



Carbon-constrained comminution

The entire industry is aware of the statistics about the comminution sector’s water and energy use. The question now is: how do we rationalise the use of these resources while boosting output to meet growing industry demand? Dan Gleeson looks for answers from the processing community

The mining sector’s drive for energy and water efficiency is relentless, with companies reporting on both their Scope 1, 2 and 3 emission status and operational water draw on an annual basis in sustainability reports.

The pressure to continuously bring down these metrics is stirring the technology community into action, knowing that the low-hanging operational fruit can only be picked for so long and more transformation moves are needed to reach the sector’s ultimate net zero destination.

Weir out to transform flowsheets

Having proven out its own Enduron® high pressure grinding roll (HPGR) product and assembled complementary downstream equipment, Weir is now ready to show the mining sector how it can transform the wider minerals processing flowsheet.

This message came through loud and clear at the recent SAG 2023 conference in Vancouver, Canada, and has been getting louder in the months since.

For instance, in December, the company released the results of a study that highlighted

an opportunity to reduce energy use and emissions in comminution by leveraging three alternative technology combinations.

The study, presented by Paula Cousins, Chief Strategy and Sustainability Officer, during a COP28 panel discussion, showed that replacing conventional technology with innovative new solutions can cut energy use by 40% while also avoiding 50% of CO₂e emissions. It was the first study of this kind to use the World Business Council for Sustainable Development’s Avoided Emissions Guidance to evaluate mining processes, with the results independently assured by SLR Consulting Limited.

Three of Weir’s technology combinations were evaluated against a Semi-Autogenous Grinding (SAG) mill and ball mill (SABC circuit) design for an archetypal mine processing 15 Mt/y of copper ore in Chile. Each circuit was based on a ‘rock to recovery’ system boundary – reducing rock direct from the mine to a size that enables the mineral to be recovered.

The combinations under the spotlight were the Enduron HPGR to replace the SAG mill at the initial grinding stage, the Enduron HPGR plus

A recent study showcased that the use of an Enduron HPGR (pictured), an STM Minerals’ vertical stirred mill and Eriez’s HydroFloat coarse particle flotation solution in place of a traditional SABC circuit design for an archetypal mine processing 15 Mt/y of copper ore in Chile could cut energy use by 40% while also avoiding 50% of CO₂e emissions

STM Minerals’ vertical stirred mill (VSM) to replace SAG and ball mills, and the addition of Eriez’s HydroFloat coarse particle flotation (CPF) solution to the HPGR and VSM equipment. All this collectively comes under the “Flowsheet of the future” Weir has been promoting.

It was the combination of all three that provided the biggest impact – around 40% less energy and the ability to avoid up to 50% of CO₂e emissions – with the trio also consuming less water than the SABC circuit it was compared against.

For Tim Lundquist, General Manager – Mining Sales (Comminution), North America, it is studies like this that should be leading more mining companies to re-evaluate flowsheet thinking of the past.

“I find it very interesting that, even with this massive industry push for carbon neutrality and greenhouse gas emission reductions, SAG mills continue to find their way into mill circuits,” he told **IM** at the recent *SME MineXchange Conference and Expo*, in Phoenix, Arizona. “Replacing tumbling mills with HPGRs and complementary equipment is not just a saving exercise when it comes to power; it is also about

the grinding media. To put the energy and environmental resources into manufacturing grinding media that is designed to be destroyed is wasteful.”

With the use of HPRGs and VSMS, the only manufactured grinding media is a ceramic-based solution built to last. Similarly, the tyres on HPGRs are expected to have a life of one-to-two years. And, on top of that, Weir now offers a 10-year (100,000 hours) guarantee on its HPGR bearing arrangement.

Lundquist added: “The big shift in flowsheet design and development is going to occur when investors start pushing back on the selection of inefficient equipment by these mine operators and realise there are solutions out there that can prove a company’s sustainability credentials.”

What is helping Weir’s cause further is the proliferation of Enduron HPGRs across the mining sector, with Weir having won several contracts over the past five-to-six years, many of which have translated into operating units in the field.

This has resulted in more widely publicised trade-off studies showcasing Enduron HPGRs in a better light – from a capital cost perspective – than previous, confirmation of the operating cost benefits over the SAG mill equivalent, and the ability to conduct more direct comparisons from one mine site to another.

“These comparisons need to be as close to 1:1 as you can find,” Lundquist explained. “Mine operators can easily do that with SAG mills due to the high population across the industry; we’re now approaching the point where they will be able to carry out the same comparisons with HPGR installations.”

Lundquist highlights two installations in Canada that could become industry “benchmarks” in the future – the 2.4 m x 2.4 m HPGR now installed at the Côté gold project in Ontario, Canada, and a similar sized unit in place at the Equinox Gold -operated Greenstone gold mine, also in Ontario.

After start-up, both units will likely be operating under extreme temperatures during the next winter, providing the benchmark other gold mining operations in the northern hemisphere will likely require to progress similar HPGR investigations.

Lundquist and his colleague Nick Logan, Product Manager – Comminution (USA), were keen to clarify that not all operations suited the Enduron HPGR treatment and that Weir was keen to test any thesis before making flowsheet assumptions.

Logan said: “We want to make flowsheet recommendations based on test work to assess how to liberate the chosen minerals with the lowest amount of energy.”

This test work can vary from enough material to carry out a “first pass” trial at one of Weir’s



facilities, to 1-1.5 t of material for a “full scale” test, Lundquist added. “Both of these are typically designed to verify feasibility assessments and make sure the material processes as designed with the same expectations around installed power, circulating load, product size, etc.”

This test work, on top of Weir’s expanding digital platform, is helping more operations understand the realities of installing and operating HPGRs in the design stage. And, on the digitalisation topic, Lundquist said “connected” HPGRs that have cloud-based access and remote monitoring for machine diagnostics are also in the works.

As well as a slew of new greenfield applications coming through the commissioning stages, the business case for Enduron brownfield installations is strengthening.

Already the company has shown how one or two HPGRs can replace upwards of 10 crushers in outdated and complex circuits, but Weir is now going modular to win market share.

“In Canada – and I expect in the US – there is a big shift towards what I would refer to as ‘modular’ HPGRs,” Lundquist said. “These are smaller, more flexible units that can be dropped into existing operations to boost throughput and size reduction capabilities.”

“Weir already has some of these projects in the pipeline. Hopefully we can say more soon.”

Metso on rationalising energy and water use

Eliminating water from the mineral processing dynamic is, of course, part of Metso’s Planet Positive aims, but the company is also cognisant of the fact that many existing processes still rely on water resources to carry out their jobs effectively.

Brian Knorr, Vice President, Technology & Innovation, Minerals, says the company is continuing to strengthen its portfolio of crushing and screening products, with Metso seeing growing demand in terms of integrated crushing

Metso’s Brian Knorr says crushing and screening equipment is inherently compatible with intermittent operation and the crusher capacity can be scaled with the use of variable speed drives in some duties

systems – especially those that include bulk and particle sorting.

The incorporation of sensor-based sorting into the processing mix, if deployed effectively and with good ore characterisation processes at the very beginning, could reduce both the energy and water requirements associated with downstream processing.

“In addition, HPGRs offer excellent energy efficiency and are amenable to dry processing when operated in combination with air classifiers,” Knorr told **IM**, explaining that this arrangement is most useful when physical separation can also be dry, such as using dry LIMS (low-intensity magnetic separation).

At the same time, Metso is homing in on developing products and processes that make efficient use of water, with water recycling and metallurgical water management remaining important areas of development.

Metso is taking a similar tack when looking at integrating its products into grids leveraging more use of renewable energy.

This is where the ability to scale to the demands of the operation, both up and down, will hold mining equipment operators in good stead. Such flexibility could allow for operators to, for example, process harder material when solar irradiation is highest in the day and softer material at reduced throughput rates after solar generation peaks.

This evolving operating context – seen already in the likes of Australia and South America – is recognised in the development of Metso products, and the company sees the importance of that capability increasing in applications using mostly renewable energy, yet, some of its products are still constrained by design architecture meant for consistent operation.

Knorr expanded on this: “Crushing and

screening equipment is inherently compatible with intermittent operation and the crusher capacity can be scaled with the use of variable speed drives (VSDs) in some duties. Likewise, grinding equipment very often utilises VSDs to increase the available turndown ratio.

“That said, this type of capital-intensive equipment provides the best return on investment when operated at full capacity and the highest potential utilisation, so development of stable power systems that utilise renewable energy will be an important area of development for the industry.”

Should mining companies look to apply bulk sorting, one would expect there to be an opportunity to bring down this overall processing power requirement. It would also open the door to multi-stage crushing and screening integrated with sorting, which, as Knorr commented, is more compatible with intermittent operations.

This type of thinking is being used further downstream of comminution in the flotation space, as Antti Rinne, Vice President, Flotation, acknowledges.

“As coarse particle flotation becomes more prominent within grinding circuit flowsheet designs, this will increase the demand for high efficiency grinding equipment for secondary and tertiary grinding circuits,” he told IM, in the process referencing a major trend in the flotation sector.

“Pumping, classification and dewatering will also require unique solutions for these circuits and those operations are compulsory for the coarse particle flotation technology currently available at industrial scale,” he added.

This is where Metso, as a solution provider able to source the equipment to pump, classify and dewater coarse particles, can facilitate integrated flowsheet designs that enable high mineral recoveries at such fractions, reducing the grinding requirements – and therefore energy requirements – further upstream.

“Unlike fine particle recovery where you can tweak levers in the flotation process to increase the recovery of fine material, coarse particle recovery involves the entire flowsheet,” Rinne said. “For instance, there are big changes in the grinding stages needed to do this and new screening and classifying steps may need to be introduced. This is before considering the auxiliaries that are integral to effective operation of the big processing equipment.”

Metso, however, is in the final stages of developing what it says is a unique technology for coarse particle flotation that could alleviate many of these challenges.

The solution can be applied in the grinding circuit and after conventional flotation, and will not require classification or product dewatering, according to Rinne.



“We believe that the best solution for coarse particle flotation (or an optimised flowsheet) will be the one that requires less auxiliaries around the main equipment, and that is what we are aiming to bring to the market soon,” he said.

Outside of the physical products in this flowsheet, Metso sees increasing circuit complexity having the potential to increase the value of advanced process control systems and digital twins such as Metso’s Geminex™ to, it says, ensure the circuits are operating in an optimal state.

Gebr. Pfeiffer tackling the megatrends

As the industry continues to look for options to address concerns over its use of energy and water resources, solution providers traditionally serving different industries have come forward with strong business propositions for the mining fraternity.

Technology providers in the cement sector are part of this move, claiming their grinding solutions and experience dealing with fiercely competitive players looking to leverage every operational efficiency serves them well to make inroads in mining. This is further aided by having platforms based on dry processing routes.

One company that understands all of this – and more – is **Gebr. Pfeiffer**.

Gebr. Pfeiffer specialises in mill technologies, with its flexible MVR vertical roller mill for dry grinding providing, it says, a substantial benefit in energy saving, granting better liberation with higher recoveries, delivering a uniform size reduction with a narrow particle size distribution (PSD) and having a high reduction size ratio of up to 1,000.

There are others in the vertical roller mill technology market competing for mining market

Gebr. Pfeiffer’s MVR vertical roller mill technology offers the highest power density in the industry, according to Mathias Dülfer

share, however Gebr. Pfeiffer’s CEO, Mathias Dülfer, says his company’s solutions have several unique advantages.

“First off, our MVR has a parallel grinding gap that does not exist on other solutions,” he told IM in early-March. “The grinding elements, in combination with the MVR suspension system, ensures that this gap – between the grinding table and the roller – stays in parallel throughout the process.”

Such a design leads to very low vibration levels, smooth operation and less fatigue on machine parts – all of which contributes to lower downtime and reduced maintenance.

“We also have active mechanical redundancy in place with our MVRs,” Dülfer added, explaining that the MVR has options for both six and four rollers to allow machine operation to continue with at least two rollers while other units undergo maintenance.

“The third differentiator is the MVR offers the highest power density in the industry,” Dülfer said. “The compact nature of the machine, with everything included in an integrated design (including a classifier), is complemented by up to 18 MW of operating power, providing production rates of up to 7,000 t/h with a single mill.”

With the multi drive concept this power is delivered by up to six identical drive modules, which Dülfer says also aids operational flexibility: “Even if one drive is under maintenance, you can continue to operate with the others. This means there is both mechanical and electrical redundancy built into our machines.”

All the above stands out from a vertical roll mill perspective, but it is also worth providing

some context into how the technology differs from the SAG and AG mill platforms it could replace.

“The consumption of energy is a big one,” Dülfer said. “You are typically using 30-50% less energy to perform the same task with vertical roller mills over SAG/AG mills.

“Yet, more than that, the ability to better control the grinding element, and the addition of an integrated classifier that operates via an air swept function, ensures you do not overgrind material.”

Overgrinding has been pinpointed as a major target area for mining companies to address, realising that the production of excess fines and the use of excess energy for a task that does not always generate value represents obvious ‘low hanging fruit’.

And, like some other vertical roller mills, Gebr. Pfeiffer’s technology can offer higher recoveries at coarser grinds thanks to the ability to generate “micro cracks” through a grinding process made up of compression and shearing. Having been proven in test work, this is a particularly useful benefit given the coarse particle recovery trend sweeping through the mineral processing world, Dülfer acknowledged.

The MVR technology, which has a feed size of up to 175 mm, also operates in various operating modes – including a de-sliming mode for separating unwanted fines and impurities – and can make PSD adjustments on the fly to facilitate improved downstream recoveries.

And, speaking of downstream benefits, the ability to offer higher recoveries even at a coarser grind and the reduction in fines production leads to reduced water demand, reduced dewatering requirements in the tailings management process and, ultimately, reduced tailings generation.

In an environment where it is increasingly difficult to obtain new or extended tailings facility permits, this is an important advantage.

Dülfer says there are other ways of improving the downstream process in mineral processing applications, referencing the company’s recent investment in **NextOre**.

Back in November, the two companies announced they were looking to integrate NextOre’s magnetic resonance sensors and real-time bulk ore sorting with Pfeiffer’s vertical roller mill technology for dry grinding as part of a strategic partnership.

Upstream of Pfeiffer’s VRMs, NextOre’s magnetic resonance sorters, in a greenfield project scenario, could reduce the concentrator size with the same amount of planned metal output, while eliminating reject material early in the process after primary crushing.

After the VRM has carried out its work in the flowsheet, potentially dry magnetic or density sorting could further reduce the follow-on water



requirements in flotation or leaching.

Dülfer says the industry is waking up to these potential benefits, with the biggest impact likely to be seen in bulk commodities, naming copper and iron ore as examples.

He concluded: “We see an obvious place where our technology – and NextOre’s – can help and assist with addressing the industry’s megatrends.”

FLSmidth acquires Farnell-Thompson in Mining CORE’26 move

FLSmidth also boasts an offering including vertical roller mill technology, however its most recent M&A activity has been focused on tumbling mill design, operation and maintenance.

FLSmidth acquired 100% of the shares in the Canadian grinding mill engineering, supply and services provider, Farnell-Thompson Applied Technologies Inc, in March, having plans to integrate its offering into its core mining business.

Farnell-Thompson, which already has a long-standing business relationship with FLSmidth, is a global supplier of engineering services, parts and mills to the mining industry. Most of its revenue and earnings are generated through the supply of mill engineering services, sale of new mills as well as of spare parts and other services to the company’s customer base, which consists of approximately 70 mills worldwide.

Prior to the acquisition, Farnell-Thompson had been a consulting partner providing these services to FLSmidth for many years. Consequently, a seamless integration of the new business and staff is anticipated.

Mikko Keto, Group CEO of FLSmidth, said: “This acquisition is fully aligned with our Mining

FLSmidth plans to integrate Farnell-Thompson Applied Technologies Inc’s grinding mill engineering, supply and services offering into its core mining business

CORE’26 strategy, which includes targeting service growth through strategic investments and prioritisation. I am therefore very pleased to welcome Farnell-Thompson and its employees to FLSmidth. We have for long enjoyed the skills and competences of the company as a dedicated business partner. By fully joining forces, we will further strengthen our market-leading position within milling and grinding.”

CITIC providing comminution consistency

One of the more recent high profile accolades **CITIC Heavy Industries Co Ltd** (CITIC HIC) received in the mining sector has come from the operators of the Kamoia-Kakula copper operation in the Democratic Republic of the Congo (DRC).

Kamoia-Kakula, owned 39.6% by Ivanhoe Mines, 39.6% by Zijin Mining 39.6%, 20% by the DRC Government 20% and 0.8% by Crystal River, has become a major copper producer over the last few years, moving from hitting commercial production on the Phase 1 mine in 2021 to producing 393,551 t of copper concentrate in 2023 under Phase 2.

The Phase 3 concentrator project is targeted for ramp up in June 2024, which, following commissioning, will have a total design processing capacity of 14.2 Mt/y and could increase annualised copper production to an average of approximately 620,000 t/y over the next decade.

This move to become one of the world’s leading copper mines has been supported by CITIC HIC, which, for Phases 1 & 2, supplied four



CITIC HIC supplied four sets of $\Phi 6.1 \times 9.75$ m ball mills to bring processing capacity at the Kamoakakula mine up to 7.6 Mt/y as part of the development of Phases 1 & 2 (photo: Ivanhoe Mines)

sets of $\Phi 6.1 \times 9.75$ m ball mills to bring processing capacity up to 7.6 Mt/y.

The debottlenecking program for Kamoakakula's Phase 1 and Phase 2 concentrators, meanwhile, has been designed to increase the nameplate ore processing capacity by 22% from 7.6 Mt/y to 9.2 Mt/y of ore.

For Phase 3, CITIC HIC has upped the ante, providing two sets of $\Phi 7 \times 10.36$ m ball mills, each with 5 MW of installed power, as part of a 5 Mt/y circuit to bring overall capacity to 14.2 Mt/y.

Kamoakakula, its contractors and the CITIC HIC team brought the concentrator commissioning in ahead of schedule and on budget on both Phases 1 and 2.

In Sierra Leone, meanwhile, CITIC HIC has supplied a PXZ50-65 gyratory crusher, a $\Phi 7.6 \times 7$ m single stage SAG mill and a CSM-1600 vertical stirred mill to the Marampa iron ore mine. These units were acquired as part of an expansion looking to more than double output from 3.25 Mt/y to 7 Mt/y.

Magotteaux's MagoSense catching on

Gaining insights into what is happening inside the tumbling mill has always been sought after, and the introduction of more accurate and robust sensor technology, plus complementary analysis platforms, is now allowing this to happen.

Magotteaux has adopted a technology from its Germany-based partner, KIMA Process Control, to offer this to the mining sector, with the MagoSense solution the result.

MagoSense uses vibration and shell-bending sensors, as well as digital signal processing

technology, to provide information about what is happening at each of the 360 degrees of the mill, Magotteaux claims. Providing the total volumetric filling and ball impact information, it allows the operators to closely follow mill operation and seek optimal working conditions that directly lead to improved performance, the company said.

All technical aspects of MagoSense, such as wireless data transmission, power supply and overall system robustness, have been proven and widely adopted by industry leaders in the cement industry, yet the tool is designed specifically for the mining industry, according to Magotteaux.

The company previously conducted a trial

installation on the primary ball mill at a platinum concentrator in South Africa. This device was measuring the total filling degree of the mill, as well as the level of direct impact of balls on liners. The latter can help minimise liner damage and wear by helping reduce the occurrence of ball impacts on liners.

With this trial concluded, the company has now deployed the solution on a commercial basis to other PGM mines in South Africa, in addition to operations in Australia and Brazil, Marius Kruger, Regional Sales and Technical Manager – Mining NAM at Magotteaux, confirmed to IM earlier this year.

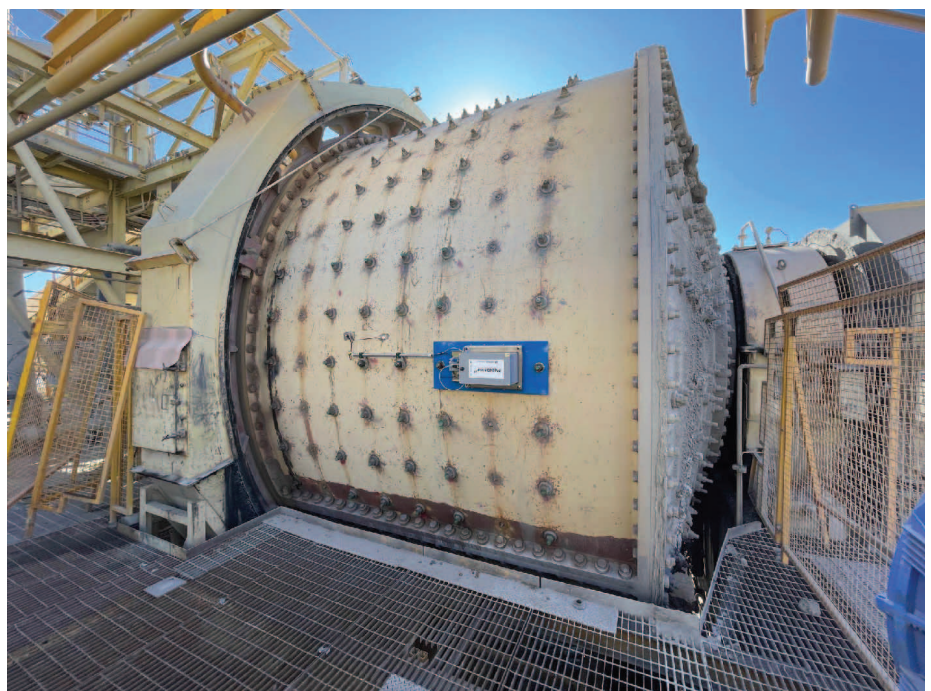
He said some of these mines are integrating the data feeds into existing SCADA systems to ensure the information reaches the right people within the operation.

The initial results from these early deployments in mining are yet to become publicly available, but two of the core unique aspects that come with MagoSense are:

- All measuring devices are installed directly to the outside of the mill shell. MagoSense does not suffer from sound interference like other off-mill sensors do; and
- The energy required to power all the electronics is supplied by a pendulum-driven electrical generator, meaning no batteries are required.

Molycop's new gen grinding media

Molycop has also been helping customers gain insights into the workings of operating mills thanks to its acquisition of MILL Trakka in November 2020.



MagoSense uses vibration and shell-bending sensors, as well as digital signal processing technology, to provide information about what is happening at each of the 360 degrees of the mill, Magotteaux says

At the same time as this, the company continues to focus on developing its range of high-quality grinding media solutions for the mining industry, with the aim of improving the longevity and effectiveness of its charged media offering for SAG mills.

The success the company has been having in this regard was recently displayed in a case study at an Australian gold operation during a marked ball wear test the operator carried out in September 2022.

This saw marked SAG balls of Molycop 125 mm NG grade and 125 mm SAG balls from a competitor charged in the SAG mill, with the retrieval conducted after a total test time of 306 operating hours.

The results showed that the Molycop 125 mm NG SAG ball outperformed the competitor's equivalent SAG ball by 11.7%, with the test indicating the competitor's SAG ball wore at a rate of 41.9 lum/h while Molycop's SAG balls wore at a rate of 37.5 lum/h.

Molycop said: "Specialised manufacturing processes and micro-alloy combinations have been developed to produce the Next Generation (NG) SAG ball.

"The tougher SAG ball was developed to meet the needs of modern SAG mills that are being operated more aggressively to maximise throughput. Traditional SAG grinding media, when used in these mills, can experience higher levels of breakage and spalling."

The potential of the new Molycop NG balls to reduce total media consumption may range from 10–15% in lower impact mill environments and up to 20–25% in higher impact mill environments, by virtually eliminating the breakage and spalling components of total ball consumption, the company says.

ME Elecmetal calls in the mill SEC

Still related to grinding media, ME Elecmetal has been analysing the performance of its own solutions in trials at Peruvian mines.

In a recently produced paper, Javier Zela, an Application Engineer at the company's Peru-based subsidiary, and Percy Jimenez, Head of Sales and Technical Support for that same subsidiary, looked at how the trials indicated a sustained increase in throughput rate and a reduction in grinding media consumption.

The case studies consisted of four mills from different mineral process plants (SAG Mill 40 ft x 26 ft, SAG Mill 32 ft x 32 ft, Ball Mill 26 ft x 40 ft and Ball Mill 16.5 ft x 20 ft), using basic operating data as supplied by the plant operators.

Three measures of grinding media consumption for optimal control were considered: kg/h, g/t and g/kWh.

"These three measures are interrelated and all need to be considered when judging the

performance of grinding media," the authors noted.

The results obtained with ME Elecmetal media as compared directly with a baseline performance showed:

- SAG Mill 40 ft x 26 ft with a 28 MW reversible drive fed with 5.5 in (140 mm) balls – circa-9% increase in throughput rate, circa 20% decrease in g/kWh ball consumption and reduction of grate pegging events;
- SAG Mill 32 ft x 32 ft with installed power of 16.4 MW in a single-stage grinding circuit, using 4 in balls – circa-13% decrease in g/kWh ball consumption;
- Ball Mill 26 ft x 40 ft with a bi-directional 16.4 MW drive and 3.5 in balls where two of the same sized ball mills are operated in parallel – circa-6% increase in throughput rate and circa-12% decrease in g/kWh ball consumption; and
- Ball Mill 16.5 ft x 20 ft with installed power of 3.5 MW, uni-directional drive and 3.5 in balls – circa-2% increase in throughput rate and circa-8% decrease in g/t ball consumption.

Considering that the use of grinding media can represent up to 40% of operating costs, these results highlight a significant opportunity for improvements, the authors noted.

"In general, the best quality grinding media will result in improvements in operational and media performance," they said. "This can be evaluated through analysis of the throughput rate and the specific energy consumption (for operational performance), and by analysis of media consumption in terms of g/kWh, g/t and kg/h (for media performance)."

The authors, in this paper, summarised that the operational practices in Peru with two case studies in SAG milling demonstrated improvements due to the increase in rock breakage with an increase in ball size and a

reduction in pegging grate events. In the other two case studies in ball milling, there was a demonstrated reduction in grinding media wear.

They concluded: "Rock breakage inside tumbling mills, and SAG mills in particular, is complex and can be influenced by several factors including ore characteristics and mill operational variables. It is worthwhile to understand the various mechanisms of rock breakage and where they tend to occur in the mill charge, but, in a simplified view, rock breakage can be represented by the mill specific energy consumption (SEC)."

Bradken ML, product development expertise on show

Bradken has recently leveraged a suite of newly-developed digital tools to track, report and construct a machine-learning model to help accomplish Freeport-McMoRan Bagdad's target objective of increasing discharge production from its Ø32 ft x 13 ft AG mill.

In 2019, Freeport Bagdad explored an expansion project that would increase site production by 20,000 t/d. As part of this expansion the AG mills were nominated for optimisation to increase discharge production and maximise potential increases in downstream capacity.

Bradken partnered with Bagdad on the optimisation of its grinding line 3 (GL3) Ø32 ft x 13 ft fixed speed AG mill. GL3 was a bi-directional mill operated with traditional bi-directional radial pulp lifters and top-hat high-low shells. The mill was inspected regularly with planned stoppage and inspection at 42-day intervals.

The mill operated at an average throughput of 814 t/h across a typical liner campaign.

In the recently published study, Bradken outlined how an advanced liner design methodology could lead to a full AG mill liner



A half-row double-wide Bradken Vortex discharge system was behind a 9.5% throughput increase and a 2.5% reduction in overall circuit energy consumption at the Bagdad mine

Sandvik is connecting its 800i series cone crushers with the latest Automation and Connective System, ACS-c 5 as it looks to continue a design philosophy based on evolution of parts, materials and technologies to improve the reliability, availability and productivity customers rely on.

“The upgraded 800i crushers with new ACS-c 5 are a natural next step in setting the bar for crushing,” Javier Valdeavellano, Lifecycle Manager 800i cone crushers, said. “Their ideal combination of high crushing forces, reliability and simplicity make them easier to operate, manage, maintain and service – leading to productivity and uptime gains that are game changers for operational performance.”

The crushers combine robust mechanical design with powerful automation to better support diverse operational roles, Sandvik says.

Sandvik 800i crushers are designed from the ground up to maximise tonnage of the desired end product. By selecting the right chamber configuration and setting the crusher program for the automation system, operators can simply start crushing, Sandvik says.

Sandvik explained: “Simplicity of mechanical design is key to maximum reliability and availability. Sandvik 800i crushers have evolved with new mechanical and automation advantages that simplify service and troubleshooting, improve safety and optimise performance while minimising downtime.”

Upgraded 800i crushers target installed inefficiency in operating mines, as well as in greenfields. For example, in flowsheets including three-stage crushing and conventional grinding, assisting SAG/AG circuits with pebble crushing, and optimising PSD for lump ores and heap leach applications. The 800i crushers are also suitable in HPGR circuits. They crush more and



Sandvik’s upgraded 800i crushers with new ACS-c 5 are a natural next step in setting the bar for crushing, according to Javier Valdeavellano

deliver finer particle sizes to the downstream processes, according to Sandvik.

The 800i crushers are ready to be connected to the SAM by Sandvik cloud-based digital assistant, the company’s evolving data capture and analysis service supporting operational excellence in crushing and screening plants.

Ali Jumaa, Digital Solution Specialist at Sandvik, said: “SAM collects information from all your connected Sandvik equipment to provide a complete overview of your entire operation. Look at the status of your connected equipment, communicate across teams, view alerts and notifications, proactively order spare parts and much more. The new SAM mobile app for iOS and Android allows you to have access to crusher data and insights in your pocket.”

package with a focus on the shell and discharge end to generate and discharge the product stream. Strategic selection of liner material for grates was used to mitigate risk of major design revisions and provide performance validation in service before revising to align with reline and increased overall reliability needs.

Optimisation efforts significantly improved AG mill performance, Bradken noted, with the final design, featuring a half-row double-wide Bradken Vortex discharge system, yielding a 9.5% throughput increase and a 2.5% reduction in overall circuit energy consumption.

“The collaborative and iterative optimisation process successfully met the customer’s production goals, showcasing advanced liner design, modelling, material selection and digital tools,” it said. “This methodology holds potential for enhancing design optimisation in similar mineral processing circuits.”

Derrick SuperStack for steel

Derrick® Corporation is partnering with Rungta Steel, one of India’s leading and fastest-growing integrated steel manufacturers, to mark what it says is a significant step in its commitment to sustainability and innovation.

The company will implement Derrick’s SuperStack® technology at its iron ore beneficiation projects in Odisha, India.

Rungta Steel is embarking on a plan to establish iron ore beneficiation plants in Odisha,

capable of producing 3.6 Mt/y of high-grade iron ore concentrate. Additionally, it plans to improve two existing 1.3 Mt/y plants by incorporating Derrick’s high-capacity, high-efficiency fine screening technology into currently operating circuits to sustainably maximise resource efficiency.

Derrick India’s Country Manager – Mining & Industrial, Amit Jain, said: “Derrick is thrilled to collaborate with Rungta on these projects that align with our shared efficiency and sustainability goals. Our SuperStack technology is equipped to exceed Rungta’s requirements for increased capacity while enhancing overall operation efficiency and product quality.”

SuperStack, designed, engineered and manufactured at Derrick’s Buffalo, New York facility, will be integrated seamlessly into closed grinding circuits, bringing significant advantages, increased productivity and improved classification to Rungta Steel’s operations, it says. These solutions will provide efficient particle classification within the 250-350-micron size range while simultaneously minimising waste generation and greenhouse gas emissions, Derrick added. 