearly as competitive as West Africa and therefore the value of the asset was not overpriced."



“ Kilimapesa’s true potential was never fully exploited under its former Goldplat owners, ”

JASON BREWER

Understand Kilimapesa’s current and future operating performance

400

The size of the current work force at Kilimapasa, up from the <10 when Caracal Gold took control of the site

On 14 September 2021 Caracal Gold celebrated a full year since assuming operational control of Kilimapesa. Production build-up has followed re-opening and re-stocking the processing plant and underground mine. Today it is processing well upwards of the 200 tpd Goldplat was sometimes achieving –

averaging above 500 tpd and on occasion in the region of 600 – 700 tpd.

"This is the result of refurbishment, optimisation and reconfiguration work on the existing plant. Based on this current plant's delivery and some additional work we have in the pipeline (a new crushing circuit and incorporation of a second ball mill), we are confident of achieving 1 000 tpd. This

will position this mine as a 25 000 ozpa producer from which we can comfortably continue to operate for more than 25 years," Brewer confirms.

Kilimapesa consists of five adits (A, B, C, D and Bull), all of which reside as entrances into a small 150 m high hillside. The adits have intersected at least four gold-bearing veins, three of which have been developed through drives, raises, and stopes. At present the B, D and Bull adits are functioning as production levels. The strike of the ore bodies is roughly east to west and the dip angle varies from 45 to 80°.

Caracal's strategy and milestones for Kilimapesa is as follows:

- Produce at a rate of 700 tpd (processed) and 1 000 oz of gold per month by the end of December 2021;
- Define a 2 Moz JORC resource within 18 months from 1 September 2021;
- Increase production from 12 000 ozpa to 15 – 25 000 ozpa within 18 months from Kilimapesa. This will



↑ The Kilimapesa process plant is averaging above 500 tpd



↑ The strategy to grow Kilimapesa's production is well underway



↑ One of the adit entrances

include the procurement, installation and commissioning of additional processing capacity; switch-over to grid power; and continued increased run-of-mine production; and

- Based on additional drilling increase the resource further, up to 3 Moz upon successful completion of a bankable feasibility study, thereby increasing

production to +50 000 ozpa within 36 to 48 months

“A lot of work has been executed and completed in a small amount of time and we are showcasing the kind of mine and operation Kilimapesa has the potential to be. We are however still at the start of our journey and have much

to achieve in the next year and a half,” Brewer states.

“We are delighted with the market reception since listing at the end of August and look forward to proactive engagement with shareholders as we rapidly advance our strategy of becoming a +50 000 ozpa producer and build a JORC-compliant resource base of +3 Moz within 12 to 18 months across our East African-focused gold mining and exploration activities,” concludes Robbie McCrae, CEO of Caracal Gold. **MRA**

TERTIARY LISTING ON THE CARDS

Caracal Gold is undergoing the process of listing on Kenya’s Nairobi Stock Exchange in October. “This demonstrates our commitment to the region and allows local investors to look at us and invest in a different asset class and support us as we grow here,” says Brewer.

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Makuutu is one of the few ionic adsorption clay deposits found outside of China



Ionic Rare Earths' Makuutu

A key player in the green energy revolution

As the switch to green energy gathers momentum, there is an increasing demand for rare earths to drive this transition. This bodes well for ASX-listed **Ionic Rare Earths' (IonicRE) Makuutu** project in Uganda, which has all the makings to become a leading heavy and critical rare earths supplier. **GERARD PETER** finds out more from MD **TIM HARRISON**.

Rare earths play a critical role in the future of clean energy. They are a key ingredient in the permanent magnets found in wind turbines and electric vehicles. Currently, the majority of global supply of low-cost heavy and critical rare earths come from southern China and mainly originate from ionic clay projects. However, these resources are diminishing as global demand increases. With its unique geology and a simple mining process, Makuutu is in a prime position to fill the void in pending supply shortages.

Harrison explains that Makuutu is one of only a handful of ionic adsorption clay deposits outside of China. Compared to hard rock rare earth deposits, clay is significantly cheaper to mine. Clay

deposits also occur on surface (0–20 m), require minimal stripping of waste material, need no crushing or milling, and comprise high levels of HREOs (heavy rare earth oxides) and CREOs (critical rare earth oxides).

Makuutu has a current mineral resource estimate of 315 Mt at 650 ppm TREO (total rare earth oxide), at a cut-off grade of 200 ppm TREO less Cerium Oxide (CeO₂). There is also significant upside for further expansion at Makuutu with recent Phase 3 drilling confirming significant expansion potential beyond the current resource, stretching out within a mineralisation corridor 37 km long. The Phase 4 infill drill program now underway will increase the measured and indicated resource at Makuutu to above 250 Mt, with results expected over the next six months.

IonicRE will implement a simple metallurgy and processing system at Makuutu. The ROM ore will be stacked and heap leached using an acidified salt solution to desorb and leach REE (rare earth elements) from the ore. Once extracted from the ore, the residue will be washed with water to recover residual reagents and REE content, prior to returning back to the mining pits where the residue and pits will be progressively rehabilitated and returned back to agricultural use.

The process liquors will be processed using membrane technology to upgrade the REE concentration, with the clean water recycled back to the heaps for washing. Excess water will be processed to recover any reagents and REE content prior to disposal of high-quality water back to the local environment

and agricultural rehabilitation once environmental standards for discharge have been met.

According to a scoping study released in April this year, Makuutu will produce approximately 800 tpa of REO initially. The aim is to increase production in two-year increments in order to increase the plant throughput up to 12.5 Mtpa by year 10 and produce roughly 4 000 tpa of REO. The life of mine is expected to be 27 years, with potential to extend further to be a multi-generational mining operation.

IonicRE aims to bring Makuutu into production in 2024. Currently, development is ahead of schedule. "We have been very bullish and have been trying to expedite activity as best we can. Typically, one would develop a project in a sequential manner. However, given the simplicity of the mining and the processing at Makuutu, we have been able to undertake a number of activities in parallel, thereby accelerating development," adds Harrison.

Furthermore, in April this year, IonicRE signed a non-binding MoU with Chinalco subsidiary China Rare Earths Jiangsu, whereby both parties agreed to cooperate in accelerating mine development and production at Makuutu. The agreement includes potential off-take agreements and project funding. Chinalco is the world's largest rare earth miner and separator by market capitalisation, and a dominant player in the highly valuable heavy and critical rare earths.

Taking the long-term approach

Harrison explains that leveraging China Rare Earths' expertise will help de-risk development and ramp-up of the project, and provide a potential destination for product in early years. "Also, if we're planning on being in production in 2024, we need to be able to have a destination to send our products. Many other rare earth projects don't have any suitors who can take their products or want their products as they are light rare earth dominant, so commonly available. As such they have stalled. For IonicRE and Makuutu, it's the opposite: there are lots of groups in China who want access to our product today. And given that all heavy rare earths' refining capacity exists in China, it's logical that our product will most likely be going there

“ Given the simplicity of the mining and the processing at Makuutu, we have been able to undertake a number of activities in parallel, thereby accelerating development, ”

TIM HARRISON



in 2024. We have however seen western demand increasing lately, although that demand is tempered with a lack of western heavy and critical rare earth separation and refining capacity today or in the near term.

In the long run, however, IonicRE is looking to develop a standalone refinery for downstream processing of its product from Makuutu. Harrison believes this would give the company a mechanism to then market its rare earths products directly to markets across the world, particularly in Europe and North America. "Given the fact that we're going to have a long-life asset, it also makes sense to look at maximising the value of Makuutu because it's going to produce a lot of rare earths for a very long time, and the demand is certainly there" adds Harrison.

Currently, the company is looking at various locations around the globe, including Africa, where the refinery could be built. Harrison says that it is important to find a location with suitable infrastructure to support such a complex metallurgical facility. "These plants require the right expertise and high purity reagents and the type of infrastructure you would typically find in technology parks. So, these are the factors we will consider when deciding on a location."

IonicRE is aiming to submit its mining licence application to the Ugandan government before November 2022. Currently, it is working on a feasibility study and conducting environmental and social impact assessments in order to support the application.

As governments look to implement alternate energy sources, prices for critical and heavy rare earths are expected to significantly increase over the next decade. Harrison states that the company is 100% focused on advancing Makuutu because of its unique characteristics. "When you understand the low capital opportunity, the high value basket and the individual rare earth elements that we have the potential for producing, along with increasing prices, then Makuutu really stands out when you look at other rare earth projects globally," he concludes. **MRA**



↑ First drill hole at Makuutu

Global decarbonisation

A strategic contributor in the making

Decarbonisation – a priority that is topping the global world’s agenda – starts with the mining industry. Renewable energy, battery storage and electric vehicles hold the key to delivering on carbon-neutral objectives and this means ensuring sufficient quantities of green metal supply, including graphite – at times the least talked about battery material but whose unique properties make it one of the most important minerals in the world – to produce these planet-saving technologies, writes **LAURA CORNISH.**

IN SHORT

TSX-listed green metals business NextSource Materials is strategically positioned to contribute materially to the planet’s decarbonisation agenda.

Africa’s Madagascar will be home to the world’s next producing graphite mine (outside of China). 100% owned by NextSource Materials, the Molo graphite project, situated in Fotadrevo, is well advanced in construction and is set to produce first graphite in July 2022.

While the company is initially targeting 17 000 tpa of graphite from Molo, this represents just the start of what is planned to be a substantially larger operation. It also represents the start of what will be a larger mining business, with a downstream ‘mine-to-the battery’ anode production strategy, and potential acquisition of additional assets and

projects within the green metals sphere.

“Our business, our primary project focus and our value-added strategy is now being accelerated and is in lock with the vision and growth objectives of our strategic investor, Vision Blue Resources,” starts Brent Nykoliati, executive vice president of NextSource Materials.



Vision Blue Resources is a battery commodity/resource-focused private investment company founded by Sir Mick Davis in 2020 to capture opportunities in the battery and technology minerals arena. Davis, who became chairman of NextSource in March 2021, represents true excellence for the business – he is the former CEO of Xstrata, former CFO of Billiton and the chairman of Billiton Coal. He is also the former founder and partner of X2Resources, a US\$5.6 billion investment fund. Through his newly established company Vision Blue Resources, he has to date invested \$29.5 million into NextSource and owns a 48% partially diluted ownership of the company. As such, the Molo project's construction requirements are fully funded to production.

"Vision Blue was created to assemble a portfolio of strategically significant investments in high quality, responsibly managed and proven battery material mining assets. We view Molo as one of the highest quality graphite assets globally which is well positioned for significant upside in growth and value. Our intent is to help NextSource become a major battery materials producer and our initial investment is just the first stage in unlocking its potential," says Davis.

Understanding the Molo project – and its potential

Molo's 2019 feasibility study outlines a phased development approach with Phase 1 producing 17 000 tpa over the first two years of production and Phase 2 producing a total of 45 000 tpa by the third year. Over the modelled life of mine (30 years), the production plant will have a pre-tax internal rate of return of 43.1% and a post-tax IRR of 36.2%. The pre-tax NPV at 8% discount rate will be \$237.1 million and the post-tax NPV \$184.3 million.

The capital mine cost for Phase 1 totals \$25 million with Phase 2 capital outlay requiring an additional \$39.1 million, for a total project cost of \$60.1 million.

Both phases will utilise NextSource's unique, fully modular build approach, which greatly reduces build time and associated costs in relation to

conventional mine construction. The company announced in June that it had initiated a technical study for a Phase 2 production capacity at a minimum of 150 000 tpa. This is a significant increase from the current Phase 2 capacity of only 45 000 tpa and was determined after recent talks with the company's offtake partners and its partnership with key processors in the Tesla supply chain for the construction of a battery anode facility to produce spheronised and purified graphite for EV batteries.

"One of the key aspects to understand and appreciate about Molo, beyond its scalability potential (substantial, considering the deposit is located within a 300-line km trend of continuous graphite on surface), is the quality of our graphite," Nykoliati states.

The mine's graphite concentrate can achieve 98% carbon purity with simple

flotation alone, has excellent thermal expansion, can be easily upgraded to 99.995% battery grade purity and contains no deleterious substances. This has been independently verified by end-users for all major demand markets for natural flake graphite, namely refractories, anode material for lithium-ion batteries, specialty graphite foils and graphene ink applications.

The graphite concentrate also has excellent flake size distribution that is well above the global average, with 46.4 % being classified as the premium-priced large (+80 mesh), extra-large (+65 mesh) and jumbo (+48 mesh) sized flake. Specifically, 23.6% of the graphite concentrate is the jumbo size (+48 mesh) that is required exclusively for specialty graphite foils, where they are used in a myriad of applications in the chemical



3D visual representation of the Molo process plant





“ We view Molo as one of the highest quality graphite assets globally which is well positioned for significant upside in growth and value, ”

SIR MICK DAVIS

sealant, fire-retardant, automotive and consumer electronics industries.

To best maximise on the value associated with such high-quality graphite, NextSource successfully registered Molo SuperFlake as a trademark in Canada.

The successful registration of this trademark means that NextSource has the exclusive right to brand all of its natural flake graphite sold in Canada as Molo SuperFlake from Molo when it enters production and begins exporting high-quality flake graphite.

A closer examination of Molo’s production targets includes:

• **PHASE 1: Production of 17 000 tpa**

The first phase of production will consist of a fully operational and sustainable graphite mine with a permanent processing plant capable of processing 240 000 tpa of ore and producing approximately 17 000 tpa of high-quality SuperFlake graphite concentrate.

• **PHASE 2: Production expansion to 45 000 tpa in Year 3 (a capacity that is now being considered at a minimum 150 000 tpa)**

Phase 2 will ramp up production of 720 000 tpa of processed ore in the

third year to accommodate additional sales, resulting in a total of 45 000 tpa of SuperFlake concentrate being produced for a mine life of 30 years.

The costing for Phase 2 is based on the addition of two modules of the beneficiation plant with a proportional increase in mining and infrastructure costs.

Construction update

Despite the challenges associated with COVID-19, NextSource has avoided any delays thus far by the fact that the modular plant is being built offshore, which has de-risked the construction process. Molo’s construction is tracking according to time and budget with overall project progress now at the 50% completion mark. Construction will be completed by November, followed by factory assurance testing. Once complete and approved by the process engineers, the plant will be disassembled and readied for transport to Madagascar.

“Our modular plant provides us with a significant advantage versus other competing projects, on both a first-mover and barrier to entry advantage. With a mere nine month build time due to the modular build approach, the entire plant, which comprises 42 modules, can be reassembled on site within a 45-day timeframe.” Nykoliati highlights.



Trenching on site

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↑ Molo core sample

All necessary company personnel have been mobilised to Madagascar to begin preparations for site works, which are on schedule to commence imminently. Plant equipment is on track to be delivered to site in Q1, 2022, with plant equipment module installation at site on schedule to begin in Q1/Q2, 2022.

Solid offtake agreements with tier one partners

Another area that perhaps positions NextSource in a 'league of its own' – relative to other junior peers in Africa – is its partnerships for offtake. In April this year the company finalised a binding agreement to construct and operate a value-added, battery anode facility (BAF) to produce spheronised and purified graphite required in lithium-ion batteries for EV and hybrid EV applications.

The partnership is exclusive to NextSource and pairs the company with two well-established and leading companies that process and supply SPG to leading Japanese anode and battery makers, who in turn supply the Tesla supply chain and other major automotive companies.

This three-way partnership provides NextSource with a complete, turnkey anode facility that is an exact duplicate of the facility that is currently processing value-added spheronised and purified graphite for lithium-ion batteries by one of the current suppliers to Tesla and other international automotive companies.



↑ Graphite rock

Commissioning of the BAF is targeted for Q4, 2022 and will be located proximal to key demand markets for graphite anode material. South Africa, Europe and North America are the jurisdictions currently being considered for the location of the facility.

Beyond this, August saw the company secure a long-term binding commercial agreement with thyssenkrupp Materials Trading for the purchase of 30 000 tpa of SuperFlake graphite concentrate from Molo. The term of the agreement is 10 years with an automatic five-year extension.

As Phase 1 initial production will be approximately 17 000 tpa, the requested offtake purchase volumes by thyssenkrupp will be phased, starting with a minimum of 7 300 tpa during Phase 1 initial production and up to 30 000 tpa to be available in Phase 2, which is targeted production by Q2, 2024.

The greater clean energy strategy

"NextSource's strategy is to be a green materials company, and we will be assessing emerging opportunities to accelerate expansion of our organic growth strategy through the potential acquisition and development of additional metals and mineral assets expected to play a vital role in associated clean energy technologies," Nykoliation affirms.

NextSource's current portfolio includes a large-scale vanadium

resource just 11 km from Molo and currently undergoing a metallurgical optimisation study. Vanadium is another metal with demand underpinned for the traditional steel making industry but is now strongly aligned with expected demand for vanadium redox batteries – a leading technology for large-scale energy storage systems that not only requires vanadium as a raw material in the battery, but flake graphite as well. This second strategic and critical mineral NextSource has in Madagascar provides an ideal platform to expand further into the critical mineral supply chain.

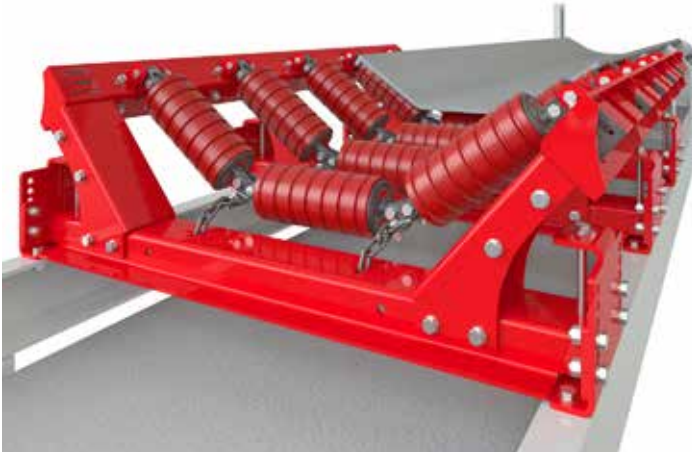
"Together with Vision Blue, we have recognised the potential for increased collaboration and mutual benefit across the asset evaluation, investment and development cycle. The onset of Molo production is just the start for NextSource Materials," Nykoliation concludes. **MRA**

EXPANDING MOLO FURTHER ALREADY ON THE CARDS

NextSource Materials recently initiated a technical study for a 150 000 tpa Phase 2 expansion of Molo – well above the 45 000 tpa planned for 2023.

The purpose of the technical study is to determine the project economics pertaining to this increase in targeted production for Phase 2.

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After

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AfriTin

Turning tin tactic to tech

AIM-listed **AfriTin** is taking its strategic objective to a whole new level. Once committed to being Africa’s tin mining champion, the company has now set its sights on becoming Africa’s technology metals champion. And the route to achieving this is already well within reach, CEO **ANTHONY VILJOEN** tells **LAURA CORNISH**.

AfriTin took the smart approach to establishing its business from the start – acquiring a historic mine with significant production potential. This enabled a cost-effective and relatively fast move into production, which then consequently positioned the business to grow rapidly thereafter.

Starting with a Namibia-based tin asset (Uis in the Erongo region) was always a smart approach as well – the country is one of Africa’s best mining jurisdictions and tin’s upside market potential as a battery metal makes it lucrative for investors and also puts it in high demand.

But there is even more to this story. Uis was always ‘appreciated’ for its tin, but today its by-products – lithium and tantalum – are what represent a new

chapter for this company. But let’s start from the beginning:

Chapter 1 – Acquiring Uis, and bringing it back into production

IN SHORT
Once a small-scale tin miner, AfriTin’s production aspirations stretch well beyond this as it taps into its scale and technology metals potential.

AfriTin was established in 2017 to acquire the tin assets of Bushveld Minerals. After the deal was concluded the company listed on AIM in November of the same year. Today the business comprises the operating Uis tin mine, housed within a very large mining licence area.

The deposit was first discovered in 1911 and developed by Iscor of South Africa as the largest hard-rock tin mine in the world. Production ended in 1990 as a result of low tin prices.

After concluding the first blast to bring Uis back into production in 2018, it was full steam ahead for the mine and its newly constructed pilot plant,

which today is delivering 720 tpa of tin thanks to optimisation and modification work implemented after the plant was started. “The ore body still holds significant volumes of tin and our intention since the start has been to scale up production,” states Viljoen.

Mining today specifically takes place across two outcropping pegmatite veins – V1 and V2 – both housed within AfriTin’s 225 km² licence area, which itself is situated within the tin-rich Damara Belt that Viljoen describes as an “African metallogenic jewel”. “There are more than 180 mineralised pegmatites mapped within 5 km of our current Uis operation,” Viljoen affirms.

Chapter 2 – The Uis expansion

“We have always known the longer-term potential for tin – demand is predicted to double by 2050 and the limited number of new tin mines on the horizon will drive the price up significantly as we move forward, and the supply deficit grows. We



The current production volumes at Uis are just the beginning



have in fact already had indications of this when the price of tin topped US\$39 575/t in August," Viljoen reminds.

With an asset that supports quick and easy expansion and a market that is increasing demand, it made sense for AfriTin to confirm its plans to increase production in September, following board approval to execute a definitive feasibility study in June this year.

The expansion primarily focuses on the Uis Phase 1 pilot processing plant which at this stage is set to increase tin concentrate production by 67%, from 720 tpa to 1 200 tpa.

The project scope consists of a modular expansion of the current plant, leveraging existing bulk infrastructure services and installed processing configurations. Approximately 70% of the project capital will be applied towards the expansion of the dry crushing and screening circuits, consisting mainly of an additional secondary crusher and vibrating screen, and a fines ore stockpile to decouple the comminution circuit from the concentrator. The balance of the project capital relates to addressing potential throughput constraints in the concentrator that may result from the increased feed rate, as well as improvements to the concentrate cleaning circuit to enhance tin recovery.

Long lead items have already been placed as well as the appointment of a project implementation team and engineering detailing to facilitate

procurement and fabrication. Completion of construction and commissioning is planned for during Q2, 2022, followed by a three-month ramp-up to nameplate capacity for the expanded plant.

"The project funding has been secured through a conditional, credit-approved N\$90 million lending facility with Standard Bank Namibia," Viljoen states.

In addition to the term loan, the intention is that Standard Bank will take over AfriTin's existing short-term banking facilities with Nedbank Namibia totalling N\$43 million. These facilities will incur an interest rate of Namibian prime lending rate minus

1%. It is further intended that Standard Bank will provide AfriTin with a N\$5 million guarantee to Namibia Power Corporation in relation to a deposit for the supply of electrical power.

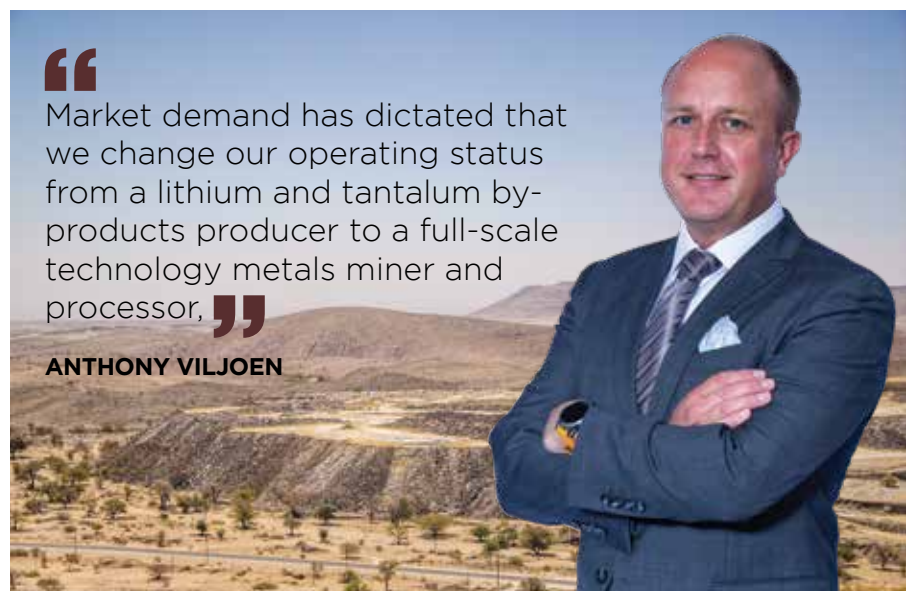
Chapter 3 – Greater Uis riches

The Damara Belt's potential doesn't only reside in tin, but also in lithium and tantalum; and this Viljoen equates to or sees as what could be the emergence of a new technology-rich region, one which AfriTin intends to fully exploit.

"While we have known Uis' technology metals potential, market demand has in essence dictated that we change our operating status from a lithium and tantalum by-products producer to a full-scale technology metals miner and processor," Viljoen confirms. "This vision is fully supported by Standard Bank Namibia as well and is now a feasible option we plan to unlock when taking our loan and an additional £13 million recent equity raise into account. We are financially well positioned to turn our strategy into reality."

Metallurgical test work to date supports AfriTin's move to become a fully-fledged technology metals company – and an 8 000 m drilling programme over the next year will be initiated to support this further.

Lithium oxide at Uis occurs primarily as the mineral petalite in the ore which is treated by the current processing facility. As such, the company aims to



“Market demand has dictated that we change our operating status from a lithium and tantalum by-products producer to a full-scale technology metals miner and processor,”

ANTHONY VILJOEN

Nameplate capacity has been reached at Uis



aimed at exploiting the differences in magnetic susceptibility of the tantalum and tin bearing minerals. The results demonstrate the potential to produce a saleable tantalum concentrate, particularly in the coarser fraction (+1 mm). While optimisation test work continues, the company will proceed with the process flow design for a pilot tantalum concentrate production facility at Uis, with implementation planned for Q4, 2021.

Chapter 4 – Beyond Uis

AfriTin’s production capacity stretches beyond Uis – and for the more immediate horizon includes two ore bodies in relatively close proximity to Uis, namely the 35 000 ha Brandberg West and the 33 000 ha Nai-Nais. Both have historically already revealed tin and tungsten and tin and lithium content respectively. “We have already commenced with confirmatory test work and mapping on both – and we have seen grades that are off the charts at Brandberg,” Viljoen highlights.

“I believe these ore bodies represent our potential to operate a multi-mine, multi-technology business – with Uis the hub at which all ore can be processed.”

“We know with confidence that we are situated on a metallogenic jewel with belts that stretch hundreds of metres wide and run for hundreds of kilometres. We have maximised on our first mover position in the region and, having already proven ourselves, intend to build a strong African technology business in an untapped technology metals province,” Viljoen concludes. **MRA**

produce a low iron petalite concentrate containing a minimum of 4% lithium oxide. It is anticipated that the process flow design of a petalite concentration circuit will involve a combination of density separation, flotation and magnetic separation methods. The current phase of the lithium oxide test work programme will investigate density separation methods to concentrate petalite. Bulk samples were acquired from the active mining area and transported to test work facilities in South Africa. Heavy liquid separation (HLS) test work and pilot dense medium separation (DMS) test work is being conducted concurrently. Preliminary results from HLS tests indicate an upgrade factor for lithium oxide of four

to five times, which is in line with the company’s projections for DMS pre-concentration. HLS and DMS test work will be followed by characterisation of concentrate samples, which will inform the second phase of test work.

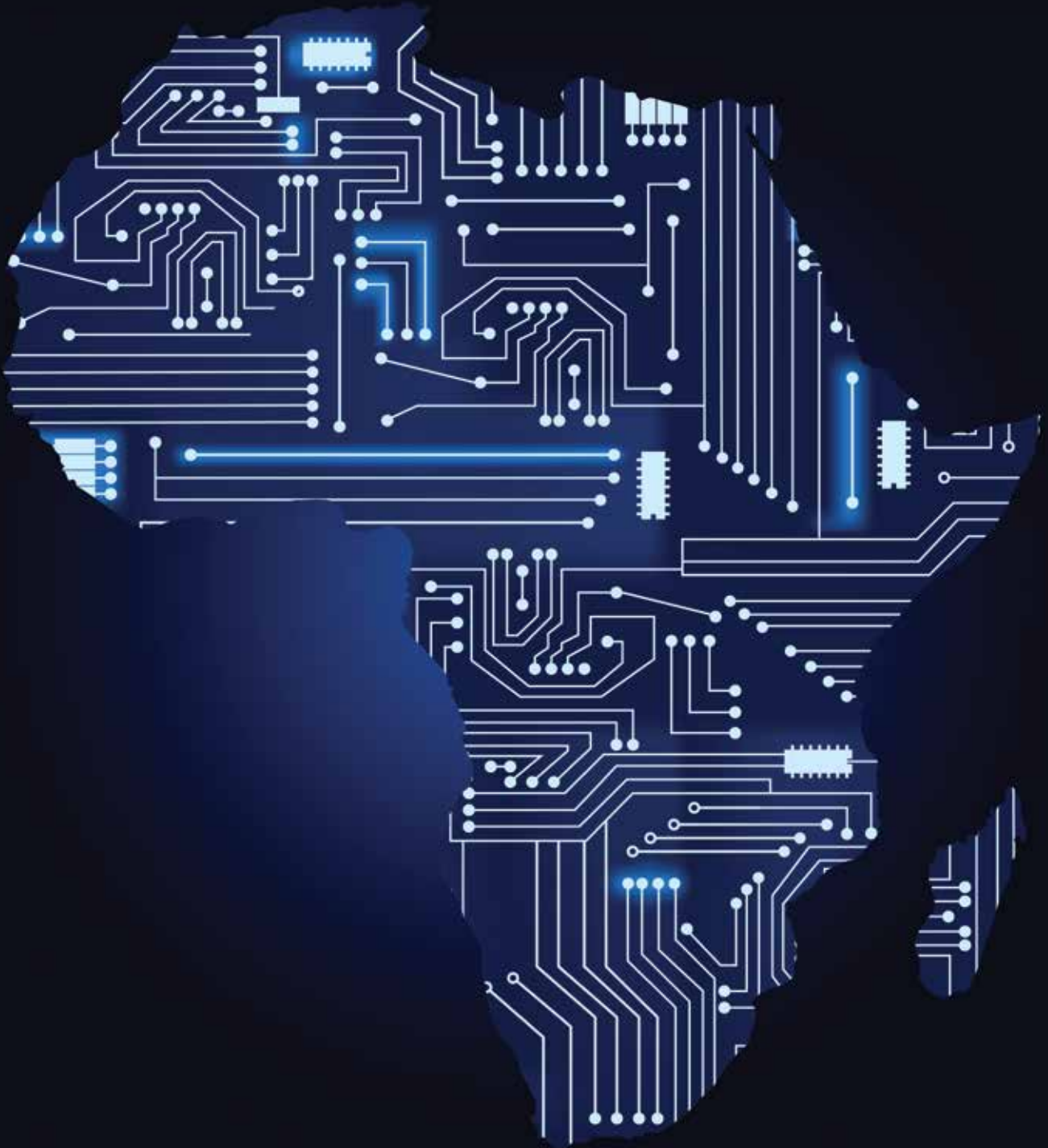
Tantalum at Uis occurs primarily within Columbite Group Minerals (CGM) which have a similar density to the tin bearing mineral cassiterite and is currently recovered as part of the tin concentrate. At present, AfriTin does not receive a credit for the contained tantalum within the tin concentrate. Therefore, the aim is to separate the tantalum bearing minerals from the tin concentrate and create a by-product.

Test work completed to date in this regard includes a range of technologies



↑ Test work is underway for both lithium and tantalum

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Lithium demand remains robust

Underpinned by EV, energy storage revolution

Lithium carbonate and hydroxide prices have more than doubled in the past year as demand growth for this critical metal continues to be driven by the use of lithium-ion batteries in the electrification of vehicles and energy storage systems. This has however led to concerns over whether lithium supply will be able to meet the strong demand growth, which continues to be supported by the global transition towards a low carbon economy, **CHANTELLE KOTZE** reports.

With several countries around the world committing themselves to decarbonisation targets to reduce their dependency on fossil fuels, the shift towards electrification has resulted in a rapid increase in electric vehicle sales and demand for batteries used in their manufacture.

According to metal commodities information services firm Roskill, the increase in demand is translating back through the supply chain into significant growth in demand for raw battery materials, lithium being one of them.

Roskill said that the lithium market is facing a very high demand growth rate for the lithium chemicals used in battery manufacture, while bringing on

new capacity, both at the resource level and the lithium chemical manufacture level. This forecast growth rate Roskill believes, is likely to create a shortage of lithium chemicals, which will result in new challenges for the lithium industry, it said in a September statement.

According to Roskill, the market balance for spodumene concentrate is heavily reliant on new projects being brought into commercialisation in order to maintain a small production surplus during most of the 2020s. However, by 2028, Roskill forecasts a shortfall in supply compared to the demand from lithium chemical converters.

For the total refined lithium chemical outlook, Roskill forecasts a small supply surplus up until 2028 when demand growth will outstrip available supply.

Roskill says that the market balance for battery-grade lithium chemicals is forecast to enter a supply deficit in the coming years because of strong demand growth and limited supply availability associated with the unfavourable economic environment in 2019 and 2020.

While the calculated supply deficit will be real, Roskill does not consider that the level of the deficit will be high as additional supply is likely to be commissioned as exploration efforts increase; and this will be complemented by changes in both upstream and downstream production technologies.

Roskill further believes that supply-side responses to higher prices and material shortages are also likely to be complemented by a demand response, reducing lithium requirements if material availability becomes restrictive to growth.



Image: 123rf.com

In order to avoid a growing supply deficit, which could result in demand destruction, substitution or thrifting of lithium from key end-use markets, lithium producers require favourable lithium prices to attract investment and incentivise the development of lithium resources.

Lithium pricing

Prices of lithium carbonate assessed by energy storage minerals supply chain price reporting agency Benchmark Mineral Intelligence reached new all-time highs on the back of limited supply and high and sustained lithium-ion battery demand in China at the end of Q3, start of Q4.

"Limited available supply within the domestic China market has served to push lithium carbonate prices to these new levels with lithium-ion battery demand remaining high and steady after a year of significant growth," Benchmark Mineral Intelligence said in an October statement.

According to Benchmark Mineral Intelligence, high-nickel cathode chemistries, which require lithium hydroxide, have not been deployed as quickly as expected. At the same time lower energy density, but cheaper, lithium iron phosphate, or LFP, cathodes have dominated the Chinese cell production industry in recent months.

The robust demand for LFP chemistry cathodes in China has placed lithium carbonate at a historically unusual price premium over lithium hydroxide, Benchmark Mineral Intelligence said in October.

"Fundamentally, with little foreseeable downside price risk to carbonate or hydroxide pricing in the near-term, as demand continues to outstrip raw material and chemical supply, the lithium industry is well and truly in the throes of its latest price rally, with further record prices expected in the coming months," the price reporting agency said.

Lithium quality in the spotlight

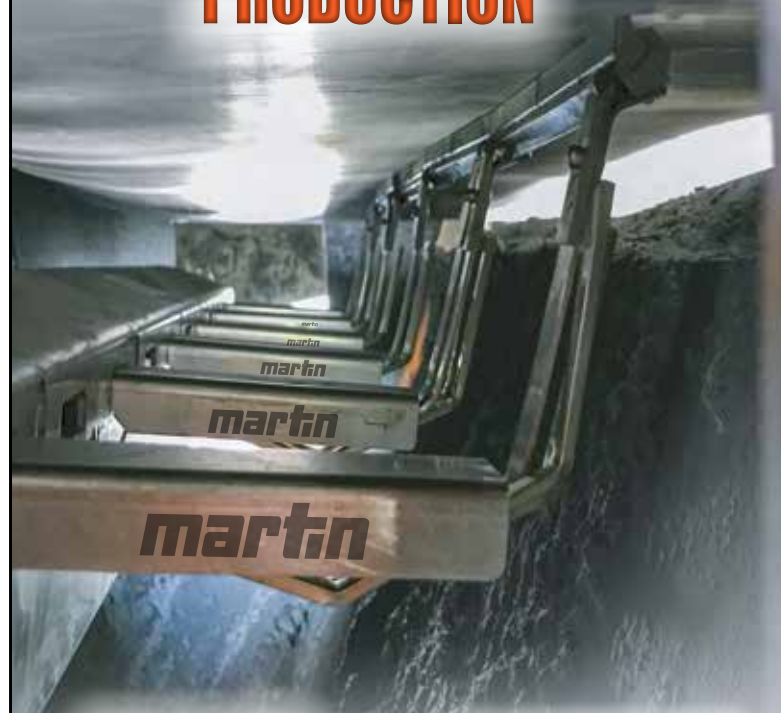
As producers fast-track their exploration programmes in a bid to bring new lithium supply online in the face of increasing demand, they are faced not only with producing sufficient volumes of materials, but product quality is also expected to become increasingly important. Producers will therefore also have to ensure that the lithium they produce conforms to battery manufacturers' stringent grade and quality specifications.

Swiss multinational speciality chemicals company Clariant highlighted, during a webinar in September, the importance of effective lithium beneficiation from hard rock lithium ores, which is produced via hard rock mining as opposed to brine operations.

Suresh Raju, global tech manager for industrial minerals at Clariant, noted the typical composition of a lithium hard rock ore contains about 12% petalite and spodumene as the lithium minerals – as well as quartz, mica and feldspar as gangue minerals from the pegmatite deposit. These gangue minerals present in hard rock ores make the beneficiation of lithium bearing minerals challenging as they have very similar properties to the lithium bearing minerals, he said.

Raju said that while the type of beneficiation circuit used depends on the minerals present, typically a multistage dense media separation (DMS) is employed to separate by-products such as tin and tantalum and to remove the silicate gangues.

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↑ Rising demand for EVs in China bodes well for the lithium price

The DMS circuit significantly improves the next stages in the beneficiation process, which usually entails flotation.

Froth flotation is the most widely used technique for the beneficiation of lithium bearing minerals such as spodumene and petalite. Anionic direct flotation is widely applied for spodumene concentration; however, Raju says that reverse flotation can also be used in order to achieve the quality specification target. This is usually followed by a multi-step cleaning process to achieve the specified quality target, says Raju.

A combination of anionic and cationic flotation is used to beneficiate other lithium bearing minerals such as petalite and lepidolite, Raju said

High-intensity magnetic separation is also usually employed to reduce large quantities of iron bearing gangue minerals such as iron oxides, amphiboles and tourmaline so that the final concentrate meets the required levels of iron content.

Speaking during the webinar, Raju said that these generalised flowsheets

consisting of multistage DMS – followed by desliming just before flotation and subsequently removing iron bearing minerals using high intensity magnetic separation – have been found to be effective in concentrating lithium minerals to marketable grades from hard rock ores, with similar flowsheets already in practice at some lithium hard rock mines globally.

However, Ruju highlighted that different flotation steps can be used within this flowsheet to help enrich the lithium concentrate to about 6% lithium oxide, which meets the standard grade of manufacturing lithium ion batteries.

Micas and feldspar can be floated to remove most of the gangue minerals and the tailings of this flotation step can be subjected to spodumene flotation where the spodumene is cleaned to achieve the required quality of above 6% lithium oxide.

Next, the tailings from this flotation step are subjected to further petalite and lepidolite flotation (if available) to achieve

a concentrate of between 4-5% lithium oxide, Raju explains.

Also speaking during the webinar, Tim Walsh, development scientist at Clariant, highlighted the company’s ability to produce custom-made collectors for lithium ores with the right selectivity, kinetics and mineral recovery profile (at laboratory scale, pilot scale and full-scale production) to ensure optimal recovery.

Clariant’s lithium collectors have significantly lower consumption compared to standard fatty acid dosage, which leads to improved flotation efficiency and better filtration performance. This also translates into reduced chemical exposure for people and the environment, reduced transport and handling, reduced emissions, reduced chemicals in waste streams, and lower energy consumption.

As ore grades change, Walsh says that Clariant continues to develop more efficient collectors for better recovery, selectivity and metallurgical performance.

Future-focused

With the next generation of battery technologies already in development, there are many opportunities to be had for producers, battery manufacturers and downstream original-equipment manufacturers (OEMs).

However, the sustainable supply of lithium-ion batteries has become and will increasingly become a key strategic industry imperative. With OEMs facing increased scrutiny on whether the raw materials and components used in their products are sourced sustainably, there is the potential for this to cause disruption at multiple stages of the supply chain. **MRA**



↑ From mobile phones to electric vehicles, lithium-ion batteries are a critical part of the green technology revolution



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Copper/cobalt

Deficits to drive healthy prices, but only from 2025

The energy transition is heralding the start of the next supercycle given the scale of demand from metal intensive renewable energy generation, storage, and electric vehicles. This is according to a recent report by metals and mining consultancy group **Wood Mackenzie**. As such, the next decade continues to present a unique opportunity for 'green energy' commodities such as copper and cobalt.

According to the report, the last supercycle was driven by China's infrastructure and industrialisation build out and ran for around a decade. The next supercycle will be multi-decade in duration as it will take that long for the world to wrap its arms around the challenge of achieving net-zero carbon emissions and it will consume vast quantities of base and critical metals such as copper and cobalt to do so.

Increase in copper mining activity on the cards

Copper, amongst many other commodities, has enjoyed a rapid recovery over the past year, initially on the back of a quick rise in consumption in China, and more recently strong demand in other key copper consuming economies such as the US and Europe. Supply disruptions over this period provided further impetus, as did investor enthusiasm on the back of copper's relative medium to longer term demand prospects that will result from the decarbonisation of the global economy.

The strong rebound in demand growth this year, together with a modest supply response, will result in a deficit and will underpin high prices. However, the upward

momentum in prices over the past 18 months looks set to stall over the next few years as the legacy of the last period of high prices back in 2017, which led to a high volume of projects being sanctioned, is now coming into fruition.

As above average mine supply growth of close to 5% exceeds that of consumption over the 2022–2024 period, Wood Mackenzie anticipates several years of surplus and as a result, rising inventories in terms of days of consumption will see copper prices under pressure once again. It will only be once stocks start to decline and deficits emerge that prices are expected to recover from the 2025 annual average low.

While a green-driven, post-pandemic recovery will underpin copper's prospects over the medium term, some

of this demand will be met by a rising share of direct use of scrap, driven by the flurry of high-quality scrapped copper foil investments that are emerging to support demand from EV battery manufacturers.

The report states that even though copper prices are expected to trend lower from 2022, a further two years of annual average prices above a long-term incentive price could encourage more mining projects to be advanced to help meet some of the requirements that are set to emerge.

Beyond 2025, an anticipated shortfall in global copper supply will emerge as the pace of supply growth slows relative to demand. Prices are expected to trade higher in reaction to these anticipated deficits and as accumulated inventories are drawn down and consumed. This should provide sufficient confidence to encourage producers to reopen closed mines and undertake incremental

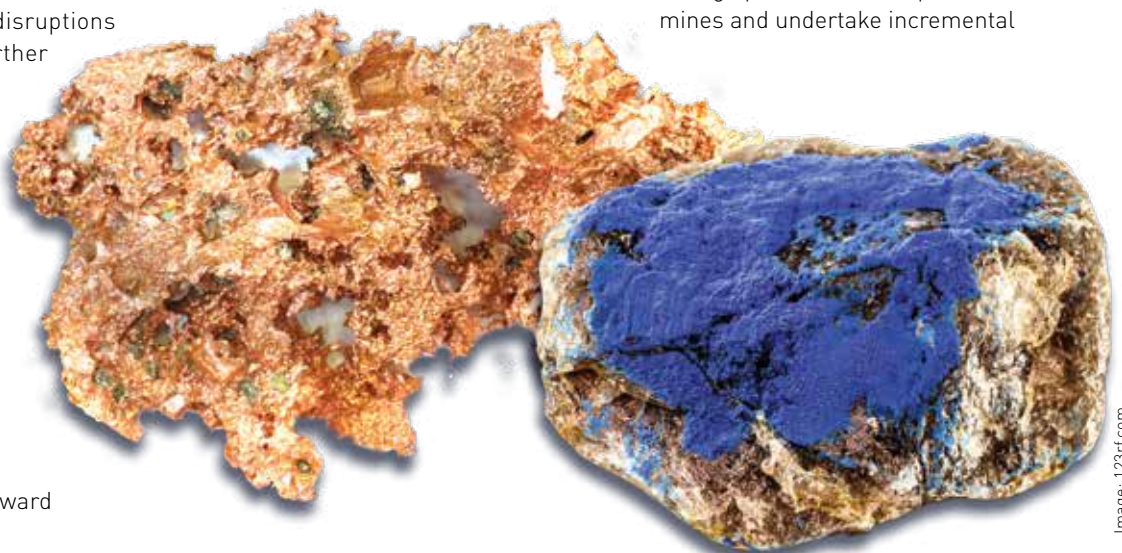


Image: 123rf.com

expansions, mine life extensions and eventually develop projects that are needed to maintain a reasonable long-term market balance.

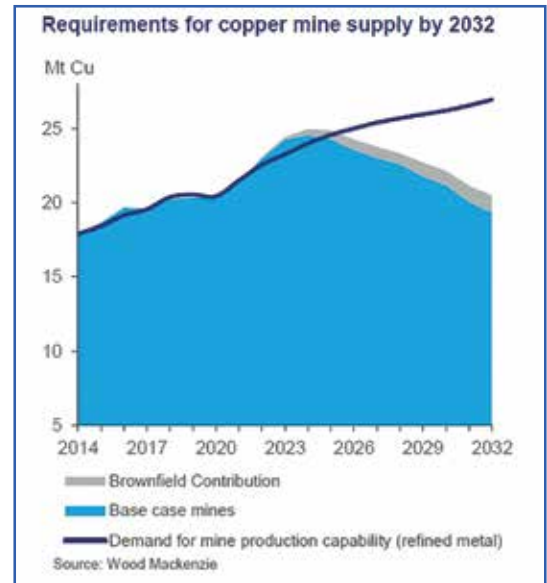
DRC operations will impact cobalt prices

Ongoing tightness in the intermediates market has been compounded in 2021 by several factors, including pandemic-related restrictions, container shortages and civil unrest in South Africa. The continued tightness has kept payables for cobalt at high levels. According to the report's calculations, with prevailing spot metal prices, payables have averaged over 85% since April of this year. This compares with an average of 65% in 2019 and 70% over 2020. While demand for metal remains relatively weak still, higher production costs and increased usage of briquettes and broken cathodes by sulphate producers has kept the spot market tight and prices at healthy levels.

Despite strong demand growth, it is expected that prices for cobalt will be

lower during the 2023–2026 period. With Mutanda mine in the Democratic Republic of Congo (DRC) confirmed to come back online, it is expected that there will be substantial surpluses over this period. In addition, the ramp-up of other DRC operations – like the Tenke Fungurume expansion and Mutoshi and increasing output from the new HPAL operations in Indonesia – will keep the cobalt market comfortably supplied.

Beyond 2027 the rapid uplift in EV sales will quickly plunge the market into steadily increasing deficits. While the addition of new Indonesian projects and CMOC's Kisanfu development in the DRC have increased the pipeline of probable and possible projects, longer term demand looks challenging to meet. By 2030, it is expected that the deficit



will rise to around 20% of demand. Given timescales required to bring on new mine supply, it is clear more investment is needed in the near term if EVs are to have any hope of becoming 'mass market' over the next decade. **MRA**



EV sales are contributing to a commodity supercycle

Image: 123rf.com

Sustainable long-term demand for tin

Electronics, low carbon technologies driving growth

Tin, often referred to as a forgotten critical metal, has been the best-performing base metal this year in terms of prices, surpassing previous record highs. The long-term future for tin looks bright as a critical raw material in the technologies required for the Fourth Industrial Revolution and the transition to a net-zero carbon economy, writes **CHANTELLE KOTZE**.

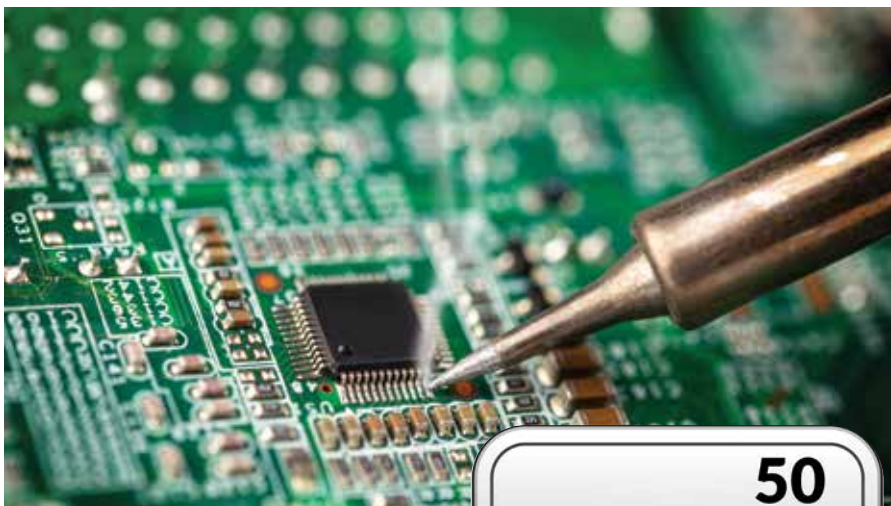


Image: 123rf.com

↑ **Tin's primary use in solder is intrinsically** tied to the manufacture of electronics, which accounts for around 80% of solder use

In terms of prices, London Metal Exchange (LME) tin cash prices broke through US\$37 000/t at the start of October, increasing over 100% year on year. The tin price rally this year can largely be attributed to strong demand and weak supply.

Unpacking current tin demand

In its 17th annual survey of tin users, which was released in October 2021, the International Tin Association (ITA) estimated that refined tin use in 2020 decreased 1.6% to 361 900 t.

While the ITA expects refined tin use to grow by 7.2% during 2021, attributed to

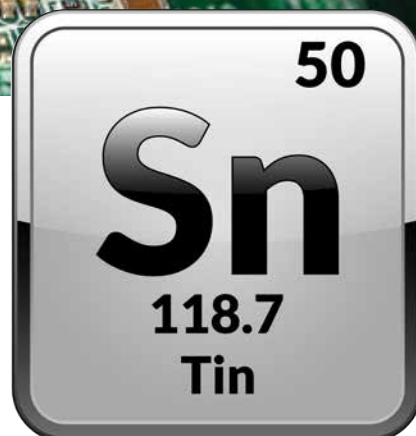


Image: 123rf.com

recovery from the COVID-19 pandemic, more recent data indicated that this could be overly optimistic as tin users have been constrained by supply chain issues experienced in the second half of the year.

The ITA survey showed that while solder still accounted for the largest

global share of tin use, this decreased slightly to 48% in 2020. However, forecasts by the ITA for 2021 indicate a global average increase of 8.8%, also resulting from the rapid recovery from the COVID-19 pandemic.

Tin's primary use in solder is intrinsically tied to the manufacture of electronics, which accounts for around 80% of solder use. In 2020, this usage was boosted by increased working, education, and leisure from home, which provided an unexpected bonus for tin demand during the period under review, according to the ITA.

The sale of semiconductor chips, used in the manufacture of electronic products ranging from cars and computers to appliances, is usually also a reasonable proxy by which to measure solder demand. According to October 2021 data from the Semiconductor Industry Association, global semiconductor sales increased 29.7% year on year in August across all major product categories and in every major regional market.

According to the ITA survey results, the second largest global use of tin is in tin chemicals, applied in PVC stabilisers, polymer catalysts and several other applications, accounting for 17% of global refined tin consumption in 2020. This is followed by tinplate, mainly for food cans, in third at 12% of global refined tin use during 2020.

Dr Jeremy Pearce, head of market intelligence and communications at the ITA, says tin often gets overlooked as a critical material in the clean energy revolution owing to its small global market size – which totalled 432 700 t in 2020 (refined and unrefined) – but notes how critical tin is to quality of life in the modern world and its role as a critical metal in the burgeoning net-zero emissions transition.

Drivers of future tin demand

Pearce – who has a keen interest in investigating future uses for tin – says that most of the future opportunity for tin we see today lies in its use in solder, as well as in energy technologies including lithium-ion battery technology.

Energy and modern technology (such as computing and robotics; energy infrastructure, storage and generation technology; and autonomous and electric vehicles) are the strongest new use drivers, with tin solder at the heart of all of these as the glue that holds together all of the electronic and electrical equipment.

“Solder use has been flat over the past decade despite a growth in electronics production of between 4% and 5% each year, due to the miniaturisation of electronics and electronic components,” Pearce points out. The ITA however expects this miniaturisation trend to start to fade, which should see solder use grow and become more closely aligned to the



Tin use skyrocketed in Q1 and Q2, 2021 in Europe and the US in particular, following the pandemic, but has since flattened in the second half of the year partly due to supply chain shortages and disruptions.

JEREMY PEARCE



growth in electronics production over the next decade.

Technologies already benefitting tin use include additions to lead-acid batteries and solder used for joining solar cells; while tin has many future opportunities in lithium-ion and other batteries, solar photovoltaic technology, thermoelectric materials, hydrogen-related applications and carbon capture catalysis over the coming decades, Pearce highlights.

Constrained tin supply threatening consumption

“Tin use skyrocketed in Q1 and Q2, 2021 in Europe and the US in particular, following the pandemic, but has since flattened in the second half of the

year,” says Pearce. This is partly due to supply chain shortages and disruptions resulting from global shipping issues.

More recently, China’s power control measures, which the country implemented to keep power consumption under control this year, have also impacted the demand for refined tin, says Pearce.

These macroeconomic risks are posing the biggest threat to tin use at the moment, he says, although noting that high tin prices driven by increased demand and subsequent shortages are unlikely to present a real threat of substitution away from tin.

In terms of future supply, ITA market analyst James Willoughby expects China and Indonesia to remain the world’s largest producers of tin – both mined and refined – in the near-term future. However, new mine projects are focused on Africa, Europe, and Australia, and could result in these regions experiencing the most growth in the next decade.

Pearce, who curates 1 500 scientific research and development papers on average each month to gauge future uses for tin, says future tin demand remains difficult to forecast based on how big an impact future use cases now in R&D could have and how soon this could take place.

The ITA forecasts tin demand to increase from its long-term demand outlook of 2% to about 3-4% over the next decade on the back of the EV revolution, energy transition, and 5G connectivity. [MRA](#)



New [tin] mine projects are focused on Africa, Europe, and Australia, and could result in these regions experiencing the most growth in the next decade.

JAMES WILLOUGHBY



Lead

Who says this battery metal has gone flat?

Due to its toxic legacy, lead is probably the last metal that one associates with green technology. However, lead-acid batteries are still a key component in the automotive industry as well as for energy storage. **GERARD PETER** reports.

According to an article on Euractiv.com, even more pure electric vehicles use lead-acid batteries for starting, lighting and ignition (SLI) as well as for other functions such as electronic door-locking and in-car entertainment. Furthermore, its proven reliability makes it the metal of choice for energy back-up services in hospitals, emergency services and public buildings.

The article further states that constraints on lithium-ion battery production to meet EV demand over the coming years opens the energy storage market to "other battery technologies" such as those using lead. So, what does this mean for lead going forward?

Increase in production predicted

A Wood Mackenzie report states that the naturally resilient nature of lead demand, honed by decades of substitution pressure, enabled lead to mitigate the worst impacts of the pandemic and rebound strongly as the world recovered. After a poor 2019, with its 0.5% demand drop, coronavirus-hit 2020 consumption dipped prices only 3.2%. Demand recovered well and is forecast to enjoy a 4.2% rebound during 2021, followed by an average of 2.3% per annum for the three years after that.

One of the key reasons for this is that half of all lead consumption goes to automotive replacement batteries. These aren't discretionary purchases: when a vehicle battery fails, it must be replaced for that vehicle to remain usable.

In the first weeks of global lockdowns, replacement demand dipped sharply as populations stayed home, as did their cars. But then, as people ventured out again, many found that weeks or months of not using their car had caused the battery to fail. The consequent surge in automotive battery demand has endured since, particularly in North America and Europe, and has more than offset the fall in OEM battery requirement caused by microchip shortages and other pandemic-related factors.

Meanwhile, lead production suffered pandemic effects on raw materials' supply from mines for primary smelters and scrap feed to secondary plants. Mine curtailments or closures impacted global mine output, which plunged 7.9% year-on-year in 2020, but a 5.4% recovery is predicted this year. However, this will still be the lowest volume of concentrate production since 2012. Primary smelter output actually increased in 2020 over the previous year, due to a large overhang of concentrate stocks from the end of 2019. This provided good volumes of feed to compensate for sagging mine production.

According to the report, global concentrate stocks are currently somewhat tight and this situation will not improve over the next couple of years as mine output struggles to build momentum. It will take until the middle of this decade before primary smelters are well supplied.

The primary concern about lead is that it is highly toxic and cases of lead poisoning have been well documented over the decades. Still, it has a key role to play both in the EV space and other sectors that will rely on battery storage for the foreseeable future. **MRA**



↑ Lead-acid batteries are still relevant even in all-electric vehicles



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Tech meets training

The missing Zero Harm piece?



Modernisation is a strategic priority for the Minerals Council and its partners, and it is an imperative for the mining industry's growth and ability to contribute positively to society.

The year 2020 showed that innovation and technology are vital to all industries as they seek to adapt to rapid change. The last year has seen intense focus on how innovation and technology can be used to serve and save humanity. In the face of unprecedented risk, every individual and organisation has been compelled to evaluate and change traditional ways of living and working. COVID-19 slowed the world down, but it accelerated change and the way industries react.

Ten insights into 4IR in mining, a report compiled by PwC in partnership with the Minerals Council and with the assistance of the Mandela Mining Precinct, identified that South African mining companies are, by their very nature, innovative, but there is significant room for the industry to embrace the fourth industrial revolution (4IR) and innovation more readily.

Key takeaways included the big role that technology innovation can have in the areas of learning and development for a more empowered workforce.

As part of its Khumbul'ekhaya initiative on health and safety, the CEO Zero Harm Forum within the Minerals Council has identified the key role that training across the whole value chain plays in embedding safe and healthy practices and has supported the Minerals Council's efforts to identify the best training solutions to enable these. 4IR tools are expected to deliver improved employee engagement and training to embed health and safety practices in everyday work processes.

Companies are already exploring new working practices to bring everyone into the digital era. Key interventions for this include: (1) Creating learning groups that team up digitally proficient staff with those less digital savvy to raise the digital know-how across the organisation and (2) Conscious investment into training staff for digital transformation.

Knowledge in hand, what's next?

At the beginning of 2021, the Minerals Council and South Africa's Harmony Gold Mining Company, in partnership with RIIS, set out to identify ready-to-

“

“[These] technologies allow employees to learn in a safe environment while being fully immersed and interacting with virtual information in real-time as they encounter their physical environment,”

MUSTAK ALLY



implement training innovations for piloting in Harmony's operational context.

A call for proposals resulted in the submission of solutions that feature virtual, augmented and mixed reality solutions as well as components of gamification that could be used to revolutionise skills training in mining.

During July and August, a panel of judges composed of the Minerals Council, Harmony's learning & development, technology and health and safety teams, and behaviour experts shortlisted the top six submissions.

These finalists went through a final round of judging by showcasing their innovations at virtual and physical events. This culminated in the announcement of WinWin International as the showcase winner and the Boiler Room and BizAR Reality being named the first and second runners-up respectively. The other finalists were Virtutec, Edutouch and sts3D.

"The Minerals Council is looking at innovation and modernisation not just



“The Minerals Council is looking at innovation and modernisation... to support social and business model change – moving from purely engineering-led innovation to people-centred innovation,”

SIETSE VAN DER WOUDE

from a technology perspective, but importantly also to support social and business model change – moving from purely engineering-led innovation to people-centred innovation,” says Sietse van der Woude, a senior executive

of modernisation and safety at the Minerals Council.

The Minerals Council recognises that innovative approaches to training and learning, leveraging cognitive and behavioural sciences, enhances the effectiveness of training delivery through improved understanding, better retention, increasing motivation, and embedding positive behaviours. These trends, in combination with 4IR technologies, have great potential to improve healthy and safe production outcomes.

“Extended Reality, Virtual Reality, Augmented Reality and Mixed Reality technologies allow employees to learn in a safe environment while being fully immersed in and interacting with virtual information in real-time as they encounter their physical environment – such as equipment or hazards, among others,” continues Mustak Ally, head of skills development at the Minerals Council.

The piloting of new technology in the mining industry can optimise the cost-effectiveness of training while taking the industry closer to its ultimate goal of Zero Harm, he adds.

The showcase is the practical demonstration of the Minerals Council's journey to a people-centred, technologically enabled, modernised mining industry in South Africa. One that brings its people along with it; one that helps us reimagine mining. **MRA**



Image: 123rf.com

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Longtemps caractérisées par le travail physique, des actifs à forte intensité de capital et des modèles d'exploitation réactifs, les sociétés minières tournées vers l'avenir se tournent vers le travail basé sur la connaissance, l'automatisation et la planification prédictive pour découvrir de nouvelles opportunités de croissance. Poussées par la transition mondiale vers l'énergie durable, les conditions de marché volatiles et la pression sur les marges bénéficiaires, les sociétés minières doivent se tourner vers les robots, les véhicules autonomes et les équipements équipés de capteurs pour augmenter l'efficacité opérationnelle et développer de nouveaux services et modèles commerciaux. Dans le même temps, elles doivent faire face à un examen public pour conserver leur permis d'exploitation, et doivent donc trouver de nouvelles façons de s'engager auprès des communautés et aller au-delà des normes minimales de sécurité et de durabilité. D'ici 2025, nous prévoyons que les sociétés minières surveilleront les conditions de sécurité des mineurs et la consommation de ressources telles que l'énergie et l'eau en temps réel. En 2025, les leaders de l'industrie deviendront des entreprises en temps réel davantage centrées sur le client. Pour prendre sa place dans la nouvelle économie de l'expérience, l'industrie minière doit se lancer dans une transformation radicale de ses activités en s'adaptant aux changements techniques, culturels et organisationnels. Les entreprises qui apprendront à "miner plus intelligemment" ouvriront la voie. Du puits au client, les solutions intelligentes SAP pour le secteur de l'exploitation minière peuvent vous aider à rendre les opérations minières plus flexibles et plus transparentes.

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Staying on top of tech

Academic partnership gives Sibanye-Stillwater a leading edge



With technology advancing rapidly across industries, particularly those that are considered 'behind the curve', it is important that the mining industry ensures it chooses the correct digital solutions. One company that is getting it right is global PGMs and gold miner **Sibanye-Stillwater**. **GERARD PETER** spoke to its head of technology, **ALEX FENN**, on the sidelines of the recent Wits DigiMine Seminar about how the company remains a digitisation front-runner in the mining sector.

It can be argued that prior to the COVID-19 pandemic, the mining industry was slow to adapt to new technologies. However, long before the sector had to learn to mine in the 'new normal', Sibanye-Stillwater embarked on a digital transformation journey to improve productivity and enhance safety at its operations. The company adopted a 'digital first' approach – one that not only adopts innovation and digital technology but also creates structures and processes that support digital transformation.

The company also recognises the importance of external expertise when choosing the right technologies for its operations. It is for this reason that it has partnered with the Wits Mining Institute and developed the DigiMine Laboratory. DigiMine is a one-of-its-kind laboratory complete with a mock mine that simulates actual underground

mining conditions and enables researchers to develop and test digital systems in a simulated environment.

Fenn explains that the research that comes out of DigiMine gives the company a lens into the future of digitisation. "The bulk of the research will not be seen in a commercial form for another three to five years. Our partnership with Wits ensures that we understand what underpins these technologies and makes them appropriate for our business before we can consider implementing them. The research outcomes give us an understanding about what we can adopt now and what we need to adopt going forward," he states.

Fenn points out that another element that has been extremely valuable is the multidisciplinary nature of the DigiMine programme. "It incorporates other faculties such as medical science, data

science, mathematics and finance. This gives us access to skill sets that we may not have internally."

Keeping it simple

While there will always be a need to review technology requirements in a mining operation, Fenn advises that it is also important to stick to the basics. A case in point is using data to improve safety at Sibanye-Stillwater's gold mines. "Rather than continue to engineer out risks, leveraging data allows us to understand behavioural trends and implement highly effective behaviour-related interventions in order to improve safety."

Another example of how sticking to the basics is the company's solution to a problem encountered by employees during training. "Our training material is in English, a language that is extremely abstract if not your first language and where words and

phrases can be misinterpreted. As a result, certain operating procedures can be misinterpreted.

“By using very basic tools to identify where there may be misinterpretation of procedures, we identified areas where our training may be ambiguous. Subsequently, we decided to change the wording and the net effect was that most employees could then properly interpret the procedures,” explains Fenn.

No doubt digitisation also requires new skill sets. And while some companies will look to fulfil these new roles on a permanent basis, Sibanye-Stillwater remains focused on its core business and therefore prefers to partner with companies and institutions who can provide these services. “It would make no sense for us to hire a person with a specific skill set who takes an extended time to do the work that a specialist company or institution, with a larger and more capable skill set, could do in a much shorter time. We will also not necessarily need certain skill



“ Our partnership with Wits ensures that we understand what underpins these technologies and makes them appropriate for our business before we can consider implementing them, ”

ALEX FENN

sets all the time so it’s an underutilised asset from a resource perspective,” Fenn adds.

There is no silver bullet when it comes to the digital transformation journey. However, what is key is how a company

adapts to this new way of mining. By investing in initiatives such as DigiMine, Sibanye-Stillwater is able to choose the right digital solutions that ensure that it will continue to remain one of the world’s leading PGM producers. **MRA**



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The research programme will look at how technologies such as AR and VR can be beneficial to mining

XR technology masterclass

Mining and education combo put their thinking caps on

Extended Reality (XR) technology is touted to be a game-changer for the mining industry. Now, in an effort to understand this technology better, Exxaro Resources has partnered with the University of Pretoria to create a research programme that will help drive sustainable and safer mining. **GERARD PETER** reports.

XR technology refers to all real and virtual combined environments and human-machine interactions generated by computer technology, including augmented reality (AR), mixed reality (MR) and virtual reality (VR). It is believed that a combination of technologies, as opposed

to relying on a single specific one, is more beneficial to mining operations.

According to Professor Ronny Webber-Youngman, head of the Mining Engineering Department at the University of Pretoria, XR technology will form a large part of a strategic intervention in dealing with mining-related challenges. "Not all

companies have the know-how to implement technology successfully. The ubiquitous nature of XR technology and its applications are evident and its relevance for mining-related challenges needs to be explored further," he adds.

It was with this in mind that the university approached Exxaro to create the Chair in XR Technology. "The

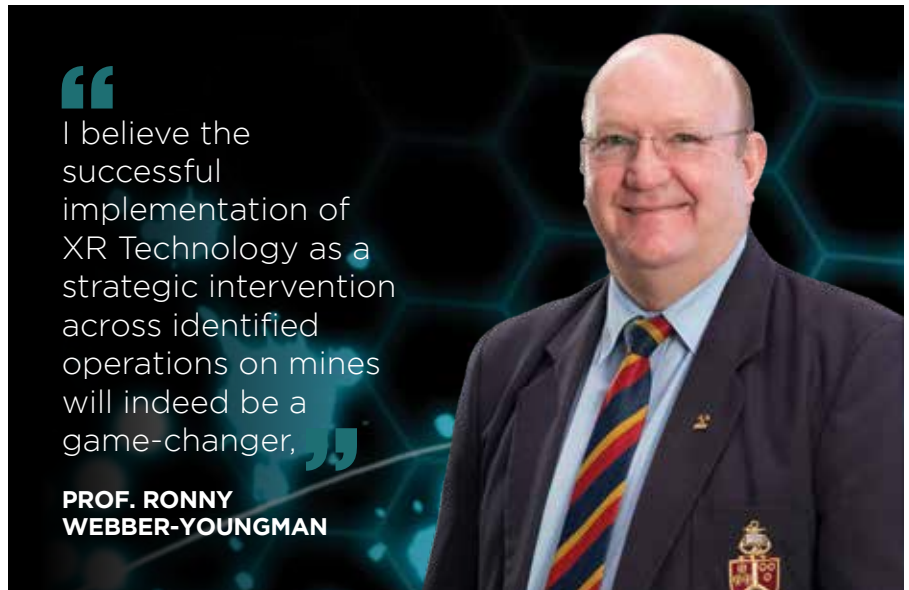
programme will offer a framework of this technology which can be used to address the respective challenges. Through work in the Chair, the identification of the best XR technology combinations for mining applications will be identified,” explains Webber-Youngman.

The programme will assist in selecting the most effective XR technologies for the specific applications, and then design interactions that can enable intuitive interaction with the virtual environment. It will also offer extensive user testing of proposed solutions to ensure that the solutions address and solve as many of the challenges as possible. Among the solutions that will be explored are: using virtual VR to communicate; individual and shared VR applications; and hand tracking versus full body tracking.

The university has also identified research topics that will help in the development of XR technology solutions. These are the current state of XR technology in South Africa’s mining industry, application areas for XR in this sector and the use of this technology on all levels of a mining operation.

Webber-Youngman explains that one of the outcomes envisaged is to develop proof of concepts to be deployed in Exxaro. “Exxaro will be used as a research platform to evaluate the effectiveness of the XR interventions and to establish the viability, within a mining industry context, of these interventions.”

Commenting on the partnership, Exxaro CEO Mxolisi Mgojo says: “We are proud to have such a strategic



partnership with the University of Pretoria and to be amongst the mining companies to explore the potential benefits of XR Technology as a strategic intervention across its operations. We believe that XR technology has immense applications for dealing with mining-related challenges and that can optimise the resources of companies like Exxaro. The possibilities of what we could develop are really exciting.”

A new way of learning

The research will be conducted at the Virtual Reality and Interaction (VRI) lab, an initiative of the Departments of Information Science and Mining Engineering at the university. The VRI lab applies XR technologies to create interactive user experiences for various applications. It also aims to

educate and train the next generation of developers and researchers with real world projects that are unique to XR technology. This is achieved through their participation in learner programmes, postgraduate research projects and industry projects.

Weber-Youngman explains that face-to-face education and training are not always possible and take much longer, especially with large groups. It is for this reason that education and training on XR technology at the university is built around interactive immersive technology (IIT), an innovation that is designed to engage trainees and give them a sense of being involved. By using VR and AR it gives learners access to study and training material. “IIT implementation changes the way we learn and apply and has already been proven to significantly improve knowledge retention.

“Also, different literacy levels on mines make visualisation of certain scenarios a very important aspect to further enhance the learning and knowledge application experience,” states Webber-Youngman.

The Exxaro Chair in XR Technology is a major step towards understanding the benefits implementing a multi-faceted digital solution – one that improves safety and productivity and enhances sustainable mining. “I believe the successful implementation of XR technology as a strategic intervention across identified operations on mines will indeed be a game-changer,” concludes Webber-Youngman. **MIRA**



↑ Officials from Exxaro and UP launch the Chair in XR Technology programme



Breaking ground

Digitalisation key to unlocking mineral wealth

Image: 123rf.com

By some estimates, South Africa has as much as R35 trillion worth of untapped mineral wealth. Despite that, the country has in recent years not attracted sufficient investment to allow for new mines to be opened or for substantial exploration campaigns to be carried out.

One way to fuel new growth in the sector is for it to embrace digital transformation. Despite the unique challenges associated with South Africa's mining conditions, embracing new technologies and digitally driven processes could result in mass benefits to the local mining sector.

That was the consensus at a recent mining roundtable hosted by Huawei and the Southern African Institute of Mining and Metallurgy (SAIMM), which featured experts from across the industry sharing some of the latest digital transformation trends in mining as well as their thoughts on how these trends could apply to South Africa.

According to Ulrich Graf, senior engineer: Industry 4.0 and IIoT, at Huawei, the sector is rapidly moving towards a point where mine environments are "all connected, all sensing, and all intelligent".

Leading these changes, he said, are global wireless connectivity standards like Wi-Fi 6 and 5G that enable much faster connections, improved reliability and latencies of less than 1 millisecond.

That allows for things like autonomous and remote-controlled trucks, excavators, and other vehicles. Importantly, it also allows for mines to embrace the "digital twin" concept. That is a virtual representation that serves as the real-time digital counterpart of a physical object or process.

Embracing artificial intelligence, meanwhile, means that mines will be more productive and safer, thanks to things like real-time resource scheduling, allocation, optimisation and risk level estimation, making evacuation easier.

Foundational skills still required

According to Jean-Jacques Verhaeghe, programme manager at Mandela Mining Precinct, digitalisation, technology research, development and innovation require a "unified and holistic approach".

Meanwhile, Professor Barry Dwolatzky, director of Innovation Strategy at the University of the Witwatersrand, pointed out that developing skills for the future is partly about ensuring that educated people are still educated with foundational skills in areas like telecommunications, coding,

modelling and data science. To this, newer areas such as AI and IoT should be added.

"When it comes to building those skills, there's nothing particularly special about mining in terms of peak level skills. For most workers the technology must fit the skills of the users and it's probably going to be possible to just pick up technologies and use them," he added.

While all the speakers acknowledged that the depth and design of most South African mines would make it difficult for them to be fully automated, they were all unequivocal about the potential impact that digital transformation could have on the country's mining industry.

"Developing technological solutions that increase safety and productivity, reduce costs and ultimately extend the life of mines will work for the betterment of local communities associated with mining and for the country as a whole," stated Verhaeghe.

Huawei and MMP recently signed an MOU that allows the Minerals Council South Africa to install and test Wi-Fi 6 kits in underground mines, in pursuit of a digitalised mining industry. **MRA**



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Collaboration is key if mines are to benefit from deep technologies such as robotics

Image: 123rf.com

The future of mining

How do we ensure technology is embraced?

By Kevin Pietersen, Hogan Lovells

In order to make mining operations fit for the 21st century, they need to overcome certain bottlenecks by embracing technologies that can make them safer and more efficient while reducing their overall impact on the environment.

Recently Hogan Lovells, in collaboration with Africa Legal, surveyed more than 400 professionals across the mining community and interviewed some of the world's leading mining experts on the future of mining. This resulted in the publication of three reports, the third of which focuses on technology. The influence of technology on the future of mining has vast potential.

With the adoption of deep technology such as data analytics, robotics, automation and artificial intelligence, mining companies can start to develop new ways of extracting minerals in remote locations, improve health and safety practices, and drive the transition to renewable energy. As mines across the continent mature and drilling becomes harder, technology will extend mine life by enabling existing resources to be maximised and new development assets to be found, thus unlocking greater value for all stakeholders.

The adoption of new technology is a must-have for mines as it is part of a company's social licence to operate, given

that companies are under pressure to operate in an environmentally friendly manner. Many new technologies present several eco-enhancing incentives regarding health and safety, carbon emissions and water impacts. Technology also means efficient production for mining companies. This is a good incentive for them to adopt new technology.

Implementing some technologies, however, will also change the nature of the employment opportunities available. Mining companies rely on local communities as a labour resource. The areas where most mines are located have an education system that is lacking to cover the new age jobs that are technology focused. This presents difficulties for on-the-job training for new jobs that would otherwise benefit the local communities.

Another issue is that adopting technology will in most instances result in loss of jobs, as current employees have skills linked to the way the mining company currently runs. Adoption of technology therefore often becomes an emotional and political issue, which

is understandable. However, when it comes to accelerating innovation, we should also bear in mind the facts, available data and business needs.

To address this skills gap, collaboration is key. Mining companies can work together with universities by making use of the research that the university provides for the industry.

Technology is a primary way for us to ensure the mining industry is future fit, has longevity, and is environmentally responsible. This is why it is so critical that we empower people who work in the mine with new skills so that they too can benefit from the new lease on life that technology can give this sector. **MRA**

ABOUT THE AUTHOR

Kevin Pietersen is a partner at law firm, Hogan Lovells





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Loesche

Evolving with the future of mining

Attracting meticulous and hesitant investors to buy into the vision of a project can be a daunting task, especially if the project belongs to a junior miner with no real track record. Partnering with the right specialist engineering and equipment supplier which offers technological advancements of its own can alleviate some of this pressure, thereby making the project more attractive, says **JONATHAN SMITH**, Loesche SA sales and marketing manager.

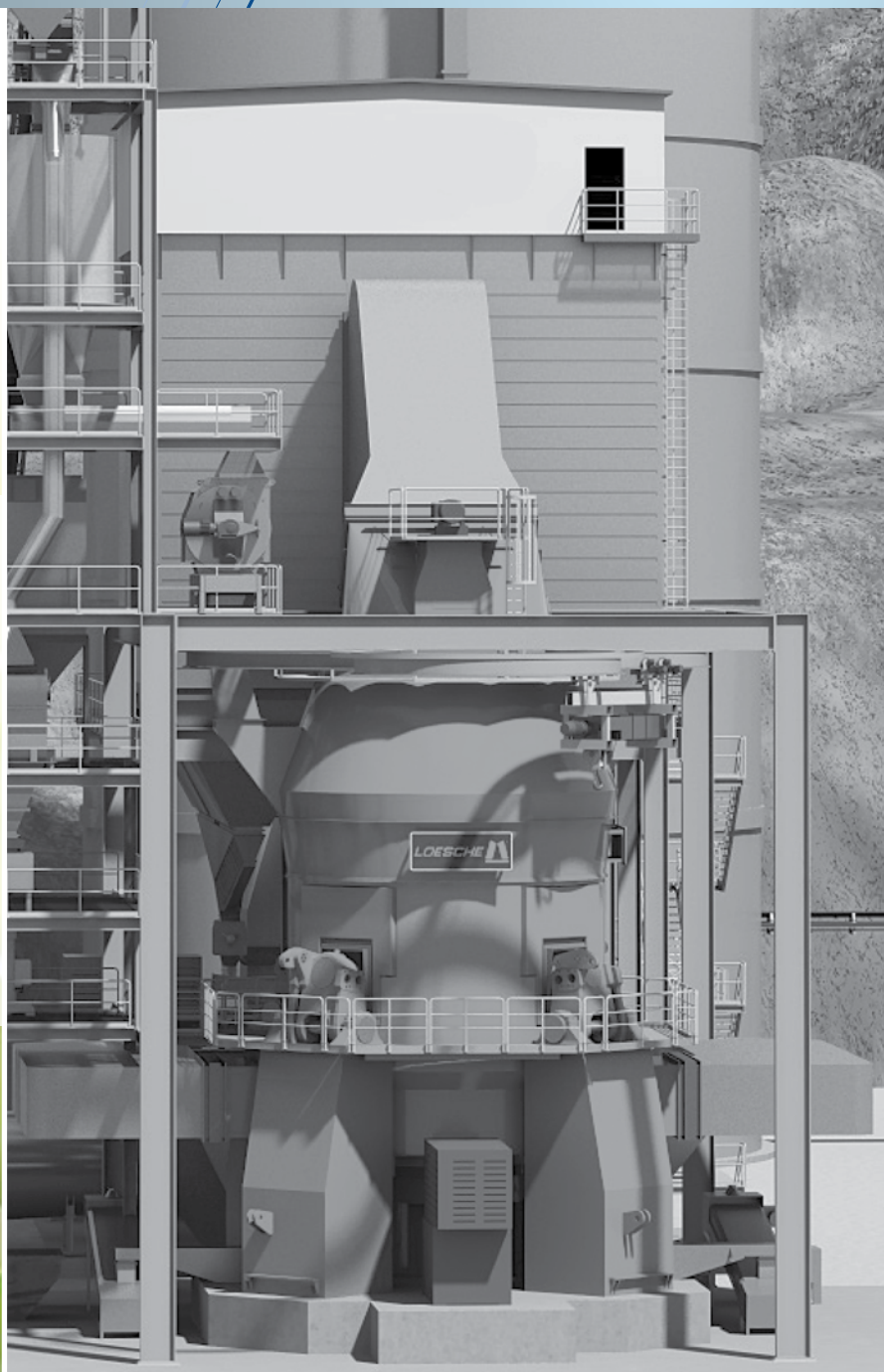
Loesche is one company that is evolving with and into the future. We have positioned ourselves as a well-established technology partner, with a heavy focus on the environmental, cost-effective processes, lowest possible operational

expenses, and increased recoveries to maximise profit margins.

For decades now, the Loesche Vertical Roller Mill has been proven in the coal, raw meal and cement industries, and this technology has now been adopted and engineered to aid miners in becoming more profitable.

Mining houses today have started to accept the new VRM technology as the way forward as it allows mines to be established and operate in areas previously unreachable, by enabling a basic supply of water and electricity that is critical to a mine's existence.





To date Loesche has been engaging with both existing and new mining projects with varying customer needs in the gold, copper, nickel, platinum, and iron ore industries, to mention just a few.

As commodity prices are fluctuating all the time, certain minerals are always climbing and the demand to produce more has been made clear. The increased pressure on the use of natural resources effectively has also been a major design issue when planning an extension or new mine and this has become a critical component during the feasibility stage.

Renewable energy delivers major milling benefits

A 12 Mtpa copper-nickel project, which is utilising Loesche's VRM technology, is in the final stages of design and is earmarked for construction start in the second quarter of 2022.

A major part of this project, which Loesche has been able to make possible with a lower energy usage in the comminution section, is the incorporation of solar energy (day) and wind energy (night) to run the entire plant. We had to take this approach because the nearest power source suitable for this project is over 2 500 km away. Use of water is controlled and is also very scarce in the area, so recycling of this valuable resource is of the utmost importance.

Loesche has looked at all aspects of mining and has brought the future forward to today. Technology and data to assess and assist in all aspects of the operation have been considered.

Apart from the benefits of using the VRM technology, Loesche has also further enhanced its mill offering by adapting the complete comminution circuit to include an artificial neuronal network which allows for automated plant control, remote plant operation and supervision. Included in the AI is the early detection of maintenance issues and the spare parts ordering.

With a mine's direct involvement to reduce costs especially, in the recovery phase, the AI technology is being extended to these circuits as well, giving the mine owners the peace of mind that the operating expenditure and recovery circuits are being monitored meticulously to maximise profitability. **MBA**



Image: 123rf.com

New bulk explosives system

Optimises productivity and blasting costs

Blasting specialist Orica has launched 4D, its latest bulk explosives technology – a revolutionary 4D bulk system that enables real-time tailoring of explosives energy to geology across a blast, delivering improvements in fragmentation, on-bench productivity and an overall reduction in drill and blast costs.

The 4D bulk explosives technology will enable Orica’s customers to seamlessly match a greater range of explosives energy across a mine’s geology and target specific blast outcomes in real-time.

By combining emulsion blended with ammonium nitrate porous prills, 4D supports both pumped and augered loading methods across dry, wet and dewatered hole conditions. An outcome of this unique capability is greater on-

bench productivity by Orica’s fleet of 4D enabled mobile manufacturing units (MMU), without the need to change raw materials in the MMU.

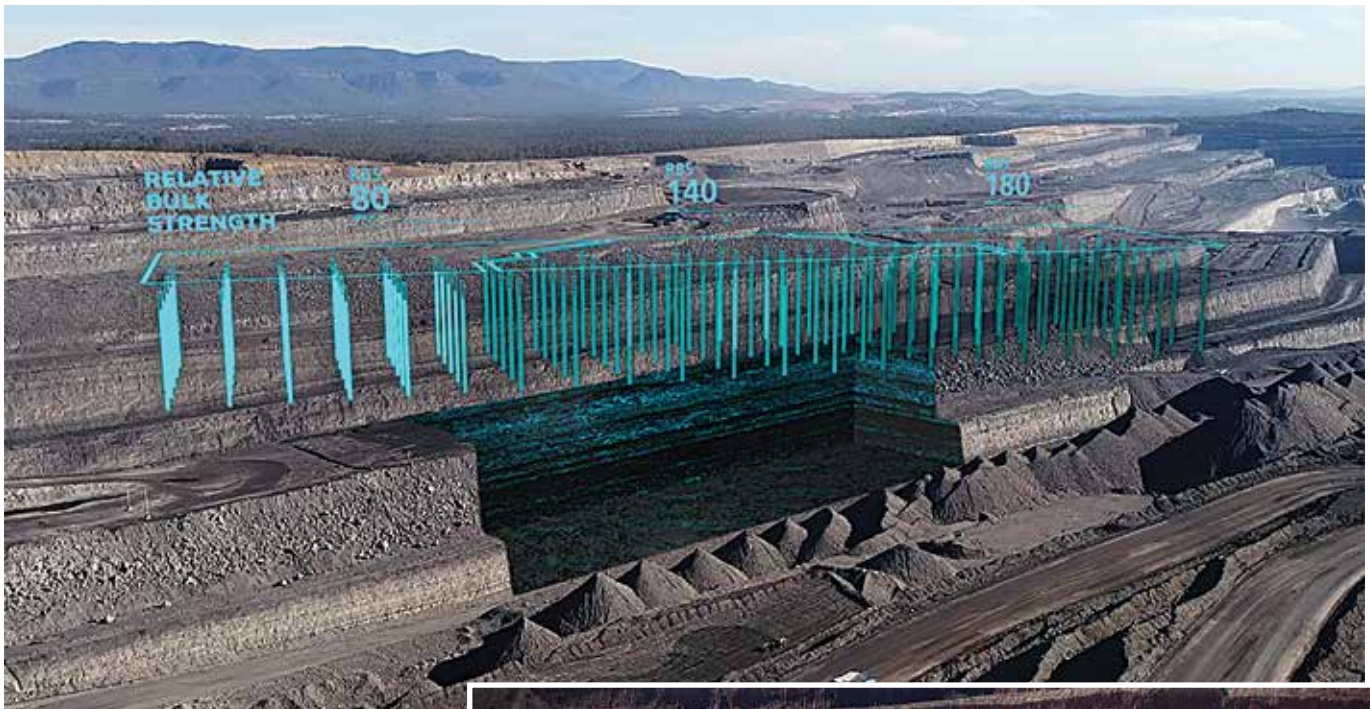
“Our 4D capability demonstrates the convergence of our new technologies and solutions, allowing our customers to think differently, mine more efficiently and operate more precisely. By combining our range of advanced digital, formulation chemistry and explosives delivery technologies with our technical expertise, we are able

to offer this breakthrough solution that will unlock greater value for our customers across their operations,” says Angus Melbourne, chief technology officer at Orica.

Delivering up to 23% more relative bulk strength for hard rock

The first release of 4D will begin with Australia from the end of the year with other regions to follow from 2022





4D enables the seamless matching of the required energy to rock strength, to target the desired blast outcomes

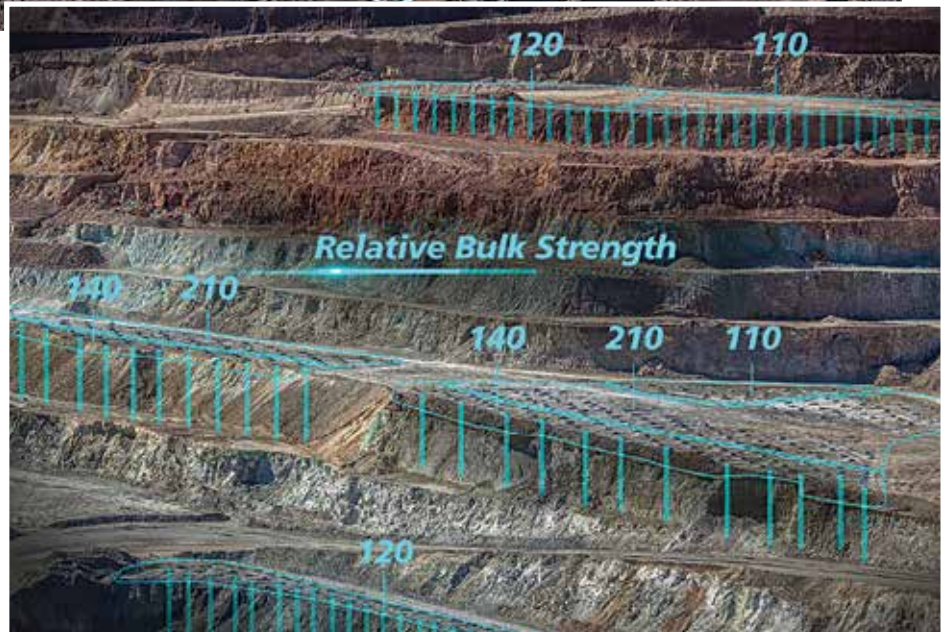
applications and up to 43% reduction in soft rock¹, 4D will enable a broader range of applications.

In hard rock, the extra energy can be used to improve fragmentation in ore blasting, or to expand patterns while maintaining the same energy per bank cubic metre (BCM) to substantially reduce drill and blast costs.

In softer geology, the potential of loading significantly lower energy products into wet holes leads to reduced cost and fume risk, as well as better management of blast vibration.

Adam Mooney, Orica vice-president: blasting technology, describes the solution and the significant change in the application of explosives, saying: "Traditionally blast designs are often driven by powder factor, which is the overall consumption of explosives for the blast, rather than the energy required for different parts of the blast based on geology, resulting in the same type of explosive being applied across a blast pattern regardless of changes in geology or the required blast outcome.

"4D now enables us to consider another dimension – the application of energy in real-time matched to the rock strength of the blast pattern as well as the desired blast outcomes, such as consistent fragmentation, fume risk reduction or better vibration control.



This is a really powerful technology that will allow customers to manage their drill and blast operations and achieve improved blast outcomes."

4D will be delivered through MMUs equipped with LOADPlus, Orica's proprietary in-cab smart explosives delivery control system that enables the ease of manufacture and accurate and efficient delivery of formulated explosives products to plan.

Integration with Orica's suite of digital blasting technologies including BlastIQ and SHOTPlus will further enable customers to leverage seamless digital workflows including blast designs and blast quality

assurance and control, as well as BlastIQ digital insights to continually optimise blasting outcomes.

4D is currently being developed across Orica's Fortis, Fortan and Aquacharge bulk systems. The technology will eventually be applied across Orica's suite of bulk systems. [MRA](#)

¹ The explosive effective energy relative to ANFO with a density of 0.8 g/cm³. ANFO has an effective energy of 2.30 MJ/kg. Energies are calculated using Orica's proprietary theoretical iDeX computer code under ideal detonation conditions, with a 100 MPa cut off pressure. Other computer codes may give different values. Actual energy values depend upon the conditions of use including the prevailing geological ground conditions, the diameter of the borehole and the degree of confinement.

Vibramech

Bringing cutting edge technology to minerals processing

Vibramech, Southern Africa's largest manufacturer of vibrating minerals processing equipment, is synonymous with quality, reliability, and robust vibrating equipment. This proud reputation is a consequence of continuous technological innovation over four decades which has cemented its status as an OEM of dependable equipment, throughout the world.



↑ Measuring vibration and conducting a modal impact test, to verify the simulation results

“We engineer solutions for each client's unique minerals processing requirements. Our current installed base of over 10 000 pieces of equipment makes us the South African leader in market share. We are proud to be the preferred supplier of vibrating equipment to project houses and mines in southern Africa,” starts David Massey, Vibramech MD.

The company supplies its equipment primarily to mining and minerals

processing industries across the globe (Africa, Europe, Asia, Australasia, North and South America), with extensive experience in gold, diamond, coal, iron ore, manganese, platinum, chrome, nickel, uranium, copper, mineral sands and aggregate operations.

“Our design practice makes use of Finite Element Analysis and Strain Gauge Analysis to prove structural integrity, with detailed attention paid to wear protection and commonality of components to minimise spare parts inventories,” Massey continues.

Introducing Vibrasure

Vibrating equipment plays a crucial role in minerals processing, and is widely used for classification, dewatering, medium recovery, scalping, trash removal, grading and desliming. Due to this crucial role, early fault detection, diagnosis and analysis become important to continuously reduce and eliminate costly, unscheduled downtime and unexpected breakdowns.

To ensure the optimal operation of its vibrating equipment, Vibramech has launched Vibrasure – an online condition monitoring system which has enabled

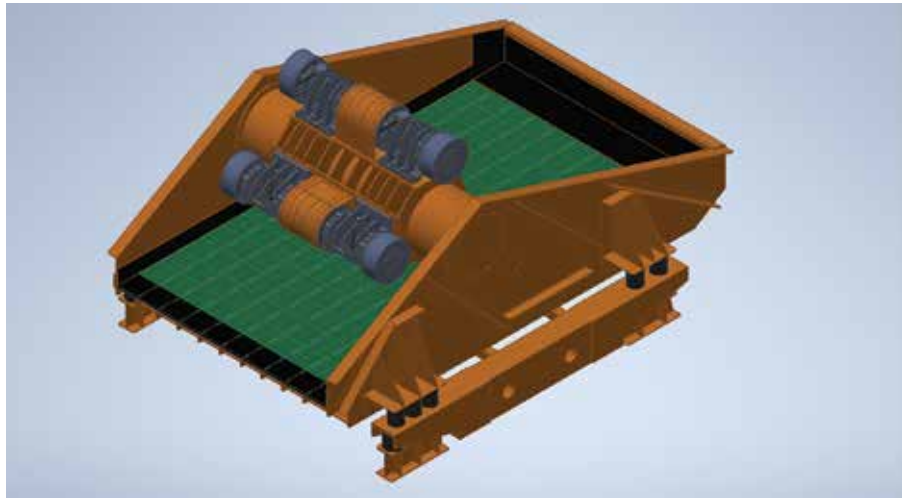
continuous vibration monitoring of the equipment operational parameters (such as vibration frequency, stroke, angle of the motion and temperature) to detect and diagnose machine faults.

Vibrasure employs structural and bearing sensors designed with the latest technology. All sensors are IP69K rated and have long-life integral batteries that can withstand the harshest of conditions.

The system also reports key parameters to a cloud-based platform. Those values can be trended over time and provide significant benefits to optimise the performance of vibrating equipment. "This further enhances our already robust and reliable equipment and cements this business as a world-wide supplier, providing our clients with the additional comfort of knowing that any deviations in equipment performance will be picked up by our engineers via Vibrasure," Massey outlines.

As sound dynamic behaviour is essential to ensure vibrating equipment reliability, all equipment is built to perform within strict dynamic parameters. All internal mating surfaces are machined in order to maintain stringent dimensional tolerances. In addition, the company's quality assurance programme makes provision for a full 3D vibration analysis to be conducted on all equipment prior to release. This is used as a benchmark for the life of the equipment.

"Our equipment needs to withstand the high wear associated with the screening of abrasive ores such as



↑ Initial 3D design, which led to the final manufactured screen as in photo

chrome, platinum and iron ore. We also have a range of speciality liner materials, paint specifications and wear prevention compounds which are used to combat the effects of corrosion in the marine and refinery applications. Vibramech even offers the option to install a screen in stainless steel," explains Massey.

The Vibramech design makes extensive use of rubber lining to reduce the effect of wear and impact on screen components. A range of steel, ceramic and polyurethane liners is available to protect screen and grizzly side plates, as well as feeder pans. An abrasion resistant / Anti-corrosion Epoxy Resin System is used to minimise wear associated with fines in wet applications.

"It is imperative that stresses induced by welding are minimised to prevent crack formation in vibrating equipment,"

Massey says. Vibramech therefore makes use of heat treatment to stress relieve all welded screen components. The overall design philosophy is to minimise welding and maximise the use of swaged fasteners.

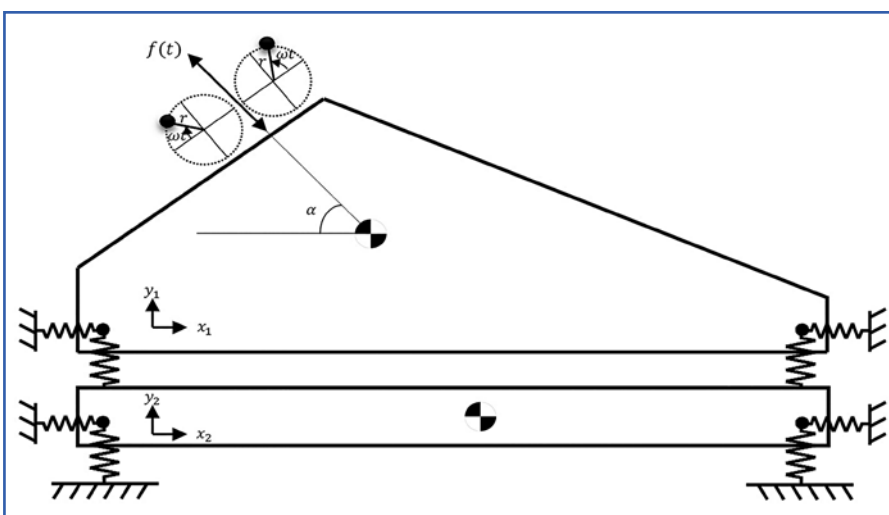
The company ensures a robust equipment design that will provide many years of reliable service, resulting in lower operating cost and reduced downtime.

Please visit Vibramech's new website at www.vibramechglobal.com for an overview on how Vibramech could assist with your current and future minerals processing requirements. **MRA**

THE TECHNICALLY CURIOUS MIGHT FIND THIS INTERESTING

To appreciate the basic working principles of vibrating equipment, a basic analogy of a mass-spring system can be used. The stroke on this system is obtained by dynamic force generated by pairs of eccentric masses, rotating synchronously at the same angular velocity, but in opposite directions (i.e., by using geared exciters or vibrator motors).

Frequency (rpm) and stroke of vibrating equipment are selected based on the specific processing duty required, with typical acceleration ranging from 3G to 5G, with 740 to 1440 rpm.



↑ Simplified analytical model of a vibrating screen and subframe

Mining workforces

Health and safety a top priority

As companies across the world continually strive to create safer working environments, now, more than ever, a renewed focus is placed on the health and safety of human capital and the enhancement of safety, health, environment and quality (SHEQ) cultures and management systems

Advance Empowered Risk Management (AERM) is a trusted institution with 18 years' experience in establishing a measurable and sustainable culture of health, safety, environment, risk and quality for clients through tailored risk management solutions and training.

According to Espee Hattingh, general manager Expert Solutions and Consulting, AERM's customer centric and practical approach entrenches the company as a long-term partner in organisations. "Our solutions embed safety cultures, from legislated requirements to behavioural compliance – from all different levels within the business structure," he says.

"We believe that SHEQ wellbeing begins with people", says Hattingh.

"Our aim is to support our clients through establishing a sustainable culture and increasing their skills and practical training profile, whilst reducing liability and protecting human capital.

"While organisations focus on their core business, our team of experts will assist clients with the design, development and implementation of all SHEQ management solutions."

"We are leaders in the field of SHEQ risk management across a range of industries including mining, construction, government and private; we also believe that driving responsibility and awareness from management levels downwards motivates a culture of risk reduction," says Herman Roets, general manager SHEQ Solutions, Mining and Related.

"Proper safety training and safety measures are pivotal to protect workers from dangerous injuries, loss of productivity and downtime," he adds. "We focus on cultivating a day-to-day safety awareness among all employees in their diverse environments that is easy to understand and easy to sustain".

When your risks are not kept in check, it can greatly affect your employees, the environment, the local community and also your bottom line.

AERM believes that SHEQ is not a luxury, but an imperative in an evolving business landscape and is assisting companies across the board to safeguard their employees and their business while increasing productivity and creating value. **MRA**

April 2022



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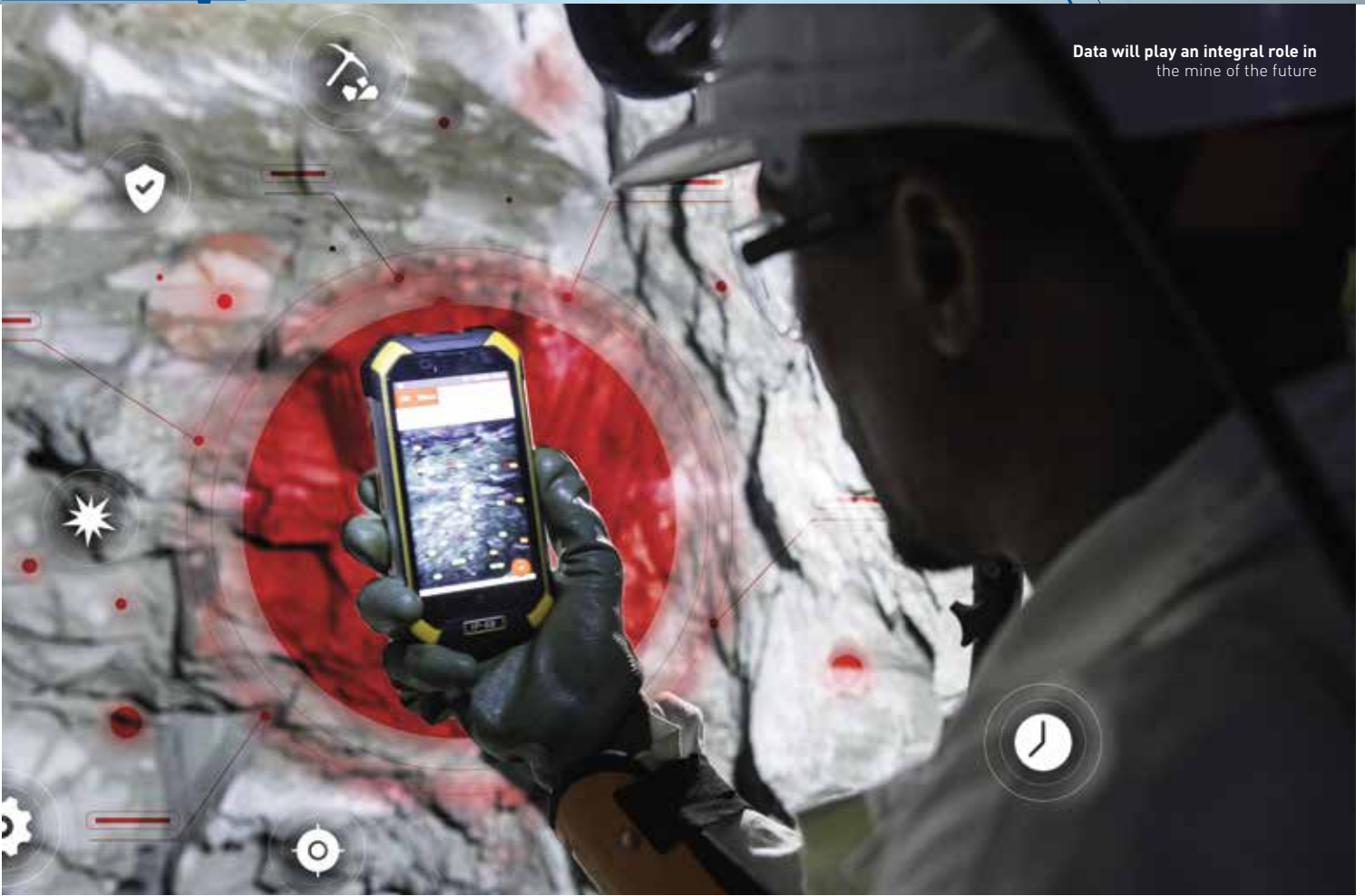
“Through this partnership, we have successfully rekindled the discussions on EVs and the whole EV ecosystem in South Africa.”

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Digital blasting innovations

Paving the way to mining's future

Embracing opportunities presented by digital technology, blasting on mines today plays a key role in defining what future mining will look like.

According to Christiaan Liebenberg, software product manager at blasting specialist BME, the process of digital transformation is also demanding unprecedented levels of collaboration. This includes mines' ongoing engagement with service providers, as well as close cooperation between blasting service providers and their specialised technology partners.

"It is clear that, at its foundation, the mine of the future is being built on the power of data – and the high-quality

decisions that good data enables," says Liebenberg. "As consulting firm Deloitte noted in a recent report on the digital revolution in mining, the functions of planning and control are increasingly data-driven."

By processing large volumes of valuable data in its 'nerve centre', the mine of the future can optimise volume, costs, capital expenditure and safety. When properly utilised, the data in this nerve centre can improve visualisation and reporting, short interval control, operations, future modelling, prediction and simulation.

Digital suite

"Having invested extensively over many years in electronic and digital aspects of our blasting offerings, BME today has a suite of resources that our customers can leverage in their technological journey," Liebenberg adds. "To highlight the integrated role that our products can play in taking mining forward, we have encapsulated these in our Blast Alliance brand."

It starts with BME's comprehensive blast planning software BLASTMAP which uses the power of modern computing to streamline the design process for each

blast. With versions relevant to both surface and underground operations, the versatility and reliability of BLASTMAP is enhanced with the use of BME's electronic detonators and world-renowned AXIS digital initiation system. The software also allows for blast patterns to be tested and simulated before actual detonation, ensuring trouble-free blasts that deliver optimal results.

"This sets the scene for us to generate, upload, store and analyse large volumes of data related to each blast. Mines of the future not only use technology to monitor and control existing processes but must use that data productively to continuously improve performance on various fronts," Liebenberg explains.

Tracking key parameters

In blasting, this includes carefully tracking a range of important parameters such as blasthole depth, stemming volumes and charge volumes. Traditionally, this was done manually in a process that could take days to



“It is clear that, at its foundation, the mine of the future is being built on the power of data,”

**CHRISTIAAN
LIEBENBERG**

find its way into management reports. The digital age is opening doors for these parameters to be measured and recorded in real time – giving supervisors and management an opportunity to intervene in the process in the interests of better results.

Mines will invariably have standards and protocols which define the acceptable tolerances on key operational parameters. In blasting, for instance, excessive over-charging of holes will have cost implications and will affect the quality of the final blast. Supervisors

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therefore need to control adherence to set limits; to do this most effectively, they need realtime data – rather than a post-blast report.

“Digital technology has made huge strides in enabling the flow of data in real time,” adds Liebenberg. “With BME’s XPLOLOG cloud-based platform, for instance, management can access XPLOLOG and immediately see the progress of the blast preparation on the block.”

Streamlining operations

Liebenberg also highlights the growing role that sensors and telematics can play in efforts to gain better availability of explosive trucks on site – for streamlined operations and minimal disruption. In the future it will be possible for any standing time to be digitally logged by operators and categorised for management to identify any recurring themes. This data could then be timeously and systematically reviewed, leading to appropriate strategies to improve overall efficiency.

“This kind of data is very useful in informing maintenance schedules, for instance. Understanding more about the exact cause and nature of truck stoppages – which is easier when data is consistently captured and analysed – can help eliminate such downtime through the most suitable maintenance solutions,” adds Liebenberg.

Meanwhile, brand and marketing manager Michelle Fedder emphasises

that the quality of output at mine level is directly dependent on the quality of the respective inputs, placing the blasting function in a particularly important position.

“As blasting takes place so early in the mining cycle, it has considerable knock-on impacts on subsequent phases. Not only do blasting products and services contribute greatly to the downstream process, but so does the data which is generated from these activities,” says Fedder.

Continuous improvement

Future-oriented mines will invariably seek continuous improvement in blasting practice, which depends on detailed assessments of each blast. Where blasts are conducted every day – or even a few times a week – the data from each blast must be quickly generated and available.



↑ **BLASTMAP** uses modern computing to streamline the design process for each blast

This is where platforms like XPLOLOG are crucial, as they can provide data that compares key elements of the planned blast with those of the actual blast.

Management can then play its role in identifying what can be done to avoid any challenges encountered. Without the right data, proposed solutions remain in the realm of guesswork. Fedder further reiterates the value of collaborative partnerships in forging mines of the future. “At BME collaboration with our other partners in the value chain, especially those whose technologies we leverage in our own solutions, is key to optimising the end-value and charting sustainable paths to success.”

Artificial intelligence

Liebenberg cites one example of how BME enhances its own driver safety performance with dashboard cameras with associated artificial intelligence (AI) capabilities. By ‘learning’ about the actions of the driver in the cab – such as reaching for an object like a can or mobile phone – the solution can generate appropriate alerts to the supervisor. This enables the supervisor to manage possible risks, and address these with the driver.

“Mines and their suppliers will increasingly be looking for this kind of digital and intelligent technology, whose functions can be carefully defined according to particular conditions and needs,” he explains. “BME sees this as another potential contributor to driver safety, and we look forward to working closely with this technology partner in developing a solution to suit our requirements.”

In conclusion, Liebenberg states that connectivity on mines remains a core feature on which the industry’s digital future relies. While major league miners can prioritise the considerable expenditure that this requires, reliable connectivity is more of a challenge for smaller, remote mines. Here again, collaborations are vital – working

both with governments in the provision of basic communication infrastructure and with technology companies to install affordable and effective on-mine networks. **MRA**



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Tread alert

AI helps to prevent tyre malfunctions

Kal Tire's Mining Tire Group and computer vision specialist **Pitcrew AI** have formed a partnership that will bring mines autonomous detection of tyre faults without the need for a vehicle to stop.



Tyre faults can be detected while a vehicle is still moving

the thermal imaging video footage for anomalies such as hot spots, belt edge and tread separations and other mechanical problems. These findings are reported into TOMS. The system then automates inspection work orders as part of a self-reinforcing feedback loop and then schedules tyre change work as necessary based on damage severity.

"We are really excited by the potential of what we might find when we combine the Pitcrew data with TPMS and our other data streams. Together, these tools bring incredibly valuable information about how the tyres are performing. We intend to build predictive models that will enable Kal Tire and our customers to make better and earlier decisions about preventive tyre repair or replacement, and that will have a significant impact on driving haul truck productivity and safety," says Christian Erdélyi, TOMS system and implementation manager global, Kal Tire.

With the system demonstrating proven success operating in hot weather regions in Western Australia, Kal Tire has worked with Pitcrew to develop a cold weather version capable of withstanding temperatures of -45 degrees Celsius. A test 'winter model' is currently operational in northern Canada.

"There is also great potential for this real-time inspection technology in underground mines where doing regular equipment inspections can be challenging as well as to support the growing move towards autonomous mining. That's why we're investing resources so heavily in this solution," adds Erdélyi.

With a range of customers showing definitive interest in the system, Kal Tire and Pitcrew expect to extend the number of automated inspection stations operating across Kal Tire serviced sites using TOMS in 2022. **MRA**

With any inspection anomalies automatically transmitted into TOMS, Kal Tire's proprietary tyre operations management system, the integration between Pitcrew and TOMS enables action and decision-making that will further enhance fleet productivity and safety.

"Tyre pressure monitoring systems (TPMS) can give a strong picture of what's happening inside the tyre, but so much that can indicate the potential for failure happens outside the tyre. We knew if we wanted to give customers the ability to make better operational

decisions – and be a part of the future of autonomous mining – we'd need to add external telematics to the mix," says Dan Allan, senior vice-president, Kal Tire's Mining Tire Group.

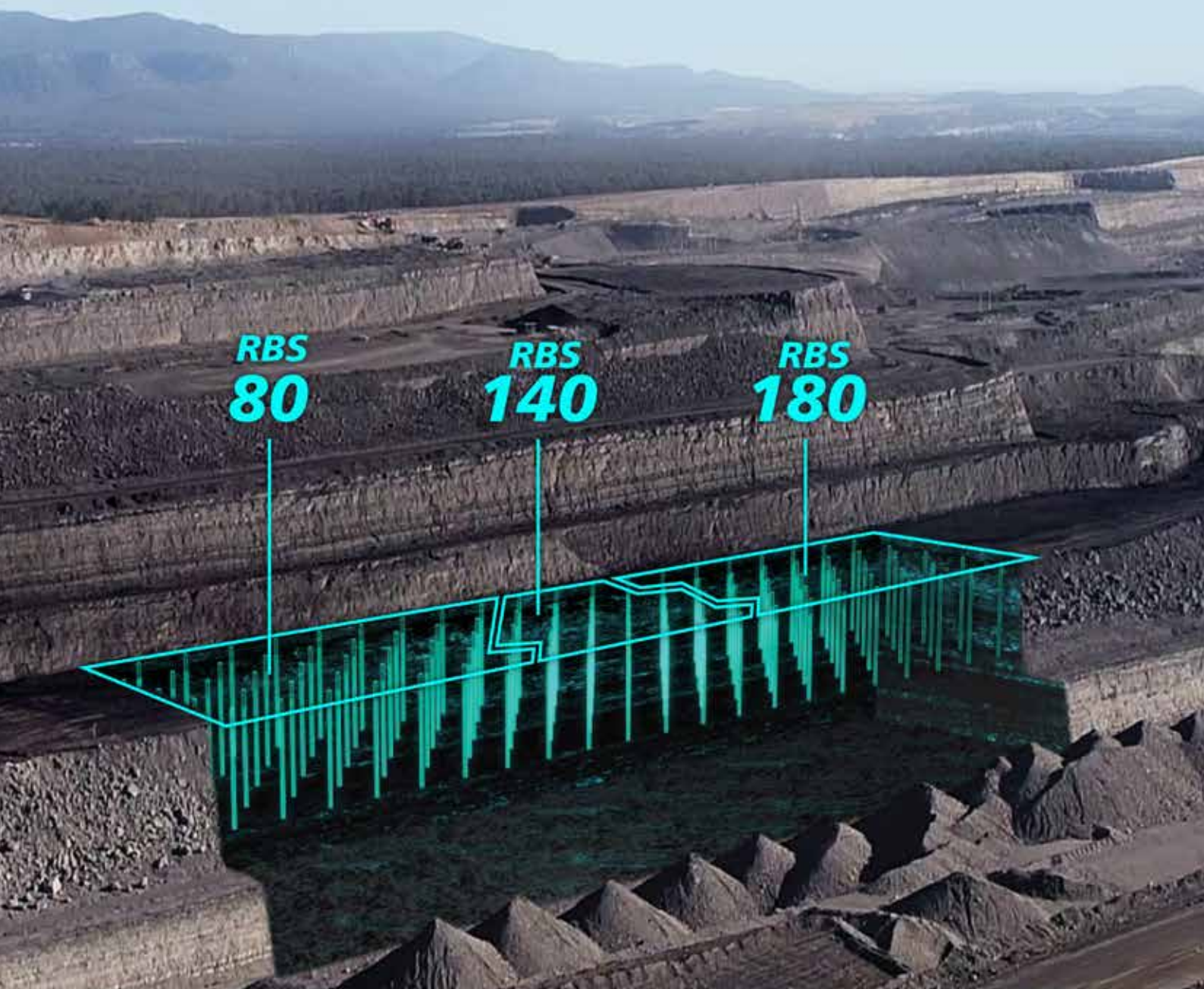
"Autonomous inspection will be a requirement for the autonomous fleets of the future. Our partnership with Kal Tire will increase access to diverse site operational conditions and accelerate the maturation of Pitcrew AI inspection technologies," adds Tim Snell, managing director of Pitcrew AI.

The automated inspection stations monitor front and rear tyres of mining trucks passing by. The artificial intelligence (AI) software searches



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Ability eMine

Fast-tracking the transition to all-electric mines



↑ eMine FastCharge provides high-power electric charging for haul trucks

eMine comprises a portfolio of electrification technologies which makes the all-electric mine possible from mine to port and is integrated with digital applications and services to monitor and optimise energy usage. It can electrify any mining equipment across hoisting, grinding, hauling and material handling. It also incorporates the eMine Trolley System which can reduce diesel consumption by up to 90%, significantly lowering energy costs and environmental impact.

“The global mining industry is undergoing one of the most significant and important transformations of our generation – and that is to become zero-carbon,” says Max Luedtke, global head of mining at ABB. “eMine is an exciting milestone to help convert existing mining operations from fossil fuel

energy to all-electric. Mines can become ever more energy efficient with vastly reduced levels of CO₂ emissions, while at the same time staying competitive and ensuring high productivity.”

Transitioning to all-electric trucks

eMine is underpinned by MineOptimize, a platform that optimises engineering in the design of the plant or mine and facilitates the transition to the digital and CO₂ free mine of the future. From 2022, it will include eMine FastCharge, the world’s fastest and most powerful charging system, designed to interface with all makes of electric mining haul trucks.

FastCharge can serve as a cornerstone of the transition to fully electrified mines across the industry. This flexible and fully automated solution is being designed for the


harshest environments, can be installed anywhere and can charge any electric truck without human intervention at up to 600 kW, the highest power available on today’s market to minimise the downtime of mobile assets. Charging time will depend on the battery capacity onboard the haul truck and the operational profile; however in many instances a suitable state of charge could be reached within 15 minutes.

eMine provides integral design planning and thinking to maximise the value of electrification, helping to design the hauling process in the most optimised way with electrical solutions that match mine constraints and help meet production targets. By fully integrating electrification and digital systems from the mine to the port, eMine further reduces overall costs and improves mine performance while significantly lowering environmental impact. **MBA**



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-Vous d'abord-

Underground mining

Taking the digital route

As the mineral sector seeks safer and more automated operations in line with the ‘smart mining’ vision, underground mining contractor **Murray & Roberts Cementation** is making good progress with its own digitisation strategy.

According to company MD Mike Wells, its new projects are increasingly embracing the power of digital technology to streamline operations and drive down unit costs. “Progress in applying wi-fi technology to underground mines is allowing us to introduce a range of digitisation initiatives in our projects,” says Wells. “This includes a condition monitoring system (CMS) to track the operating data of trackless mining machines (TMMs) in order to monitor their health.”

This widens the scope for more effective predictive maintenance, and also indicates patterns in operator behaviour that management can address and improve. With modern TMMs being fitted with a higher degree of electronic control units (ECUs), all interconnected and feeding data back to the machines’ control units, underground wi-fi now allows real-time data captured by the CMS data loggers to be sent to control rooms for instant analysis and action by specialist software applications

“We are also applying production control systems (PCSs) – making use of heavy-duty ‘plods’ or tablets – in the cabin of machines,” adds Wells. “Rather than using manual paper systems, operators can have digital pre-start checklists and can log the starting and stopping of various activities underground.”

Creating a digital communication network

These technologies provide valuable information to supervisors and managers in their allocation of people, machines and other services where they are required. In particular, the real-time transmission of the data allows decisions to be taken faster – leading to better results and greater efficiency in the application of resources.

Wells states that fixed installation monitoring is another important element of the benefits to be leveraged from a digital communication network. This relates mainly to static equipment like dirty water pumps and ventilation fans, which are central features of most mining operations. “By linking these systems to the mine’s digital backbone,

we are able to monitor their operation, and importantly also start and stop them, from a central control room.”

A key resource behind this strategic direction is intelligent solutions specialist Insig Technologies – recently acquired by group company Murray & Roberts – who is developing agnostic interfaces between the systems of various original equipment manufacturers (OEMs).

“We are aiming for agnostic systems and data loggers that will ‘talk to’ machines from various TMM suppliers. For instance, we want to be able to activate a ventilation-on-demand functionality from a remote location. This would allow an operator to divert ventilation capacity to a heading where a blast has just taken place, facilitating more rapid extraction of fumes and facilitating quicker re-entry,” explains Wells.

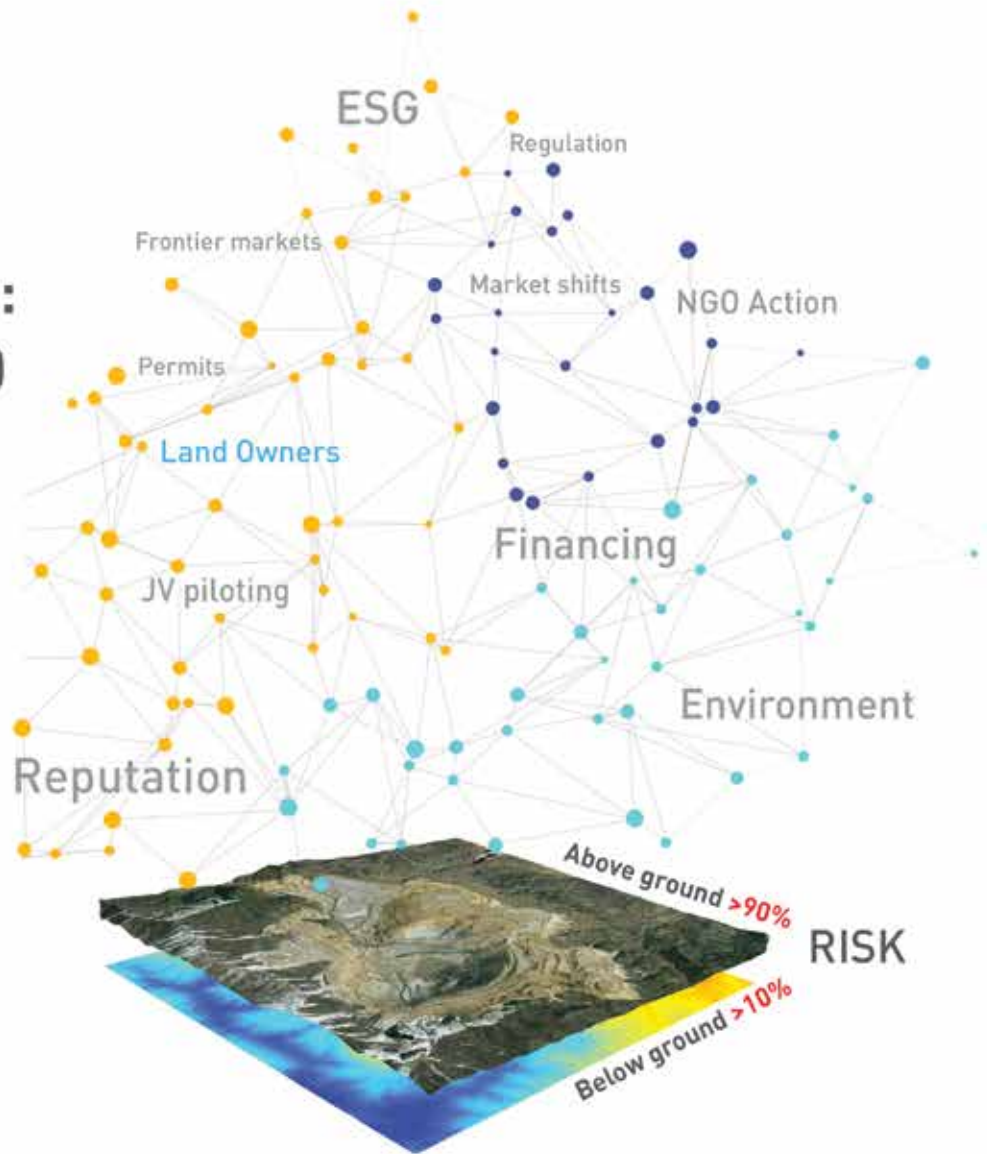
Murray & Roberts Cementation has already implemented many of these innovative strategies at B2B’s Otjikoto gold mine in Namibia, and will also roll them out with a battery-powered mining fleet at Ivanhoe Mines’ Platreef project in Limpopo province, South Africa. **MRA**

Linking systems to the mine’s digital backbone enables Murray & Roberts Cementation to monitor their operation, and importantly also start and stop them, from a central control room



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The COVID-19 pandemic has been a catalyst for mining companies to embrace IIoT

Image: 123rf.com

Pandemic push

COVID-19 spurs on IIoT in mining

New research by the global mobile satellite communications company, **Inmarsat**, reveals a rapid increase in the maturity level of the Industrial Internet of Things (IIoT) across the mining sector since the start of the COVID-19 pandemic.

Respondents from the sector reported that Covid-19 has demonstrated the importance of IIoT to their businesses, with many accelerating IoT deployments in response to the pandemic.

According to the research, adoption has seen huge progress from 2020 to 2021. 82% of mining respondents have now fully deployed at least one IIoT project, with 37% having achieved this in the twelve-month period from the second quarter of 2020. Of the remaining 18% of mining respondents that have not yet adopted IIoT in any form, all of them are either currently trialling it, or plan to deploy or trial at least one IIoT project in the next two years.

A further 81% of mining respondents indicated they had accelerated, or intend to accelerate, the adoption of IoT in response to COVID-19 challenges.

Commenting on this acceleration of IoT in the mining sector, Nicholas Prevost, director of mining innovation at Inmarsat, says: "While the mining sector

has, historically, lagged behind other industries in its adoption of radical ideas and new technologies, the sector has made considerable progress in terms of IoT adoption and development over the last few years and is very upbeat about its potential. The COVID-19 crisis has only served to accelerate the rate of IoT adoption in many mining businesses and we are now seeing evidence that those companies that are increasing the speed of adoption of IoT and associated technologies are gaining an advantage, through their ability to keep operations going autonomously and with greater insight."

Commenting on the research, Mike Carter, president of Inmarsat Enterprise says, "The rapid increase in IIoT deployments over the last few years highlights the considerable progress global industry has made to overcome some of the world's most challenging forces. It is particularly interesting, though logical, that COVID-19 has further catalysed businesses to increase their reliance on Industry 4.0

technologies, and particularly IIoT, in order to maintain business continuity. Those businesses implementing IoT technologies ahead of their competition and across their value chains are those who stand to win in the long term.

"While our findings point to IIoT driving significant uplifts in efficiency, sustainability and safety across global supply chains, there are areas where organisations can make improvements to draw the optimum benefits from the technology. Connectivity, data management, skills shortages, security threats and investment levels remain challenges as the world's production and supply chains become increasingly digitalised and intertwined.

"Inmarsat's global ELERA network is inspiring new possibilities and enabling organisations from all sectors to access IoT anywhere. Ideally suited to the rapidly evolving world of IoT, our industry-leading narrowband network provides global reach, extraordinary resilience, and the fastest speeds, along with the smallest low-cost terminals in their class." **MRA**



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If its not INVAL®, it's not Invincible

**TRUST IS
WHAT MAKES
OUR NAME
OUR PROMISE.**

Major industries in South Africa and globally trust Invincible Valves to continually innovate and invest in valve solutions for their industries.

With in-house rubber lining services for valves, pipes, fittings and vessels, we are able to offer complete service, maintenance and reconditioning services with exceptional service, pricing and quality standards.

The bond we have with our customers, coupled with world-class facilities means that the Invincible Valves team is able to continually provide customers with our enhanced services that leads to their profitability.

GENERAL INDUSTRY | MINING | PETRO-CHEMICAL | POWER GENERATION | WATER | SEWERAGE

LEVEL 2
BBBEE

